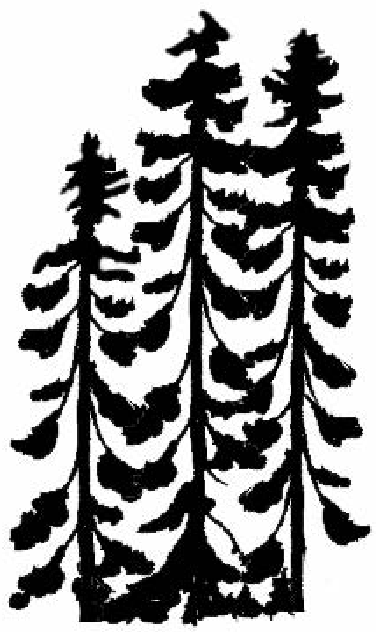
A 500 BBL/D BTL PLANT for GALENA ALASKA



Next Step — An Engineering Pre-Feasibilty Analysis

EXECUTIVE SUMMARY

This report considers a biomass-based alternative liquid fuels plant at Galena, Alaska that could provide communities along the Yukon River with an environmentally clean diesel fuel as well as naphtha, in lieu of conventional fuels transported to the region from Nenana via the Tanana River.

The report is in three sections: A description of the project and a very preliminary screening of economics; a preliminary examination of the wood resources of the region as to whether they are adequate to supply the plant on a sustained-yield harvest basis; and a description of a wood harvest and transportation system that would move wood to a plant at Galena. A fourth report, done separately, considers the feasibility of moving the clean fuel products from the plant to communities up and down the Yukon. Our preliminary conclusion is that while a plant such as this is not commercially economic at most locations because of its small size, under special circumstances it is at Galena. The technology companies we would work with – Choren Industries and Shell Oil – have a working demonstration plant of this size in Germany but are now developing commercial-scale plants that would produce 6,000 barrels per day of products.

We believe a 500 barrel/day plant at Galena could produce fuels at or below the present cost of fuel oil in the Yukon region, by attracting grants as a demonstration project of a biomass-based alternative fuel plants in remote areas. The U.S. Department of Energy is interested in what we are considering at Galena and has programs to support development of small-scale alternative fuels plants. The U.S. military is also interested in small-scale alternative fuels plants that could produce fuels for military use in remote areas. The Air Force is very interested in Fischer-Tropsch fuels for high-performance jet aircraft because of the superior qualities of the fuel. We believe a demonstration project at Galena would attract support from the federal government and others because it would spur further research and development of small-scale Fischer-Tropsch plants that might be commercial. A capital contribution from a source such as the federal government could improve the economics of a Galena plant substantially to the point that it could produce diesel fuels at prices at or substantially below the prices for which conventional diesel was sold for in the region in 2006.

We consider two levels of support for the galena BTL plant. First, in 2005, the US Congress authorized a 50¢/gallon energy credit for Fischer-Tropsch fuels made from bio-mass. Although scheduled to expire November 2011, we believe this credit will be extended along with similar credits for biodiesel, CNG and ethanol. The second level of support is for the higher cost of building and operating a small scale BTL plant in a very remote rural location. For example, under a case we consider of a federal grant that covers 50 percent of the capital cost of the plant, we believe a Galena plant could produce diesel for $3.70/gallon without energy credits and $3.00/gallon with energy credits assuming $70/ton (a conservative estimate) as the cost of the biomass. If the biomass cost could be reduced to, say, $45/ton, the cost per gallon drops

to $3.11/ gallon without an energy credit and $2.42/gallon with the credit. If there is no federal grant, the cost of diesel with biomass at $70/ton is $4.43/gallon or $3.85/gallon if the biomass cost is reduced to $45/ton. (See Table 1 and 2 pages 12 and 13 of the BTL for Galena Section.) Harvesting to support the plant would be done under sustained-yield forest practices. In operation, the plant itself would create approximately $3 million per year in new payroll and benefits in the region and additional payroll for seasonal jobs associated with the $8 million/yr wood harvesting operation.

The transportation/power generation fuels technology we consider incorporates the Fischer-Tropsch process. The first part of the plant is a gasifier which converts carbon-based material (in this case a woody biomass) to a synthesis gas that is fed into the Fischer Tropsch unit, which basically rearranges the chemistry of the gas into a wax product, which is then fed to a third stage of the plant, which converts the wax into liquid products like diesel and naphtha.

The Fischer Tropsch process was developed in Germany in the 1920s, was used extensively during World War II and is used today in Qatar, South Africa and Malaysia to produce a wide variety of liquid fuels and petrochemical products from coal and natural gas. In recent years Choren Industries, of Germany, has developed a commercial biomass gasifier and, in an agreement with Shell (which has substantial experience with Fischer Tropsch) is building biomass-based Fischer Tropsch plants in Europe, China and, potentially, the U.S. We would propose using the Choren-Shell process in a plant at Galena. The plant we envision would be virtually identical to the 500 barrels/day plant Choren and Shell now operate at Freiberg, Germany.

The plant would produce 500 barrels a day of liquids, of which 70 percent would be diesel (350 barrels/day) and 30 percent naphtha (150 barrels/day). The plant would produce 5.365 million gallons of clean diesel yearly (350 b/d X 42 gal./barrel X 365 days) which is well within the volume of diesel fuel and heating oil now sold in the upper-to-lower Yukon River region. About 3 million gallons of naphtha would be produced yearly (150 barrels/day X 42 gal./barrel X 365 days). The naphtha produced is of a high quality suitable for petrochemical manufacture. Since there is no petrochemical market in Alaska, we propose to modify the fuel for use in additional power generation locations along the Yukon.

This study was produced in part with Mini-Grant Assistance funds made available through the Department of Commerce, Community and Economic Development and the Denali Commission.

CHOREN INDUSTRIES BTL

"Choren Industries has developed a biomass to energy program in Europe with a primary focus on synthetic transport fuels. In 2005, Choren partnered its advanced bio-gasifier technology with Shell's commercial Fischer-Tropsch technology to build the next generation bio-refinery.

Commonly referred to as BTL, Choren's technology is supported by the European Community and Auto Manufacturers. Choren is planning to build up to five - one million ton per year BTL plants or bio-refineries in Germany over the next seven years to help the EU meet requirements for bio-renewable transport fuels in 2007 and beyond"

QUESTION

- Can Choren build similar sized BTL bio-refineries in the US?
- Will Choren's European BTL program work in Alaska?

YES TO BOTH!

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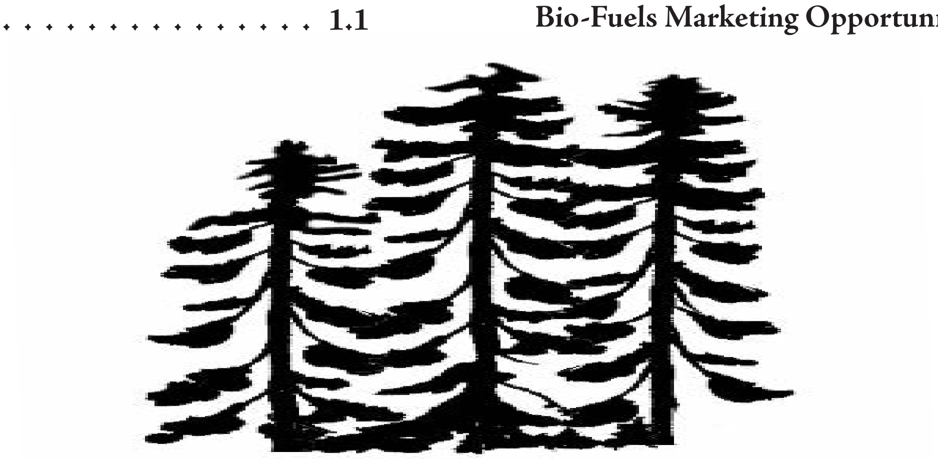


BIOMASS TO LIQUIDS PLANT FOR GALENA - WILL IT WORK?

THE SIMPLE ANSWER IS YES — BUT NOT WITHOUT SOME CREATIVE WAY TO FINANCE THE PLANT.

The First Step - Biomass (wood) Study

Like other Interior Alaska locations bio-mass, trees along the Yukon presents a potential feed stock for a F-T plant. We have evaluated a potential 300-500 bbl/d bio-mass (BTL) for this location using approximately 340 tons per day or 117,000 tons/year.

In a very simplified analysis of the bio-mass option we relied on a 1981 study of a regional timber harvesting operation, with the further assistance of one of the study authors. The study was the Yukon Basin Timber Survey, by Alaska Information and Research Services and Northern Forests, Ltd.

The 1981 study showed green wood chips being delivered from harvesting areas in the middle-Yukon region to the mouth of the Yukon, a 1000 mile round trip for $109/green unit, with a unit weighing approximately 2.25 tons. Delivering the wood chips or whole logs to an F-T plant near Galena would reduce transportation costs, but the extent of the cost-savings would require further study as well as an update of the 1981 estimate of timber harvesting costs. Authors of the 1981 study also note that there have been changes in regional land ownership as well as increased barge construction and fuel costs, which mean that relying on the 1981 study of timber harvesting was no longer sound.

In January of 2006, the City of Galena contracted with Alaska Natural Resources to Liquids LLC, to update the 1981 study. ANRTL in turn contracted with the original authors to update this study. The results are in and it appears that there is sufficient woody biomass along the Yukon River assuming that village lands, Doyon lands and state lands could all be accessed to spread the harvesting across a wide area along the river. The costs to deliver the logs (chipped) to the Galena site are higher than expected, approximately $70/dry ton but the Galena BTL site should still be able to produce ultra clean diesel fuels below $3.00/gallon FOB Galena, a lower cost than today's fuel prices along the river.

Conclusion: Preliminarily analysis indicates that the wood/biomass resource base is available within the region to support a BTL plant at Galena. The findings of this analysis are attached as Appendix 1 and 2.

The Second Step – Updated Forest Stewardship Plan

The study update performed by Northern Development Consultants uncovered some issues with the previous and outdated Forest Stewardship Plan which led them to over estimate delivered costs of wood to Galena. A new (updated) Forest Stewardship Plan needs to be done for the region to develop the best approach to harvesting the wood resource.

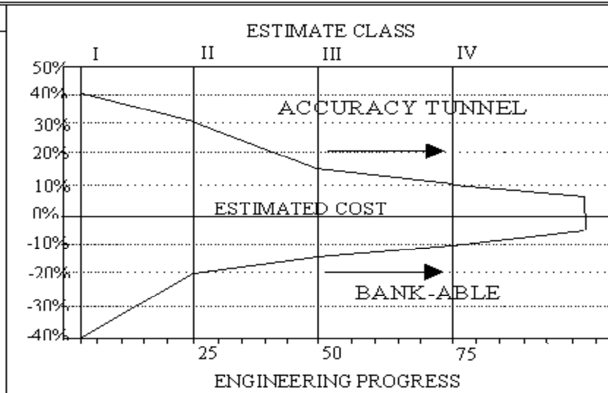
This may result in the delivered costs of wood dropping by as much as $10/ton, a significant savings in annual fuel costs and a 22¢/gallon drop in the initial price of F-T diesel at the BTL plant outlet. It is our understanding that Gana-A'Yoo is eligible for a $40,000 grant from the Forest Service to conduct this study. We strongly recommend that this study be *undertaken as soon as possible and recommend that Gana-A'Yoo retain Northern Development Consultants to do the study as they are very familiar with the needs of the proposed Galena BTL program.*

Conclusion: A new updated Forest Stewardship Plan will improve the economics and financability of a Galena BTL project. See Appendix 3 for an outline to apply for the Forest Stewardship Plan funding.

The Third Step – Pre-Feasibility Study

An assessment of the available biomass was undertaken with a contract with the City of Galena. The results of this study indicated that the area has a sustainable quantity of biomass (estimated at 117,000 tons per year) to support a biomass to liquids (BTL) plant at Galena. The next step is to determine the cost of building/operating a BTL plant at Galena through a pre-feasibility engineering study. A pre-feasibility study is the first of several steps taken to evaluate a proposed project site. The pre-feasibility study is designed to provide a broad over view of the potential site and supporting utilities. This next chart illustrates where a pre-feasibility study lies along the road to recommending a CHOREN BTL project for Galena.

MINIMUM INFORMATION REQUIRED TO DEVELOP ESTIMATES					
ESTIMATE CLASS	I	II	III	IV	
ESTIMATE TYPE	PRELIMINARY FEASIBILITY	FEASIBILITY BANKABLE	DEFINITIVE	DETAILED	
ACCURACY RANGE	+40% To -40%	+30% To -20%	+15% To -15%	+10% To -10%	X = Info Required to Obtain Stated Accuracy Range
PURPOSE	Screen	Study	AFE	AFE	
GENERAL PROJECT SCOPE	X	X	X	X	Project Scope, Design Basis, and Execution Strategy
	X	X	X	X	General Geographic location and Site Requirements
	X	X	X	X	Special Considerations that Impact Project Costs
	X	X	X	X	Utilities and Other Infrastructure Requirements
			X	X	Detailed Project Schedule
PROCESS	X	X	X	X	Block Flow Diagrams w/Primary Flow Steams and Utilities
		X	X	X	Preliminary PFDs w/Heat & Material Balance
		X	X	X	Engineered PFDs w/Heat & Material Balance, and Preliminary P&IDs
			X	X	Engineered P&IDs



Generally the first step is the preliminary feasibility study. Depending upon the complexity of the project it can cost millions but for the potential BTL project in Galena we expect to cost approximately $150k to $200K as much of the biomass studies have been conducted under separate contracts.

BTL PLANT ECONOMICS - THE REAL ISSUE

ALTERNATIVE FUEL COSTS — ARE THEY COMPETITIVE IN THE U.S.?

CHOREN Industries has been successfully developing a BTL program in Europe for a number of years and recently began designing BTL plants for China. The US was a potential market on the horizon but without some form of economic support from the US government or a US law requiring bio-renewable transport fuels, alternative fuel refineries such as CHOREN's BTL program could not compete with petroleum based diesel fuels.

Six basic elements will control the entry of any new alternative fuel into the US motor fuels market plus the level of support the alternative fuel will receive from government at all levels and the public:

- ✦Price of the alternative fuel must be competitive with the price of conventional fuel;
- ✦The feedstock must be economically sustainable;
- ✦The alternative fuel technology must be proven and commercial;
- ✦The alternative fuel refinery must be located in the US;
- ✦The feedstock must be from domestic resources; and
- ✦The alternative fuel must be compatible with the existing transportation infrastructure.

PRICE SUPPORT FOR ALTERNATIVE FUELS IN THE US

The US has for many years economically supported alternative transportation fuels. The most notable is ethanol used in gasohol and compressed natural gas (CNG) and recently biodiesel made from vegetable oils. While both state and federal government subsidies helped support these alternative fuel programs, the majority of the economic support was on the federal level and it came in the form of a reduction in the motor fuels excise tax collected for a particular fuel. In the example of gasohol, the federal excise tax was 18 ¢/gallon. The federal tax on gasohol was 5.4¢/gallon less. This allowed the gasohol supplier to market its fuel at the pump for the same price as conventional fuel, collect the tax at the pump and keep 5.4¢/gallon. The consumer saw the same price at the pump and was happy. The gasohol supplier collected the 5.4¢/gallon but ethanol was only 10% of the volume of a gallon of gasohol so in fact the ethanol supplier received 54¢/gallon for each gallon of ethanol sold to the blender. Every 5 years the ethanol credit is renewed by Congress so its not guaranteed but ethanol has been receiving this tax credit for 30 years now.

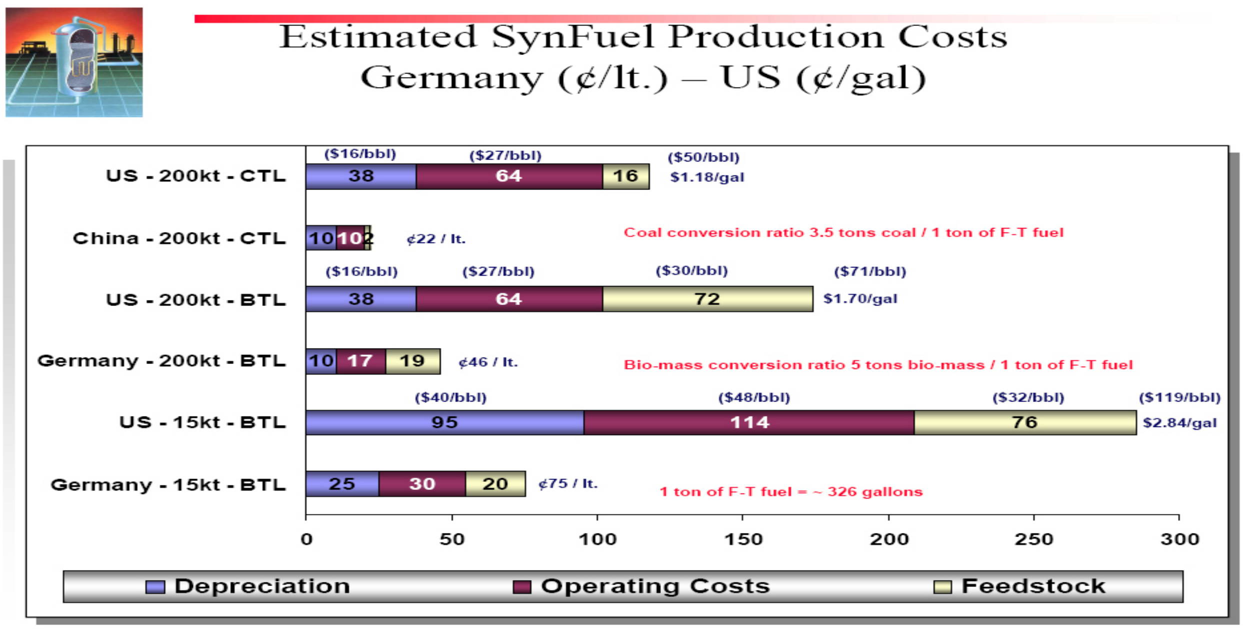
In the case of CNG, the federal excise tax on diesel is 24.4¢/gallon but the federal excise tax on CNG used in that same diesel engine is only 7.4¢/gallon. This allowed the CNG supplier to sell CNG at the pump for the same price (equivalent) as diesel and keep 14¢/gallon. Biodiesel broke the pattern when Congress gave it a $1/gallon tax credit in 2004. Since the federal excise tax on diesel is only 24.4¢, the biodiesel supplier could not collect enough money at the pump from the taxes collected so the federal government changed the rules and now allows the biodiesel manufacturer to receive a direct payment from the federal government for each gallon of biodiesel sold into the US diesel market.

In August 2005, the US Congress after seven years of lobbying, granted a 50¢/gallon "energy credit" for F-T diesel made from biomass and coal. For the first time A CHOREN style BTL program could receive economic support on the federal level. *Although a BTL energy credit will require a continuing lobbying effort to maintain; in general once approved they tend to always be renewed.*

But is it enough and can F-T BTL be competitive with petroleum based diesel in the US market?

CHOREN's ESTIMATED COST OF F-T DIESEL

Based upon CHOREN's designs for the Beta (15kt) and Sigma (200kt) BTL plants in Europe, we estimated that a Beta BTL plant would produce F-T diesel "SunDiesel" at $2.84/gallon and SunDiesel from a Sigma BTL plant would cost approximately $1.70/gallon. *We did not raise the European fuel cost numbers for a U.S. built BTL plant because we assumed that a BTL plant would cost less to build and operate in the US than in Germany. This assumption may not apply for a Beta plant built in rural America and will not apply for a BTL plant built at Galena.* We assumed a feedstock cost of $70/dry ton delivered to the Galena BTL plant and comparable financing rates.



As the world price of crude oil rose, the wholesale price of diesel began approaching the $1.80/gallon level in the US, a price that a CHOREN Sigma scale BTL plant could be competitive with. If one assumes a $55/bbl crude cost and a typical US refining spread of $16/bbl this results in a projected wholesale cost of $1.69/gallon. With the introduction of ultra low sulfur (ULS) diesel into the US market 3-Q 2006, the refining costs are expected to increase to $19/bbl so the whole sale price of petroleum based diesel will approach $1.76/gallon; right in the estimated range of cost for CHOREN's BTL diesel for lower 48 markets. If you add in the 50¢/gallon energy credit economically a CHOREN Sigma BTL program should work. However, if crude oil prices drop to $35/bbl as some bank financing programs predict, the wholesale price for diesel could drop to $1.29/gallon. As long as the BTL energy credit remains in place, a CHOREN Sigma BTL program will still be price competitive.

We don't see any way a Beta sized BTL plant could be price competitive except in the rare case where you are paid to take a biomass feedstock or the federal Government provides some sort of capital support. *The City of Los Angeles is considering paying a BTL/BTE plant up to $18/ton to take green biomass. This could result in a lowering of the finished price of the F-T diesel by over $1.00/gallon. Certainly well within today's wholesale price of diesel in California even without the 50¢/gallon energy credit. There may be other unique locations where the government will provide up to a 50% grant to build a Beta plant and because of its remote location, diesel prices are well about the national average like in rural Alaska.*

There is always the possibility that biomass based F-T or bio-renewable F-T will receive the same consideration as biodiesel, $1/gallon in some future Congressional action. But it will take an operating BTL plant on the ground before a Congressman will agree to sponsor new legislation to do so.

While a motors fuels energy credit is the largest form of economic support for a bio-refinery in the US today a Beta BTL plant at Galena will require more than is available today.

A $1/gallon energy credit similar to that of biodiesel could eliminate the need for a Federal Grant but the IRR would be cut in half. A combination of the biodiesel credit and a $20 million Federal Grant would work well but all BTL programs in the U.S. would benefit making it harder to fit into the federal budget program.

The Department of Energy is currently proposing to support up to three U.S. based bio-refineries demonstration projects. Each project could receive up to 50% of the capital costs in the form of a three year grant not to exceed $80 million each. Unfortunately, the minimum size for this DOE grant consideration is more than twice the size of the BTL plant Galena could support (700 tons per day or 255,000 t/a). Perhaps Congress could require that the DOE consider at least one location where the rural economy/market could support a smaller scale program. August of 2006, is the deadline to apply for these grants. Choren is proposing a BTL plant in Arkansas that will meet these requirements. If Congress provides for one additional location for a rural demonstration program, Galena could fit into the DOE program.

CONCLUSION

The City of Galena, the local Native Villages, the State of Alaska and the U.S. Congress have the opportunity to build a biomass to liquids plant at the site of the recently closed Galena Air Force base that can be sustained with local natural resources, provide employment opportunities for hundreds of area residents, produce transport fuels that are environmental friendly and price competitive with petroleum based fuels and generate electricity for the area at considerably lower costs than today.

It will take a financial commitment by the City and State of Alaska for the pre-feasibility study, a willingness to understand and manage renewable regional forest resources and a desire to control the future fuel costs for this region of the Yukon River. The Alaska Delegation will have to work with Congress to provide the needed financial incentives to make an Alaska BTL plant work, something that is getting harder to do each year.

Choren BTL technology is proven and operational in Germany. With Shell Oil joining Choren Industries in 2005, the technology risk and financiability of a Choren BTL program is the U.S. has been improved. Large scale BTL plants are economic and will work within the existing U.S. fuels market. A smaller scale BTL plant for Galena shares all of the attributes of a larger BTL plant except the economics of size (scale). If we can overcome this issue, Galena, Alaska will become the fuel center for the interior of Alaska along the Yukon River.

Galena, Alaska 300-500 bbl/d Biomass (BTL) F-T Plant

The Next Steps:

Revised Forest Stewardship Study & Pre-Feasibility Study

Galena is located on the Yukon River west of Fairbanks and northwest of Anchorage. It is a small community of approximately 650 but acts as a regional bulk fuel distribution center. Galena has a small U.S. Air Force forward interceptor base that is scheduled to close as well as other government facilities. We selected Galena as a site for evaluation of a small F-T plant in a rural location because of its remote location but also its well-established fuel transportation and storage infrastructure. Galena also has an identified coal deposit on the Yukon River 8 miles from the community that may consider in the analysis of a small plant, as well as extensive unused timber resources in the region that could possibly supply wood to a small (250-340 tons / day 117,000 tons per year) BTL F-T plant producing 300 to 500 bbl/d - 4.5 to 7.6 million gallons per year ultra clean diesel and naphtha fuels.

Biomass (wood) Study – The First Step

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Conclusion: Preliminarily analysis indicates that the wood/biomass resource base is available within the region to support a BTL plant at Galena. The findings of this analysis are attached as Appendix 1 and 2.

FINDINGS OF TIMBER HARVEST IN ALASKA'S MID-YUKON RIVER BASIN
"A Conceptual Analysis" (see Appendix 1)

Overview

Purpose of this analysis is to preliminary determine volumes and costs of timber biomass in the Mid-Yukon River region to supply a proposed Biomass to Liquids (BTL) plant at Galena, Alaska.[1]

Harvest methods proposed are based on mechanization and mobility, with logs delivered to selected riverside locations for loading onto barges to be sent to Galena, where they will be unloaded and chipped (green) for subsequent drying. The dried chips will then be fed to the proposed BTL plant. The feasibility of a plant at Galena is subject to further study being conducted by Alaska Natural Resources to Liquids, LLC (ANRTL).

This report will be accompanied by a revision of the "Institutional Analysis" of 1982 (Footnote 1), and a Digital Terrain Model (DTM) that will cover a selected site in the region. The DTM will be prepared by True Nature Interactive of Anchorage. It will allow observers to "fly through" (on computer) the chosen area to show conditions as they exist, and show over projected time estimated vegetative changes as the area is harvested, then reverts again to a growing forest. The DTM work will begin in May 2006.

Conclusions

- Based on extensive inventories of the village lands in the region there may be insufficient timber to produce 117,000 dry tons annually, based on the Sustained Yield Principle, if the supply for a BTL plant originates from village lands only. However, by adding timber from other owners in the region (being Doyon, Ltd., State of Alaska, U.S. Dept. of Interior) there is more than enough timber, based on a non-declining periodic sustained yield, provided silvicultural forest practices are "put into play".

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[1] This analysis t is an update of the July 1981 study "Timber Harvesting in Alaska's Yukon River Basin – A Conceptual Analysis" by Forests North, Ltd., that accompanied the report "Timber Harvesting in Alaska's Yukon River Basin – An Institutional Analysis", May 1982, by Michael Bradner of Alaska Information and Research. Both were done for Richard Holden & Associates, Juneau, Alaska under contract to the Bering Straits School District. Those reports were based on the best knowledge available at that time. This report is more site specific than the original, and is based in part on a smaller selected area of the Yukon River (Kaltag to Tanana), and new information and technologies developed during the past 25 years.

- The above statement is based on estimating yields using the Area Regulation system.[2] A more complicated, but more accurate system of estimating yield is one or more forms of the Volume Regulation system, where standing volume of mature and over mature timber plus annual growth of younger timber (based on growth, yield and mortality) are all considered.[3] This would undoubtedly result in a greater potential annual volume of timber available from the region, again considering the Sustained Yield Principle.
- The harvesting and delivery costs for 117,000 dry tons of timber is currently estimated at $69.69 per dry ton (post chipping, before drying).
- All timber would be "purposefully" logged for biomass, which is an unusual situation, because most wood biomass destined for energy projects is developed adjunct to mature conversion mills (pulp, lumber, veneer, etc.) and is considered a waste or low value product.
- Harvesting will predominantly be accomplished by mechanical equipment, described herein.
- Before actual operations begin there should be more intensive review of the forest resources, including calculating the growth and yield for the various species; site specific timber cruising, and updating of the costs presented herein.

FINDINGS OF TIMBER HARVEST IN ALASKA'S MID-YUKON RIVER BASIN "An Institutional Analysis" (see Appendix 2)

Overview

The institutional analysis of timber harvest and log transportation for a proposed Biomass-to-Liquids (BTL) plant located at Galena Alaska in the Mid-Yukon Basin. The feasibility of a plant at Galena is subject to further study being conducted by Alaska Natural Resources to Liquids, LLC (ANRTL).

Galena is a site strategically located in the Mid-Yukon River region, 28 miles upstream from the confluence of the Yukon and Koyukuk Rivers, the latter entering from the North. At this confluence the Yukon shifts from flowing west and makes a 45-degree turn to flow south Galena is the site of a recently closed Air Force Station, has infrastructure including an all weather airfield built by the Air Force, and surplus military buildings, pads, and other facilities. The community may also be eligible for receipt of BRAC money, allocations of federal funding made available for communities making adjustments following closure of military facilities. The City of Galena is located on the North bank of the Yukon River, is a first class city organized under Alaska law, operates a city school

[2] Area in acres ÷ estimated rotation period in years

[3] For example a slightly modified "Hanzlik Formula" (Annual cut = Volume of mature and over mature timber ÷ rotation period in years + volume of new growth)

district, a large statewide correspondence school program, a regional boarding school, and is a hub-distribution center for the Mid-Yukon region. As a recently operating military site Galena has excellent infrastructure and power generation facilities.

Conclusions

- Harvesting timber and riverboat/barge transportation is a historical industry for the residents of Alaska's Yukon River, though except for a period in the first half of the last century it has not been a major source of revenue.
- There is sufficient timber, of all ownerships, adjacent to the Mid-Yukon River to support a moderate sized Biomass to Liquids (BTL) plant at Galena. Modern mechanical harvest is the preferred method.[4]
- Towboat/barge wood transport on the Yukon River between Kaltag and Galena is both technically and economically feasible using towboat and barges with drafts to 6 feet.
- Equipment of this size is not present on the Yukon River and would have to be acquired by the project and project operated, or preferably operated under contract with one of the two operators on the river. Efforts should be made to make harvest oriented river equipment a direct project cost and eligible for government assistance.
- Log harvest by independent operators by log raft from Tanana to Galena is practical and would be a source of supplemental feedstock for the Galena based BTL plant.
- Log transport using equipment of private Yukon River towboat/barge operators is also possible and practical. Wood could be transported from the Lower Tanana River, the Yukon River above Tanana and from points between Tanana and Galena supplemental to rafting.
- Costs listed herein are conservative. It is highly probable that cooperative planning with existing Yukon River Barge operators can lower river transport operational costs.

Disclaimer

Past timber inventories in the region are adequate for determining volumes at a particular point in time, but they are not particularly helpful in determining long term sustainable yields based on growth, yield and mortality. Because this report is referenced on imperfect and incomplete knowledge concerning the timber resources of the mid-Yukon River region the

[4] See accompanying report Appendix 1 *"Timber Harvest Alaska's Mid-Yukon River – a conceptual analysis"* June 2006

author is not responsible for any errors or omissions, and cautions that any future timber harvest must be based on site specific timber cruising and growth and yield studies.
Conclusions noted herein are conservative, and may or may not stand the test of time. As the project is further developed new information should be entered. For example, the cost of diesel fuel to power harvesting equipment and marine vessels will undoubtedly change, and this should be the largest source of changes to the currently estimated costs. Once a BTL plant is operational all fuel for harvesting, transport and support can come from that plant, theoretically lowering fuel costs. Other changes will occur in the cost of labor and other elements of the Operation and Maintenance (O&M costs) of machines. These changes may be positive or negative.
This report does not include the cost of investment in harvesting equipment or marine vessels. Investment costs are being budgeted in the ANRTL report. Nor does this report include timber harvest preparation including cruising and harvest unit layout, or reforestation.

Updated Forest Stewardship Plan – The Second Step

The study update performed by Northern Development Consultants (Appendix 1) uncovered some issues with previous area inventories which led them to conservatively estimate delivered costs of wood to Galena. For example, growth and yield data was not available to utilize in determining the time required to reforest an area after initial harvesting.

It is felt this, and other environmental questions can be answered if the major local land owner (Gana-A'Yoo) would sponsor a new Forest Stewardship Plan covering the lands of Galena, Koyukuk, Nulato and Kaltag, the Gana-A'Yoo organization.

It has been preliminarily estimated that updated forestry work (also considering wildlife, recreation, clean water, etc.) may result in the delivered costs of wood dropping by as much as $10/ton, a significant savings in annual feedstock costs and a 22¢/gallon drop in the initial price of F-T diesel at the BTL plant outlet.

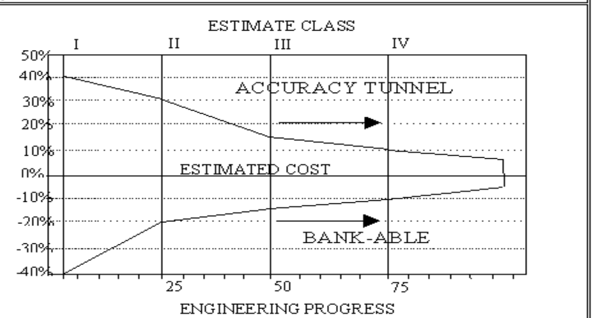
It is our understanding that Gana-A'Yoo is eligible for a $40,000 grant from the Alaska Dept. of Natural Resources, Division of Forestry, to conduct this study. We strongly recommend that this study be undertaken as soon as possible and recommend that Gana-A'Yoo retain Northern Development Consultants to do the study as they are very familiar with the needs of the proposed Galena BTL program.

Conclusion: A new updated Forest Stewardship Plan will improve the economics/financing of a Galena BTL project. See Appendix 3 for an outline to apply for the Forest Stewardship Program funds.

Pre-Feasibility Study – The Third Step

An assessment of the available biomass was undertaken with a contract with the City of Galena. The results of this study indicated that the area has a sustainable quantity of biomass (estimated at 117,000 tons per year) to support a biomass to liquids (BTL) plant at Galena. The next step is to determine the cost of building/operating a BTL plant at Galena through a pre-feasibility engineering study. A pre-feasibility study is the first of several steps taken to evaluate a proposed project site. The pre-feasibility study is designed to provide a broad over view of the potential site and supporting utilities. This next chart illustrates where a pre-feasibility study lies along the road to recommending a CHOREN BTL project for Galena.

MINIMUM INFORMATION REQUIRED TO DEVELOP ESTIMATES					
ESTIMATE CLASS	I	II	III	IV	(see chart below)
ESTIMATE TYPE	PRELIMINARY FEASIBILITY	FEASIBILITY BANKABLE	DEFINITIVE	DETAILED	
ACCURACY RANGE	+40% To -40%	+30% To -20%	+15% To -15%	+10% To -10%	X = Info Required to Obtain Stated Accuracy Range
PURPOSE	Screen	Study	AFE	AFE	
GENERAL PROJECT SCOPE	X	X	X	X	Project Scope, Design Basis, and Execution Strategy
	X	X	X	X	General Geographic location and Site Requirements
	X	X	X	X	Special Considerations that Impact Project Costs
	X	X	X	X	Utilities and Other Infrastructure Requirements
			X	X	Detailed Project Schedule
PROCESS	X	X	X	X	Block Flow Diagrams w/Primary Flow Steams and Utilities
		X	X	X	Preliminary PFDs w/Heat & Material Balance
		X	X	X	Engineered PFDs w/Heat & Material Balance, and Preliminary P&IDs
			X	X	Engineered P&IDs



Generally the first step is the preliminary feasibility study. Depending upon the complexity of the project it can cost millions but for the potential BTL project in Galena we expect to cost approximately $150k to $200K as much of the biomass studies have been conducted under separate contracts. Typically in a pre-feasibility study you are not as concerned with utilities if they are in the area. Galena is a different story. It will be important for the first pass to have a very good idea on the local electric grid, the minimum and maximum electric loads, projected growth, the existing base heating system, sewage and water systems because this is a remote area. The "red" **X** indicates that for this remote location, utility information will be required on the first pass.

Engineering companies familiar with building in arctic conditions and in locations along the Yukon River will be added to the normal compliment of engineering companies evaluating the following factors at the Galena location:

1. Soil and foundation requirements – including earth quake requirements;
2. Electrical distribution systems and local generation capacity/reliability;
3. Base/Town heating requirements;
4. Air quality including wind, temperature, humidity;
5. Waste treatment and sewer systems;
6. Water quality and availability, including river water;
7. Fuels tank storage, siting, market demands, local usage of offsite products;
8. Fire protection
9. Availability of heavy lift equipment – evaluation of local build or modules
10. River docks for loading and unloading;
11. Wood/feedstock siting and storage;
12. Population location/skills/availability for construction / operation
13. Available housing during construction – construction camp
14. Other features unique to Galena that will impact the building and operation of a 500 barrel per day CHOREN BTL plant.

Preliminary Economics

The design and costs of a Galena BTL plant are based upon Choren's existing 300 t/d demonstration BTL plant operating in Freiberg, Germany. As a demonstration plant the economy of scale is not realized. However, for the existing fuels market along the Yukon River and wood resources available to support this size plant; this is an optimal size BTL plant. A more detailed analysis of the fuels market is being conducted under a separate contract with the City of Galena. This analysis assumes that the Galena BTL plant will not produce enough fuels to satisfy the entire market along the Yukon from Fairbanks to the Bering Sea. Thus market volumes will not be a limitation. We have chosen a minimum rate of return of 20% pre federal income tax and established a minimum sales price for the F-T diesel, naphtha and waste heat electricity to achieve this goal. The table below provides the various set points used in the economic analysis.

Alaska Beluga CTL Project Summary of Data Inputs				
First Year of Project		2006		
Payout in Years		15		
Financing via Bonds =1, Bank = 2		2		
Trade Zone issue Bonds= 1, Municipality = 2		1		
Cost of Debt-Long Term Bonds		5.00%		
Cost of Debt - Long Term Financing		7.00%		
Cost of Debt- Construction / cash flow		7.00%	0	Future value
Bond Sinking Fund / Working Cash - interest rates	3.00%	4.50%	21	Depreciation (years)
Bond Issues 100% Day 1 =1, Prorated during const =2	**2**	7.00%	Cost of AIDEA/Loan Financing	
Tax Authority Allows % of Taxes to go to Sinking fund and what % - See Note in cell E-20		no	75.00%	8.00%
Base Cost of BTL F-T Plant		$85,000,000		
Federal Support for BTL Plant ($) Grant = 1, loan = 2 & amount in cell C-13	**1**	$42,500,000	0.00%	% of CAPEX
Bond recovery Year 16 = 1, 1/15 each year =2, refinance yr 16 =3	3	$0		
Adjusted Plant Cost for Financing		$34,000,000		
Total Cost		$91,707,713	89.71%	% Debt to CAPEX
Equity/Debt Ratio (Equity Owner)		20.00%	9.27%	Equity 100% CAPEX
Equity / Owner		$8,500,000		
INITIAL DEBT		$34,000,000		
Interim Financing (Construction)		($4,768,851)		
Total Amount Borrowed		$39,772,713		
Calculated Equity/Debt ratio (project)		55.6%		
Development Dollars		$935,000		
Development Percentage		1.10%		
Adjusted Cost of F-T Plant in $/installed Barrel		$183,415		
F-T Plant Liquid / Products Production				
Daily Liquid Production bbls/d	500			
% Diesel	70.00%			
% N Butane	0.00%			
% Naphtha	30.00%			
MW of excess power sold	1.0	mw-hr		
FEEDSTOCK REQUIREMENTS				
Plant Feedstock ton/day (today)	340	BDU/Day		
Annual Feed stock requirement (tons)	117,640	Ton/yr		
CO2 Emissions Reduction Credits Yes or No	no	$7.00	ton of CO2 reduction	
CTL Plant Product Prices				
Current Price CARB no. 2 Diesel	$3.00	gallon		
Avg. Price Naphtha PetChem Grade	$1.90	gallon		
Avg sale price of diesel & naphtha $ / gal	$2.67	gallon		
Electric sales ¢/kw-hr	$0.15	per kw-hr		
Gov Energy Credit (Rebate)				
F-T Diesel	$0.50			
% of rebate to project after payout	0.0%			
Term of F-T Diesel Rebate in years	15	years		
BTL Process Costs (in $ / bbl)				
BTU content per pound (BTU/LB)	7500	15	mmbtu/ton	
Base Raw Material cost $/ton	($70.00)	First Year Wood Purchase Price $70 /ton or $4.67 per mmbtu		
Calculated Raw Material costs		($8,234,800)		
O&M Contingency Fund	($2.00)	($346,000)		
BTL Plant O&M Costs	($41.00)	($7,093,000)		
Transport Cost - to Market - Diesel	$0.00	$0		
Transport Cost - to Market - Naphtha	$0.00	$0		
Insurance/ Royalty	($3.00)	($547,500)		
Total Costs in $/bbl (w/o fuel rebate) 1st yr	($93.76)			
Total Costs in $/yr (adj for actual operation & w/o fuel rebate)		($16,221,300)	(estimated)	

The base cost of the Choren BTL plant is estimated to be $75 million plus an additional $10 million for the wood handling equipment, tug, barges and a prepayment for 6 months of wood supply for a total of $85 million. Interest during construction adds an additional $4.7 million for a total estimated cost of $91.7 million. This is considerably more than for a similar BTL plant that could be built in German, however we have assumed that the BTL plant will be built in modules in Anchorage and shipped by barge to Galena for final assembly.

We have assumed that the Federal Government will co-fund half of the base cost of the Galen BTL plant as a demonstration plant for rural areas. (The DOE is currently proposing to co-fund up to three bio-refineries in the lower 48 at much higher support levels.) With an additional equity investment of $8.5 million (20%) the BTL project will require an additional $40 million of commercial financing.

Utilizing the set points as shown in the table, the Galena BTL project will be able to produce F-T diesel fob the plant at just under $3.00/gallon. This assumes $70/dry ton for wood chip costs delivered to the plant. It also assumes $45/bbl operating costs, both considerably higher than the costs in Germany. The pre-feasibility study will help provide a better understanding of the actual costs for operating at Galena as will an updated Forest Stewardship study.

Central to an economic Galena BTL operation will be the current Energy Credit provided for BTL's under the 2005 Transportation Bill that Senator Ted Stevens and Congressman Don Young worked so hard to secure. These credits must be renewed every 5 years and the Alaska Delegation has pledged to work hard to ensure that this happens. Fortunately, Energy Credits for BTL will be tied to similar credits for ethanol and biodiesel so there will be broad support for renewal.

This next chart provides a summary of the BTL plant economics for the data points set in the previous table. We have assumed that all expenses escalate at 2% per year and all incomes escalate at 1% per year to provide a worst case scenario. We also assume that both State and local taxes will be based upon receiving a % of the net cash flow of the BTL project and not be based upon the more traditional way of taxing based upon depreciated value. The higher the market value for the diesel, the higher the taxes received by the State and local governments.

As you can see the equity owner recovers his investment in about 4 years; a good return for Alaska, even better for such a rural environment. If the market price for F-T diesel is above $3.00/gallon, the economics will be better.

The F-T naphtha can also be a good stationary fuel but it will require some modifications to the diesel engine to use it. Our plan is that the wood handling equipment along with the tug will be equipped to use this fuel source to help lower the costs of gathering and delivering the wood chips to the Galena location.

The model allows us to provide a % of the net cash flow to be paid to the wood supplier but for these runs we have set this data point to zero and just escalated the delivered wood chip costs by 2% per year.

THE PROPOSED ANRTL BTL PLANT
ALASKA BTL Plant
ECONOMIC MODEL FOR A 500 BBL/D
BTL PLANT LOCATED AT Galena
Financed with Long Term Bank Debt at 7 % cost of money
WITH AN EQUITY INVESTOR AT 20.00 % OF TOTAL CAPITAL INVESTMENT

NOTE: THE MODEL DOES NOT USE CO2 EMISSION CREDITS IN THE ECONOMICS

ANNUAL BASE FEED-STOCK PRICES ARE SET WITH INFLATION AT 1% AND ARE INITIALIZED IN CELL B-95

WITH $42.5 MILLION IN SUPPORT FOR THE F-T PLANT WITH A FEDERAL TRANSPORTATION ENERGY CREDIT EQUAL TO 50¢/ GALLON

IN GENERAL THE BTL PROCESS USES APPROXIMATELY 5 Ton's of INLET BIO-MASS TO PRODUCE 1 TON OF LIQUIDS

DEPENDING UPON THE F-T TECHNOLOGY UTILIZED THIS CARBON CONVERSION RATIO CAN BE HIGHER OR LOWER

THIS MODEL ASSUMES A 5 to 1 RATIO OF INLET BIO-MASS TO OUTLET LIQUIDS PRODUCED (340 BDU's TO PRODUCE 500 BARRELS OF PRODUCT)

500	BARREL / D PLANT
$91.71	MILLION DOLLAR CAPEX INVESTMENT
5.90	Average Ratio of Cash Flow to Debt Service Year 1 through Year 15
1.15	Average Ratio of Cash Flow to Debt Service + O&M Year 1 through Year 15
94.8%	F-T Plant Availability
$2.670	AVG. PRODUCT PRICES (diesel, n butane & naphtha)
$70.000	/ bdu in the 1st year of operation - Includes 0 % of NCF Overide Bonus
$81.268	/ bdu in the 16 th year of operation - Includes 0 % of NCF Overide Bonus
117,640	Tons of Bio-Mass per Year
15	YEARS FINANCIAL PAY OUT
$183,415	per installed bbl
$0	in CO2 Emission Credits paid to F-T Project per year at $7 /ton for 10 years
$3.22	Average Tail Gate Sales Price of F-T Diesel for the First 15 Years
$2.04	Average Tail Gate Sales Price of Naphtha for the First 15 Years
$75.12	Avg Purchase Price per bdu for the First 15 Years - Includes a 0 % of NCF Overide Bonus

F-T PROJECT ONLY - NET CASH FLOW DISTRIBUTION TO PROJECT PARTICIPANTS AVERAGED OVER 15 YEARS & 25 YEARS

		Years 1 - 15 Avg Yearly Payment Before Payout		Years 16 - 40 Avg Yearly Payment After Payout		Total Payment To Project
	Project CF	% interest of NCF	Cash Flow	% interest of NCF	Cash Flow	over 15 years
0.00%	Feed-Stock Owner	0.00%	0	0.00%	0	$0
8.00%	State / Taxes	8.00%	272,583	8.00%	194,988	$4,088,739
0.00%	Nation Grant	0.00%	0	0.00%	0	$0
3.00%	Developer	3.00%	102,218	3.00%	73,121	$1,533,277
89.00%	Equity Owner	89.00%	3,032,481	89.00%	2,169,242	$45,487,220
0.00%	Bond Sinking Fund	0.00%	0	0.00%	0	$0
0.00%	Bond Holder	0.00%	0	0.00%	0	$0
100.00%	Total payment / period	100.00%	$3,407,282	100.00%	$2,437,351	$51,109,236

Average Imputed priced paid for feed-stock at plant inlet (Price + Rebate) $ / ton (avg over 15 & 25 year periods)

	before payout (yrs 1 - 15)	after payout (yrs 16 - 40)
Feed Stock COSTS	$75.119	$91.81

TE: CHART ABOVE DISPLAYS NET CASH FLOW DISTRIBUTION TO PROJECT PARTICIPANTS AVERAGED OVER YEARS 1-15 & Years 26 to 4

"NOT YEARLY NET CASH FLOW DISTRIBUTIONS FOR ANY PARTICULAR YEAR"

This model assumes an initial market price for F-T diesel of $3.00 and naphtha of $1.90 / gallon plus a transportation Energy Credit of 50¢/gallon for 15 years

Price Flexibility – Depends Upon Level Of Support

Table 1 (below) shows a range of possible costs of producing F-T diesel at wood costs of $70 per ton under eight assumptions of a federal capital grant and energy credit[5] expressed as cents-per-gallon. The base case is a project with a 25% Internal Rate of Return, with costs indicated for each case. Prices with asterisk * indicate case with 20 percent IRR, as in a case where an investor would take a lower IRR.

TABLE 1

DIESEL PRICE ($/GAL) REQUIRED FOR A 500 BBL/D BTL F-T PLANT AT GALENA WITH WOOD COST OF $70/TON AT A CAPEX OF $85* MILLION AND EQUITY OWNER 25 % PRE FED TAX IRR

*70% Diesel – 30% Naphtha – 7% Interest Rate - $43/bbl O&M - Diesel Transport Fuel - Naphtha Sold FOB BTL Plant – Energy Credit on 100% of Products – 20% Equity Investment – 117,600 tons/yr bio-mass *CAPEX includes $10 million for wood handling and barge equipment plus $4 million pre-payment for 18 months of wood supply*

	No Economic Support	25% CAPEX Grant $21,250,000	50% CAPEX Grant $42,500,000	75% CAPEX Grant $63,750,000
Equity (millions)	$17	$12.75	$8.5	$4.25
*	$4.82*	$4.18*	$3.54*	$2.89*
	$5.12/gal	$4.40/gal	$3.70/gal	$2.98/gal

	50¢/gallon for 15 yrs	25% CAPEX Grant 50¢/gallon for 15 yrs	50% CAPEX Grant 50¢/gallon for 15 yrs	75% CAPEX Grant 50¢/gallon for 15 yrs
Equity (millions)	$17	$12.75	$8.5	$4.25
*	$4.13*	$3.49*	$2.85*	$2.21*
	$4.43/gal	$3.71/gal	$3.00/gal	$2.29/gal

*Equity Owner at 20 % IRR - $/gal

Most likely case in blue

Table 2 (below) shows cases with a lower cost of wood ($45/ton instead of $70 per ton) and a range of possible costs of producing F-T diesel under eight assumptions of a federal capital grant and energy credit expressed as cents-per-gallon. The base case is a project with a 25% Internal Rate of Return, with costs

[5] ***In 2005, the US Congress authorized a 50¢/gallon Energy Credit for Fischer-Tropsch fuels made from biomass. Scheduled to expire in November 2011, we anticipate it will be extended along with similar credits for biodiesel and ethanol.***

indicated for each case. Prices with asterisk * indicate case with 20 percent IRR, as in a case where an investor would take a lower IRR.

TABLE 2

DIESEL PRICE ($/GAL) REQUIRED FOR A 500 BBL/D BTL F-T PLANT AT GALENA WITH WOOD COST OF $45/TON AT A CAPEX OF $85* MILLION AND EQUITY OWNER 25 % PRE FED TAX IRR

*70% Diesel – 30% Naphtha – 7% Interest Rate - $43/bbl O&M - Diesel Transport Fuel - Naphtha Sold FOB BTL Plant – Energy Credit on 100% of Products – 20% Equity Investment – 117,600 tons/yr bio-mass *CAPEX includes $10 million for wood handling and barge equipment plus $4 million pre-payment for 18 months of wood supply*

No Economic Support

Equity (millions)	$4.24*
$17	$4.54/gal

25% CAPEX Grant $21,250,000

Equity (millions)	$3.60*
$12.75	$3.83/gal

50% CAPEX Grant $42,500,000

Equity (millions)	$2.96*
$8.5	$3.11/gal

75% CAPEX Grant $63,750,000

Equity (millions)	$2.31*
$4.25	$2.40/gal

50¢/gallon for 15 yrs

Equity (millions)	$3.56*
$17	$3.85/gal

25% CAPEX Grant 50¢/gallon for 15 yrs

Equity (millions)	$2.91*
$12.75	$3.14/gal

50% CAPEX Grant 50¢/gallon for 15 yrs

Equity (millions)	$2.27*
$8.5	$2.42/gal

75% CAPEX Grant 50¢/gallon for 15 yrs

Equity (millions)	$1.63*
$4.25	$1.71/gal

*Equity Owner at 20 % IRR - $/gal

Most likely case in blue

AN ADDITIONAL THOUGHT:

Bio-mass harvest could stimulate a historic rural industry: One other consideration, we feel, is that in the case of a small rural plant supported by bio-mass from regional timber harvesting, the operation of the plant and the harvesting could provide a considerable economic stimulus to the regional community, particularly if the harvesting is integrated with a sawmill or some other way to use higher-value wood. This is beyond the scope of this report, but we would observe that small-scale wood harvesting is a very old industry in rural villages along the Yukon River and its tributaries. Harvesting wood to fuel steamboats operating on the river was a major source of cash for the communities, and lasted until diesel-fueled boats began operating on the Yukon system in 1948.

Conclusions

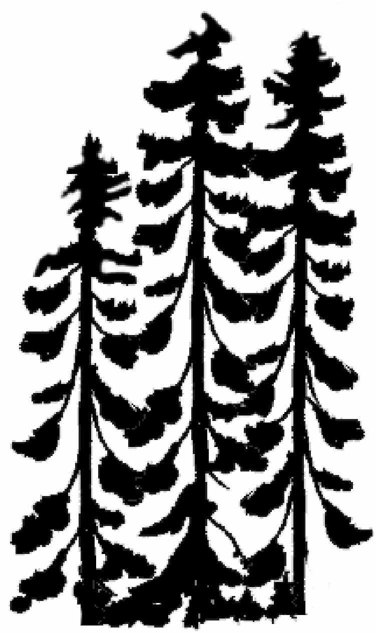
- Harvesting timber and riverboat/barge transportation a historical industry for the residents of Alaska's Yukon River could provide over $7 million per year, a major source of revenue.
- There is sufficient timber, of all ownerships, adjacent to the Mid-Yukon River to support a moderate sized Biomass to Liquids (BTL) plant at Galena. Modern mechanical harvest is the preferred method.
- Towboat/barge wood transport on the Yukon River between Kaltag and Galena is both technically and economically feasible using towboat and barges with drafts to 6 feet.
- Equipment of this size is not present on the Yukon River and would have to be acquired by the project and project operated, or preferably operated under contract with one of the two operators on the river. Efforts should be made to make harvest oriented river equipment a direct project cost and eligible for government assistance.
- A revised Forest Stewardship study and BTL engineering pre-feasibility study should improve the economics of a Galena BTL plant.
- A 500 barrel per day BTL plant at Galena could provide sustainable ultra clean diesel fuels at less than today's market price to the people of the region and jobs for hundreds of local residents.
- F-T fuels from the Galena BTL plant will always be environmentally superior to crude oil (petroleum) based fuels.
- F-T transport fuels and waste heat electricity produced from the Galena BTL plant will be "carbon neutral" – that is they will have no negative impact on the levels of CO_2 emissions.
- The engineering pre-feasibility study is estimated to cost under $200,000 and could be completed in less than eight months.

APPENDIX 1

TIMBER HARVEST IN ALASKA'S

MID-YUKON RIVER BASIN

- A Conceptual Analysis -



Northern Development Consultants
Anchorage, Alaska

For

Alaska Natural Resources to Liquids, LLC
Contractor to the City of Galena, Alaska

June 2006

Timber Harvesting in Alaska's Mid-Yukon River Region
– A Conceptual Analysis –

Terry T. Brady, M.S.
Northern Development Consultants
Anchorage, Alaska
June 2006

This report has been prepared for Alaska Natural Resources to Liquids, LLC
A Contractor to the City of Galena, Alaska

All data and conclusions are the responsibility of the author (see disclaimer)

Table of Contents

Introduction

Purpose of this report is to preliminary determine volumes and costs of timber biomass in the Mid-Yukon River region to supply a proposed Biomass to Liquids (BTL) plant at Galena, Alaska.[1]

Harvest methods proposed herein are based on mechanization and mobility, with logs delivered to selected riverside locations for loading onto barges to be sent to Galena, where they will be unloaded and chipped (green) for subsequent drying. The dried chips will then be fed to the proposed BTL plant.

The feasibility of a plant at Galena is subject to further study being conducted by Alaska Natural Resources to Liquids, LLC (ANRTL).

Disclaimer

Past timber inventories in the region are adequate for determining volumes at a particular point in time, but they are not particularly helpful in determining long term sustainable yields based on growth, yield and mortality. Because this report is referenced on imperfect and incomplete knowledge concerning the timber resources of the mid-Yukon River region the author is not responsible for any errors or omissions, and cautions that any future timber harvest must be based on site specific timber cruising and growth and yield studies.

Conclusions noted herein are conservative, and may or may not stand the test of time. As the project is further developed new information should be entered. For example, the cost of diesel fuel to power harvesting equipment and marine vessels will undoubtedly change, and this should be the largest source of changes to the currently estimated costs. Once a BTL plant is operational all fuel for harvesting, transport and support can come from that plant, theoretically lowering fuel costs. Other changes will occur in the cost of labor and other elements of the Operation and Maintenance (O&M costs) of machines. These changes may be positive or negative.

This report does not include the cost of investment in harvesting equipment or marine vessels. Investment costs are being budgeted in the ANRTL report.

Nor does this report include timber harvest preparation including cruising and harvest unit layout, or reforestation.

[1] This report is an update of the July 1981 study *"Timber Harvesting in Alaska's Yukon River Basin – A Conceptual Analysis"* by Forests North, Ltd., that accompanied the report *"Timber Harvesting in Alaska's Yukon River Basin – An Institutional Analysis",* May 1982, by Michael Bradner of Alaska Information and Research. Both were done for Richard Holden & Associates, Juneau, Alaska under contract to the Bering Straits School District. Those reports were based on the best knowledge available at that time. This report is more site specific than the original, and is based in part on a smaller selected area of the Yukon River (Kaltag to Tanana – See Figure 3), and new information and technologies developed during the past 25 years.

This report will be accompanied by a revision of the “Institutional Analysis” of 1982 (Footnote 1), and a Digital Terrain Model (DTM) that will cover a selected site in the region. The DTM will be prepared by True Nature Interactive of Anchorage. It will allow observers to “fly through” (on computer) the chosen area to show conditions as they exist, and show over projected time estimated vegetative changes as the area is harvested, then reverts again to a growing forest. The DTM work will begin in May 2006.

Figure 1
Autumn at the Float Plane Lake, Galena, Alaska
(Photo courtesy of KIYU Radio, Galena)

Figure 2
Yukon River during Fall Freezeup
(Photo courtesy of KIYU Radio, Galena)

Conclusions

✓ Based on extensive inventories of the village lands in the region (Figure 3 and Table 1) there may be insufficient timber to produce 110,000 dry tons annually, based on the Sustained Yield Principle, if the supply for a BTL plant originates from village lands only. However, by adding timber from other owners in the region (being Doyon, Ltd., State of Alaska, U.S. Dept. of Interior) there is more than enough timber, based on a non-declining periodic sustained yield, provided silvicultural forest practices are “put into play”.

✓ The above statement is based on estimating yields using the Area Regulation system.[2] A more complicated, but more accurate system of estimating yield is one or more forms of the Volume Regulation system, where standing volume of mature and overmature timber plus annual growth of younger timber (based on growth, yield and mortality) are all considered.[3] This would undoubtedly result in a greater potential annual volume of timber available from the region, again considering the Sustained Yield Principle.

✓ The harvesting and delivery costs for 110,000 dry tons of timber is currently estimated at $69.69 per dry ton (post chipping, before drying).

✓ All timber would be “purposefully” logged for biomass, which is an unusual situation, because most wood biomass destined for energy projects is developed adjunct to mature conversion mills (pulp, lumber, veneer, etc.) and is considered a waste or low value product.

✓ Harvesting will predominantly be accomplished by mechanical equipment, described herein.

✓ Before actual operations begin there should be more intensive review of the forest resources, including calculating the growth and yield for the various species; site specific timber cruising, and updating of the costs presented herein.

The author wishes to give thanks to Will Putman, forester, with the Tanana Chiefs Conference (TCC) for providing data on the forest inventories of the targeted region.

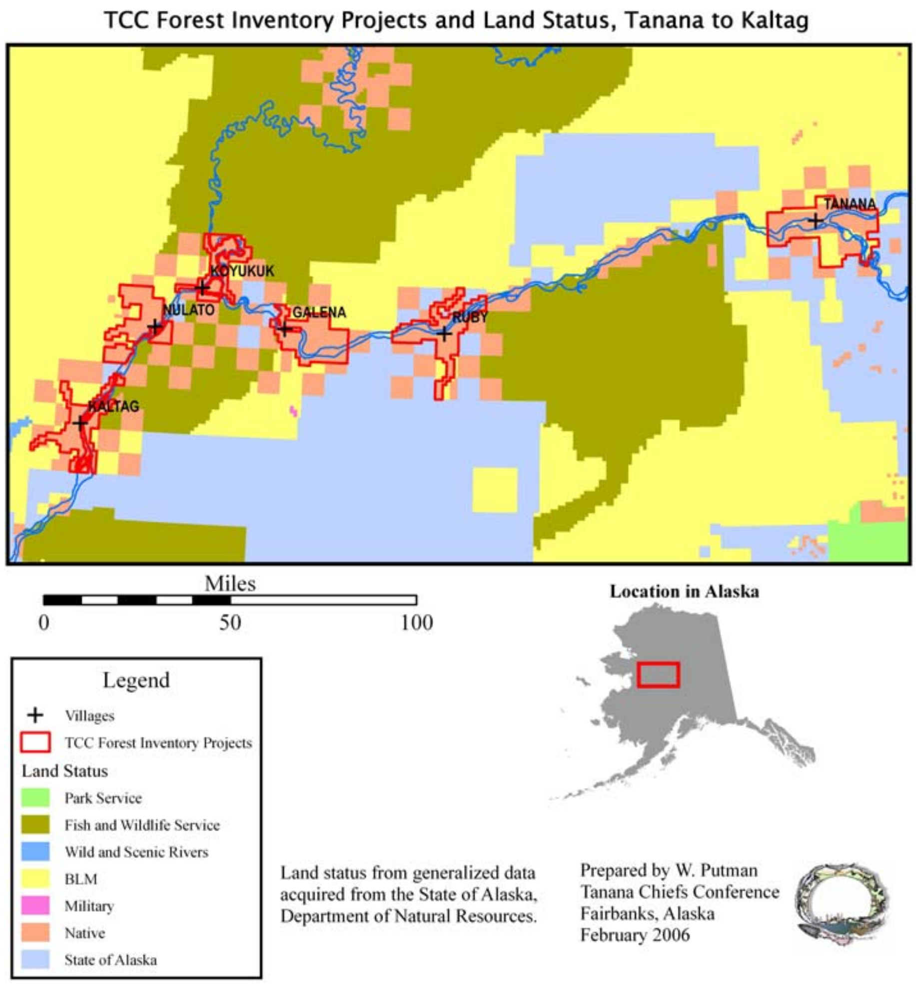
[2] Area in acres ÷ estimated rotation period in years
[3] For example a slightly modified “Hanzlik Formula” (Annual cut = Volume of mature and overmature timber ÷ rotation period in years + volume of new growth)

The Region

The Biomass to Liquids (BTL) project centers about the Yukon River community of Galena. From Upstream it includes the villages of Tanana and Ruby. Downstream it includes the villages of Koyukuk, Nulato and Kaltag.

Lands of Galena, Koyukuk, Nulato and Kaltag are jointly managed by the Gan-A' Yoo Limited Alaska Native corporation. Doyon, Ltd., the State of Alaska, and the U.S. Dept. of Interior are other major landowners in the region. Other small parcels including private land and Native allotments are also in the region.[4]

Figure 3



Extensive timber inventories conducted by the Bureau of Indian Affairs and the Tanana Chiefs Conference for the villages of Tanana, Ruby, Galena, Koyukuk,

[4] None of the land owners, or managers has, to date, committed timber resource to this project.

Nulato and Kaltag are used in this report as the basis for estimating the cost of harvesting and delivering woody biomass to Galena.

Figure 4
Galena, Alaska - on the north bank of the Yukon River

The Timber Resource

Table 1 shows the estimated volume of timber located on the village lands of the mid-Yukon River region. Because some villages were only categorized for spruce and hardwoods, and not individual species, the table breaks down the species into these two categories.

"Spruce" includes white spruce, black spruce and tamarack. "Hardwoods" includes birch, aspen and cottonwood. As there is little aspen in the region and cottonwood appears to be the greater volume of hardwood, the author has arbitrarily divided the hardwoods between cottonwood and birch (Table 1).

A goal of this report is to identify timber for a Biomass to Liquids (BTL) plant with an annual input requirement of 110,000 dry tons, or 157,766 green tons (Tables 1 & 4). The BTL process is species neutral, and even timber size, and shape, neutral.

Annual timber harvest volumes, for a 20 year period, are based on an Area Regulation method (Table 1). Had there been adequate growth and yield studies in the region it would have been more accurate to base both annual or periodic harvestable volumes and rotation age using a Volume Regulation method.[5]

Figure 5
Boreal Forest at Sunset, Mid-Yukon River
(Photo courtesy of KIYU Radio, Galena)

[5] A problem with the Area Regulation method is that it does not recognize increased incremental growth of remaining timber, or new tree growth, following initial harvest in "stagnant forests" or one that is losing volume due to insect attacks and pathogens, conditions that describe much of the forest of Interior Alaska.

Figure 6
Aerial Satellite Views of Timber of the Mid-Yukon River Region

The imagery shows lighter green trees, on better drained sites. These are hardwoods. The darker green trees, also on drier areas, are spruce. Yellow-brown areas are wetlands. In winter all areas can be used for travel as the ground and swamps are mostly frozen. Note how timber follows the water courses. Planning harvests on individual sites must be very site-specific, not only to “stay in the trees” but also to protect potentially sensitive areas.

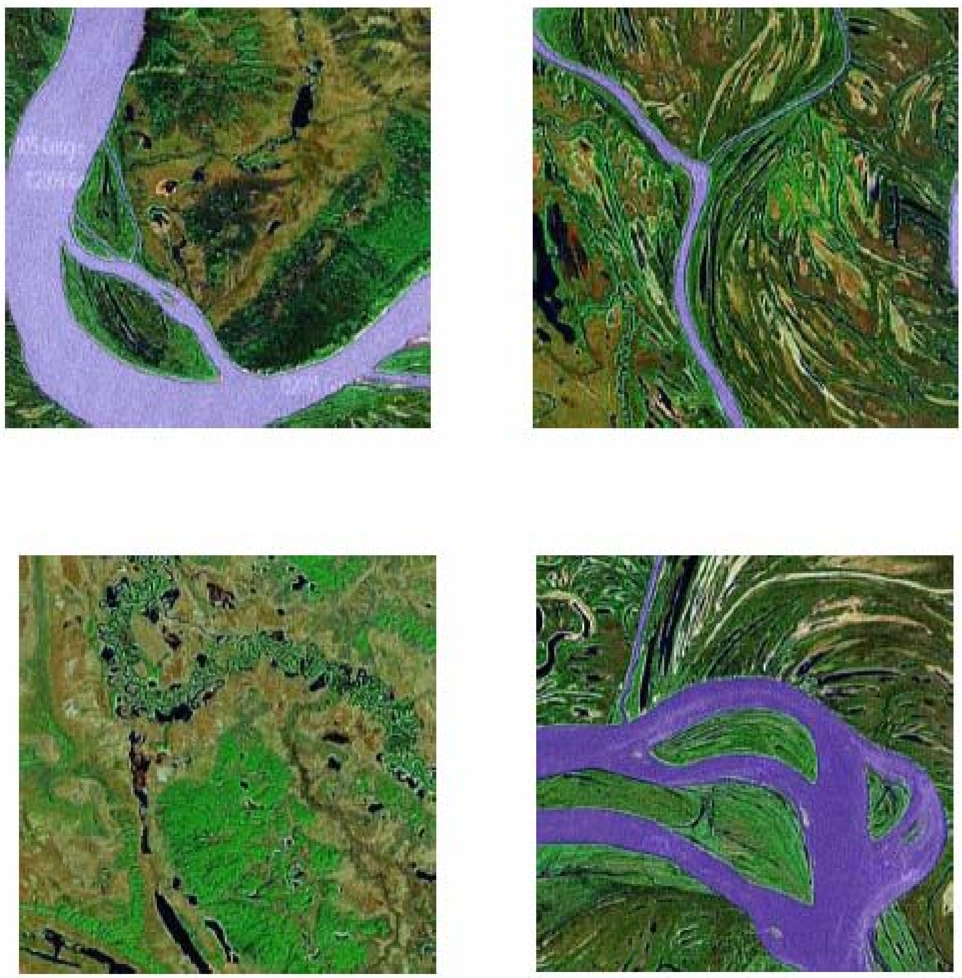


Table 1

Mid-Yukon River Village Timber
Adapted from Tanana Chiefs Conference and Bureau of Indian Affairs Extensive Inventories

Total Forest Acres		230,297
Total Net Volume Ft^3		585,889,709
Weighted Ft^3 Net Volume/Acre		2,544
Weighted Short Tons/Acre (Green)		46
Spruce		63%
Hardwood		
Birch	**40%**	15%
Cottonwd	**60%**	22%

Required Harvest	
Estimated Annual Harvest Green Tons	157,766
Estimated Annual Harvest Ft^3	8,739,722
Estimated Annual Harvest Acres	3,435 [a]
Estimated Daily Harvest Acres	18

Potential Based on Rotation Period (Area Regulation) [Note 1]

80 years	**90 years**	**100** years
7,323,621 Ft^3	6,509,886 Ft^3	5,858,897 Ft^3
2,879 Acres	2,559 Acres	2,303 Acres
132,203 green Tons	117,514 green Tons	105,762 green Tons

Note 1- The forests of the Mid-Yukon primarily consist of even aged stands. Because there have been few, if any, "growth and yield" studies in the area the author has chosen to utilize the Area Regulation method of determining initial period (20 year) an

[a] Acres are based on potential square feet of harvest area utilizing both “patch clear-cut” and “single tree selective cutting” programs, to be determined based on site specific cruising. Dispersing cutting units throughout the landscape will have the effect of lowering visual impacts.

Species are: white spruce (*Picea glauca*), black spruce (*Picea mariana*), cottonwood (*Populus balsamifera*), birch (*Betula papryrifera*) and aspen (*Populus tremuloides*)

Table 2

Estimated Weighted Average Stem Weight and Volume

Weighted Average Weight per Ft^3 (Green)	36.10	Lbs
Weighted Average Diameter Breast Height per Tree	**10**	inches
Weighted Average Top Diam	**3**	inches
Weighted Average Stem Height	**55**	feet
Weighted Average Volume per Stem	15	Ft^3
Weighted Average Lbs per Stem (Green)	524	Lbs
Estimated Average Basal Area (Ft^2/acre) of Trees	**120**	(See Note 1)
Weighted Average. Number Stems/Acre	220	
Weighted Average Timber Ft^3 Volume/acre	3195	
Estimated. Weighted Average Stem Tons/acre	58	
Weighted Average Moisture Content Wet Basis %	43.42%	

Note 1 - Ranging from 100-250 Ft^2/acre

Sources for this table are Mid-Yukon River Basin Tanana Chiefs Conference and Bureau of Indian Affairs inventories; site specific cruising conducted by Dan Renshaw, P.E., for the report “Wood to Gas to Power”, Alaska Village Electric Cooperative, 1980; as well as timber that would be targeted for a BTL plant. Thus the size standards are not necessarily averages across a broad landscape.

Harvesting Technology

For purposes of this report the following mechanical equipment has been selected for timber harvest and log transportation. Estimated investment in such equipment, based on current new prices, or prices for used machinery deemed suitable, is shown in Table 3. This investment is not included in the estimated Operational and Maintenance costs used to determine costs shown in Table 4.

Table 3
Estimated Harvest Equipment Investment

Equipment List Investment

Item	Number	$
Generic Feller-Buncher	2	$ 500,000.00
Generic Grapple Skidder	3	$ 750,000.00
Stroke Delimber	2	$ 150,000.00
Track Dozer	1	$ 150,000.00
Pickup	2	$ 60,000.00
Service Rig (on tracks)	1	$ 100,000.00
Wheel Loader	1	$ 150,000.00
Crawler Crane	2	$ 600,000.00
Camp	1	$ 300,000.00
	Total	$ 2,760,000.00

Note: Marine Equipment not Listed this Table

The estimated investment in marine equipment is subject to additional study and is not included in the above table. Estimates to operate marine equipment (1 2000 hp towboat, 4 200x40x10 foot barges) is based on best available information considering the Yukon River is not a charted river, operations are seasonal (between frozen periods), there are no formal navigation aids, and river currents vary greatly depending on river stages and locations. Also, fuel and labor costs are higher there than more developed regions of the "Lower 48" states

Figure 7
Harvesting & Transport Flowchart – Showing Typical Equipment

Table 4
Mid-Yukon River - Estimated Furnish (wood chips) Cost

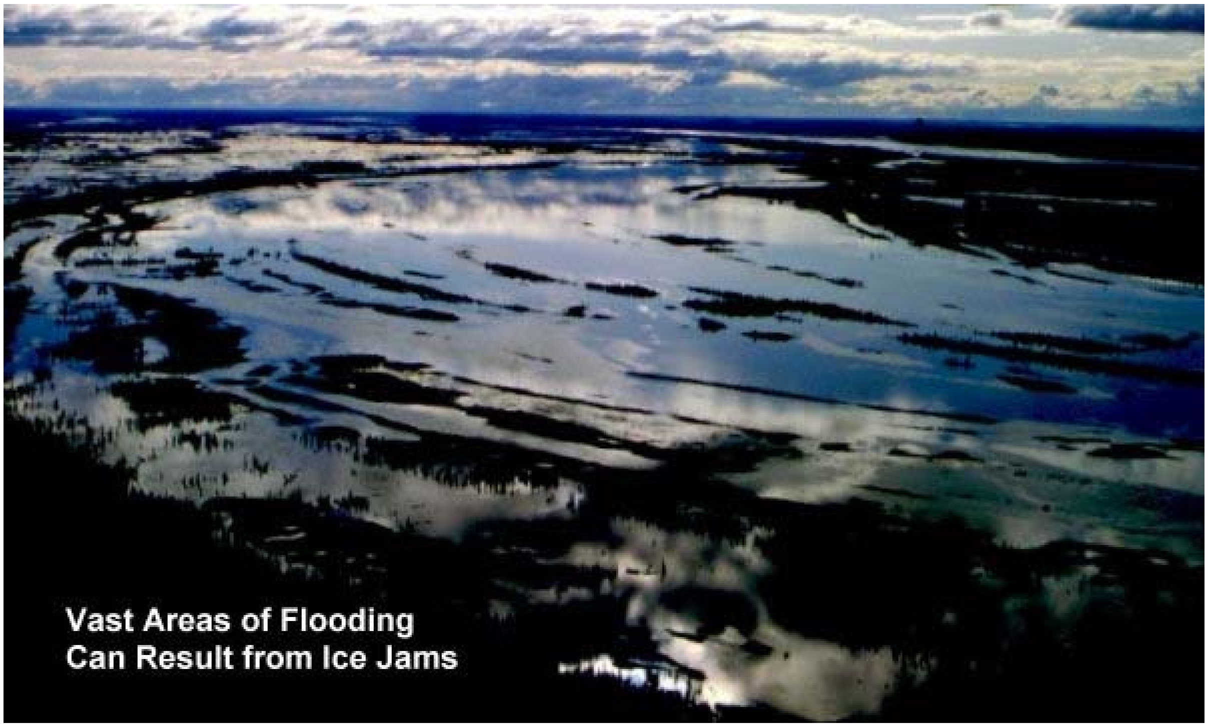
Not including stumpage, roads, layout, reforestation & cost of money

Timber Harvest Costs

110,000	annual dry tons					
157,766	annual green tons					
80%	Percentage Summer Barged					
126,213	annual green tons Summer Barged					
31,553	annual green tons Summer Rafted					
839	daily green tons					
16	hr/day harvest					
188	harvesting days/yr based on slowest machine					
	No. Units	O&M $/Hr @		Annual Hrs		Annual $
Generic Feller-Buncher	2	$	137.96	3,010	$	830,650.19
Generic Grapple Skidder	3	$	122.89	6,021	$	739,886.02
Stroke Delimber	2	$	92.39	6,021	$	556,235.34
Track Dozer	1	$	100.54	**2,000**	$	201,075.00
Pickup	2	$	34.43	**2,000**	$	68,868.75
Profit and Risk at	**20.00%**	over costs			$	562,109.54
		Total Harvest/Load/Unload			$	3,372,657.22
		Per Green Ton			$	21.38
Barge Transportation					$	1,250,666.95
		Barge Transport per Ton			$	9.91
Rafting Costs					$	48,295.45
		Raft Build/Float per Ton			$	1.53
Log Loading/Unloading						
Wheel Loader	1	$	144.75	1,606	$	232,404.44
Crawler Crane	2	$	161.03	803	$	129,267.44
		Load/Unload Logs			$	361,671.88
		Load/Unload Logs per ton			$	2.29
Purchase Price Per Ton Rafted Logs		**$**	**30.00**			
Total Purchase Rafted Logs					$	946,595.45
Chip Preparation (At Plant Site)						
		O&M $/Hr		Annual Hrs		Annual $
Generic Chipper		$	370.43	3,345	$	1,239,038.78
		Per Green ton			$	7.85
Management Costs					$	207,500.00
		Per Green Ton			$	1.32
Harvest Support Costs					$	239,260.50
		Per Green Ton			$	1.52
	Wood Chip Total (Before Drying)					**$7,665,686.24**
		Per Green Ton				**$48.59**
		Per Dry Ton				**$69.69**

Harvesting Constraints

Figure 8
Flooded Yukon Valley
(Courtesy National Weather Service, Alaska-Pacific River Forecast Center)



Any program affecting the land is faced with constraints. Some are physical, such as the potential of river flooding, others are legal and institutional, such as following the letter and spirit of laws, regulations and best practices designed to protect, and even enhance the environment and the living creatures that are part of the ecosystem being amended.

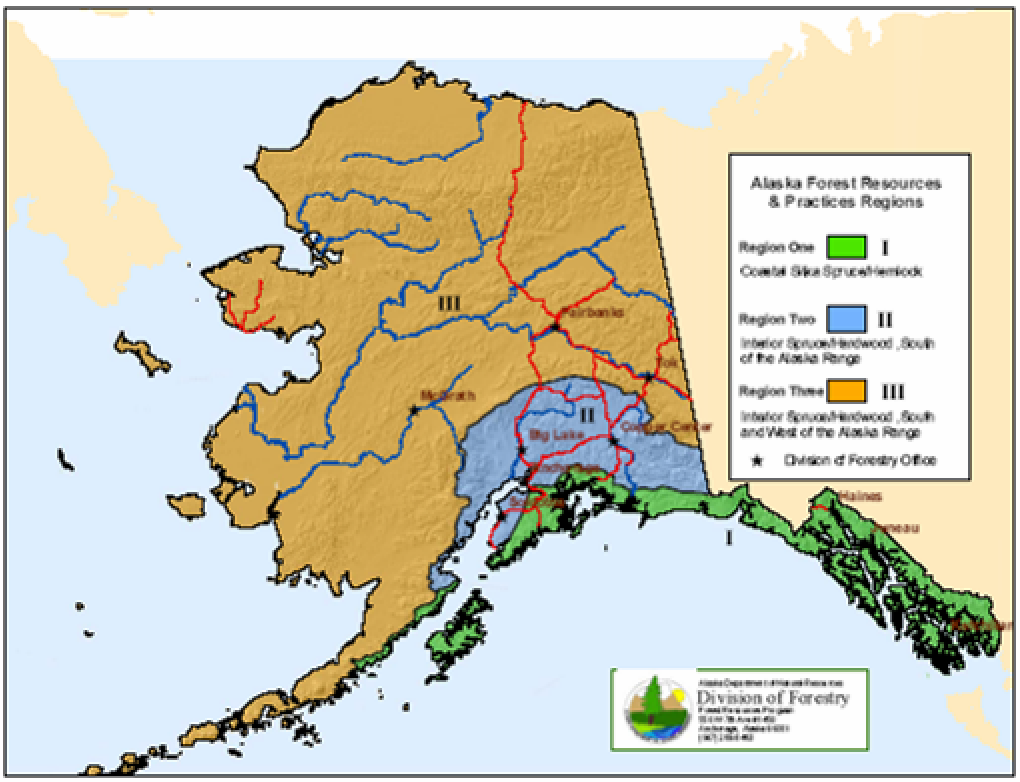
For example, any timber harvest planning for the mid-Yukon River region must take into consideration the possibility of river flooding, either following heavy summer rains, or more often occasional ice jams that act as dams backing up water many miles and overflowing the river banks.

When timber is harvested in winter it will have to be moved to and piled at strategic locations so that barges can, in summer, be brought alongside for loading. If logs are piled (decked) in a flood prone area there is always the chance of losing some of the winter's work.

Picking higher ground adjacent to the river, and even building berms around log decks may be helpful. There may be other physical constraints applied, or logs may be decked away from the main channel, but in any event, this may add to harvest costs … all possibilities that must be considered during the engineering phase of harvest planning.

Other considerations that may cause constraints to log placement, barge loading zones, and timber cutting will be found in the Alaska Forest Practices Act (AS 41.17), regulations and published Best Management Practices (BMPs), particularly concerning riparian areas. The Yukon River lies within Alaska Forest Region III (Figure 9) for regulatory purposes.

Figure 9
Alaska Forest Practices Regions

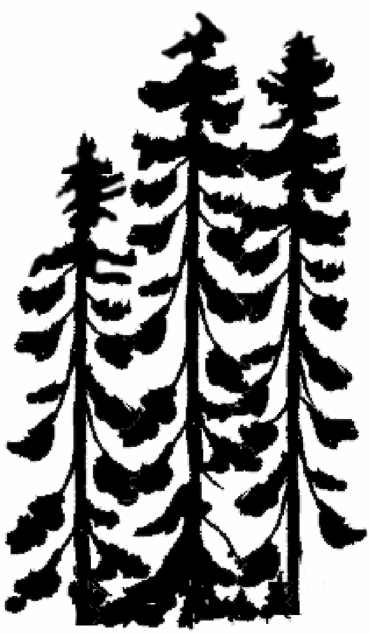


APPENDIX 2

TIMBER HARVEST IN ALASKA'S

MID-YUKON RIVER BASIN

- An Institutional Analysis -



Alaska Information & Research
Anchorage, Alaska

For

Alaska Natural Resources to Liquids, LLC
Contractor to the City of Galena, Alaska

June 2006

Timber Harvesting in Alaska's Mid-Yukon River Region
– An Institutional Analysis –

Michael Bradner
Alaska Information & Research
Anchorage, Alaska
June 2006

This report has been prepared for Alaska Natural Resources to Liquids, LLC
A Contractor to the City of Galena, Alaska

All data and conclusions are the responsibility of the author (see disclaimer)

Table of Contents

Preface

This report is an update of the May 1981 study *"Timber Harvesting in Alaska's Yukon River Basin – An Institutional Analysis"* by Alaska Information & Research, that accompanied the report *"Timber Harvesting in Alaska's Yukon River Basin – A Conceptual Analysis", July* 1982, by Forests North, Ltd.

Both were done for Richard Holden & Associates, Juneau, Alaska under contract to the Bering Straits School District. Those reports were based on the best knowledge available at that time. This report is more site specific than the original, and is based in part on a smaller selected area of the Yukon River (Kaltag to Tanana – See Figure 2), and new information and technologies developed during the past 25 years.

This report accompanies the June 2006 report, *"Timber Harvesting in Alaska's Mid-Yukon Basin – A conceptual Analysis"* that reviews the timber resource of the mid-Yukon Region and estimates the costs and procedures of harvesting and transporting the wood to Galena.

The final phase of these revised reports will be an electronic Digital Terrain Model of a selected area, near Galena, that will digitally depict a theoretical timber harvest and the expected results of such a harvest over time.

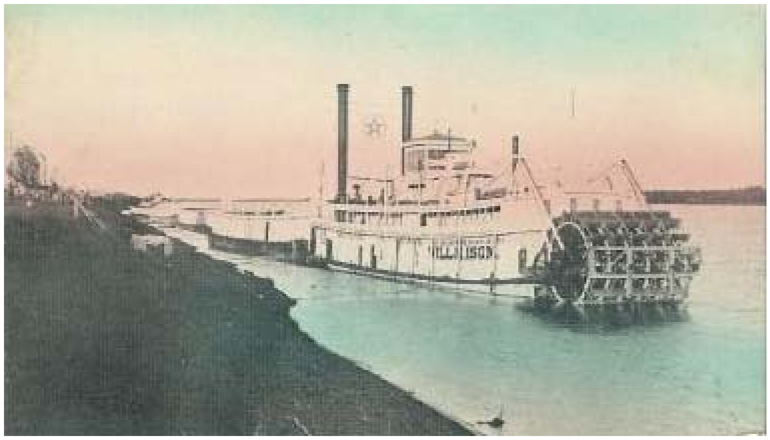
A major purpose of this report is to relate the project to the social-economic history of the region.

Harvesting timber and transporting it on the river, either as freight or fuel, is a time honored endeavor that peaked during the early years of the 20th Century following the discovery of gold in the region between Nome, Alaska and Dawson City, Yukon Territory. Many individuals and families were gainfully employed in wood cutting. For example:

> "I watched Dad cut wood for steamboats there at Kallands. You didn't have to have a contract then. Long as you had a woodpile on the bank, steamboats would buy wood. At that time there was about twenty-five steamboats up and down the river. Twenty-five different ones! Well, you see, all the freight comes in from St. Michael, up the river.
>
> "There was the Steamer *Sarah, Susie-Louise,* the *St. Michael* and *Minneapolis, Julia B., Delta,* the *Reliance* with Captain George Green, and Jack Green was on the Steamer *Alaska* later on. And there was the Steamer *Alice* and *Tanana.* The *William Isem* was one of the biggest at that time on the river. It went from Sanfransisco (sic) to Alaska and paid for herself that one trip. It ran on the Yukon after that. Then there was the two Army transports, the Steamer *General J. W. Jacobs* and *Jeff Davis*. Then down from Dawson there was the *Whitehorse* and the *Kaska*. Later on was the Steamer *Yukon*, sister ship to the *Alaska*. So, you see, that all took a lot of wood." (The author, the late Edgar Kallands was born, in 1903, at Kallands about 35 miles downriver from Tanana. His mother was Native, from Nulato, and his father was a Gold

Stampeder from St. John's, Newfoundland. Kallands was one of the Relay Dog Team Drivers that raced serum from Nenana to Nome in 1925 to combat a diphtheria epidemic. He later was a storekeeper at Kaltag. He was also an experienced Yukon River boat pilot. (An Excerpt from "Edgar Kallands - Kaltag A Biography")

Figure 1 – Many Steamboats Plied the Yukon River



There's a river boat a-wooding
up beside a muddy bank
Safety valves a-screaming
now they're hauling in the plank
And the great wheel starts a-churning
she's a-shaping Destiny,
A-heading up the river
through an empire yet to be.

S.C. Ells, in Northland Trails

Introduction

The following is an institutional analysis of timber harvest and log transportation for a proposed Biomass-to-Liquids (BTL) plant located at Galena Alaska in the Mid-Yukon Basin.

The feasibility of a plant at Galena is subject to further study being conducted by Alaska Natural Resources to Liquids, LLC (ANRTL).

Galena is a site strategically located in the Mid-Yukon River region, 28 miles upstream from the confluence of the Yukon and Koyukuk Rivers, the latter entering from the North. At this confluence the Yukon shifts from flowing west and makes a 45-degree turn to flow south.

Galena is the site of a recently closed Air Force Station, has infrastructure including an all weather airfield built by the Air Force, and surplus military buildings, pads, and other facilities. The community may also be eligible for receipt of BRAC money, allocations of federal funding made available for communities making adjustments following closure of military facilities.

The City of Galena is located on the North bank of the Yukon River, is a first class city organized under Alaska law, operates a city school district, a large statewide correspondence school program, a regional boarding school, and is a hub-distribution center for the Mid-Yukon region. As a recently operating military site Galena has excellent infrastructure and power generation facilities.

Disclaimer

Because this report is referenced on imperfect and incomplete knowledge that is subject to further engineering concerning operating a purpose-built fleet (1 towboat and 4 barges) to move logs during the ice-free summer season, the author is not responsible for any errors or omissions.

Conclusions noted herein are conservative, and may or may not stand the test of time. As the project is further developed new information should be entered. For example, the cost of diesel fuel to power marine vessels will undoubtedly change. Once a BTL plant is operational all fuel for harvesting, transport and support can come from that plant, theoretically lowering fuel costs. Other changes will occur in the cost of labor and other elements of the Operation and Maintenance (O&M costs) of vessels and support equipment. These changes may be positive or negative.

This report does not include the cost of investment in harvesting equipment or marine vessels.
Investment costs are being budgeted in the upcoming ANRTL report.

Conclusions

✓ Harvesting timber and riverboat/barge transportation is a historical industry for the residents of Alaska's Yukon River, though except for a period in the first half of the last century it has not been a major source of revenue.

✓ There is sufficient timber, of all ownerships, adjacent to the Mid-Yukon River to support a moderate sized Biomass to Liquids (BTL) plant at Galena. Modern mechanical harvest is the preferred method.[1]

✓ Towboat/barge wood transport on the Yukon River between Kaltag and Galena is both technically and economically feasible using towboat and barges with drafts to 6 feet.

✓ Equipment of this size is not present on the Yukon River and would have to be acquired by the project and project operated, or preferably operated under contract with one of the two operators on the river. Efforts should be made to make harvest oriented river equipment a direct project cost and eligible for government assistance.

✓ Log harvest by independent operators by log raft from Tanana to Galena is practical and would be a source of supplemental feedstock for the Galena based BTL plant.

✓ Log transport using equipment of private Yukon River towboat/barge operators is also possible and practical. Wood could be transported from the Lower Tanana River, the Yukon River above Tanana and from points between Tanana and Galena supplemental to rafting.

✓ Costs listed herein are conservative. It is highly probable that cooperative planning with existing Yukon River Barge operators can lower river transport operational costs.

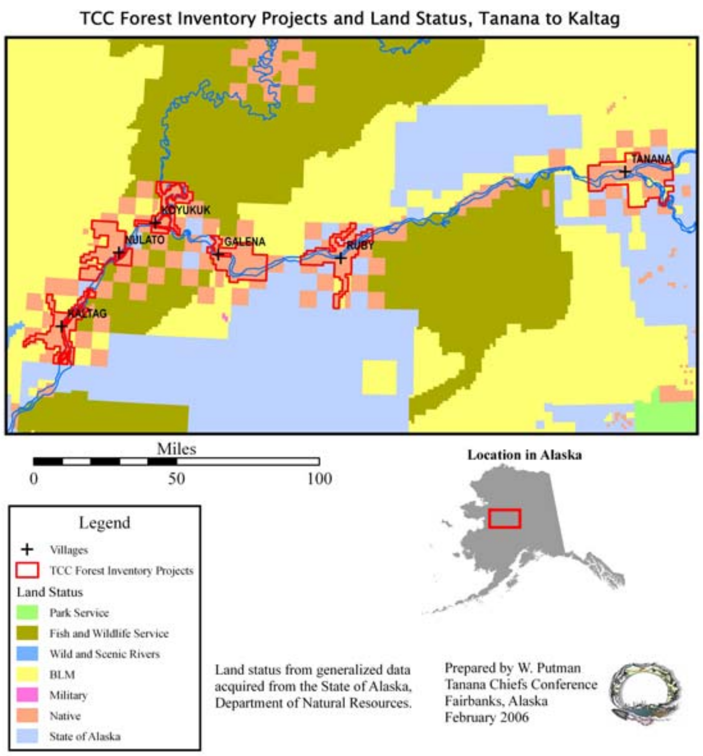
[1] See accompanying report "*Timber Harvest Alaska's Mid-Yukon River – a conceptual analysis*" June 2006

Transport regions

Primary harvest transport region

Most of the timber feedstock for a BTL plant would be transported to Galena via the Yukon River by barge from downriver harvest sites, and by rafting from upriver harvest areas. The river transportation season would be four and a half months from late May until early October. Product would be transported during this season to Galena for stockpiling sufficient for the plant to operate 365 days a year. While winter breakup conditions vary from year to year, conservatively the season can be expressed as 120-days – June, July, August, and September.

Figure 2



Extended region of operation

The extended region of harvest operation would be from the areas below the village of Kaltag, 72 miles downstream on the Yukon River from Galena and upriver to a point just above the City of Tanana, 150 miles upstream from Galena. The river in this region is wide, and has a stable single channel with moderate currents between 5 and 7 mph.

These favorable characteristics of the river prevail to a point just above the City of Tanana. In this area the river begins to narrow into a region known as the Ramparts of the Yukon. In this region the river is narrower, swifter, and bordered by steep hills

(Ramparts). The upriver harvest zone is 150 upstream from Galena, while the downstream zone extends 72 miles.

The two harvest zones combine to make a river transportation zone 122 miles long. It should be noted that a small zone of both the Lower Tanana and Koyukuk Rivers also offer potential for river transport.

The river transport area therefore divides into two zones:

(1) The downriver harvest area requiring barge and transport upriver to Galena, and;

(2) The up river zone requiring downriver transport by small vessel assisted rafting. It should be noted that nothing precludes barge transport in this upper sector of river

Socio-economic Impact

The downriver harvest area includes the villages of Koyukuk, Nulato, and Kaltag, and Galena. The upriver zone includes Ruby and Tanana, with a possible employment reach to Rampart, and Stevens Village, 60 miles and 134 miles upriver from Tanana. It is also possible that employment benefits might extend to Koyukuk River villages and to Minto on the Tolovana River a tributary of the Tanana River.

It is significant to note that woodcutting was once a primary industry in the region of the Yukon Basin, as well as many other areas of rural Alaska. Wood was the primary fuel for homes, commercial facilities, schools, and most significantly, the steamboats, which operated on the Yukon and Tanana Rivers. Steamboats used wood for fuel until 1948, resulting in wood yards up and down the river systems, located at strategic locations for both wood loading by the vessels and harvest availability. Wood was usually cut in the early winter before heavy snowfalls and stored in wood-yards near loading points.

Wood yards for steamboats commonly operated through contract cutters, and woodcutting was a significant source of income for nearby village residents Wood was commonly cut in the early winter period, just after freeze-up but before heavy snow cover. World War II introduced oil to the villages generally delivered in barrels (55 gallon drums). After the war schools and other users shifted to bulk fuels. In 1948 the Alaska Railroad converted its two remaining steamboats, the Steamer Nenana and the Steamer Alice to oil, ending the era of a wood cutting industry along the river.

There were four significant negative impacts on the economy of this region beginning in the 1930s.

(1) President Roosevelt froze the price of gold. This action gradually strangled the gold mining industry, especially eliminating small mines that employed local people, such as south of Ruby and up and down the Yukon.

(2) Fur fell from fashion. Russian fur imports and fur farming further put the rural fur industry in a downward spiral it never recovered from.

(3) Then beginning in the 1930s, the bush plane increasingly eliminated teamster work in rural Alaska, meaning freight hauled by dog teams and horse teams. This was also winter work.

(4) The final straw was woodcutting, the final impact being the conversion of the Alaska Railroad steamboats to burn oil.

Significantly, three of the above were winter components of the local economy. The fourth, mining, provided summer work. By the mid-1950s the only mining jobs remaining were at larger mine sites, such as the dredge operations in Nome, Hogatza on the Koyukuk River, and those near Fairbanks. Rural residents often worked at these sites as village crews. However, by the early 1960s most of these operations were gone, and as a result the economy of rural Alaska was largely gone.

An interesting benefit of the BTL plant is that it returns woodcutting to the Yukon Valley and in a mode of operation that virtually guarantees local employment. Further, increased river traffic and log handling at loading and unloading points will be a source of summer employment. In the upriver region there will be opportunity for independent operators who will cut and raft logs to Galena or possibly utilize independent or project contract barging.

Impact of a Galena BTL plant and wood harvesting

In the context of the previous discussion of rural socio-economic conditions, the potential of a Biomass to Liquids (BTL) plant located at Galena is that it would return a traditional wood cutting industry to the middle Yukon. The period of employment would be seasonal, functioning in the early winter and late spring. Shipping, loading, and unloading operations would provide summer employment.

Further, the end-product, a fuel meeting new federal ultra-light sulfur standards, would be transported and utilized along the entire Yukon River, with a market possibly also extending to villages on the Bering Sea and Norton Sounds coasts.

New ultra-light sulfur fuel requirements

The plant would also manufacture a fuel meeting new federal ultra-low sulfur standards. The product of a biomass plant at Galena would be virtually sulfur free. New EPA rules will require so-called ultra-low sulfur fuel, less than 15 parts-per-million, compared with diesel fuel at 500 ppm to 3,000 ppm sulfur, starting in 2006. These new rules will not apply to rural Alaska immediately, but will apply to off-road construction machinery beginning in 2008 and to other uses in rural Alaska in 2010. For a practical matter all engine fuels after 2010 will be designed for ultra-light sulfur fuel. The development of a

Galena plant would fit fairly closely with timetables for phase in of ultra-light diesel in rural Alaska.

Transportation of harvested wood

Barge operations Galena to Kaltag

This region downriver from Galena is expected to be the primary harvest zone (village regions of Kaltag, Nulato, Koyukuk). This is also the river region of the primary towboat and barge operation. Kaltag is 72 miles below Galena, but different harvesting points will mean barge hauls shorter than 72 miles, and possibly longer if harvest takes place below Kaltag.

Towboat

Figure 3 – Utility Towboat [2]

One utility towboat will be required with a crane on the foredeck, pilothouse moved mid-ship, and with an elevated pilothouse to see over the barge load. Maximum draft would be 6-feet, fully loaded. The purpose of the crane on the foredeck is to do utility work around the log barges and in loading and log discharge areas. A minimum professional crew of six will be required. Two deck hands may prove necessary, but they would participate largely in loading and unloading operations along with at least one deck officer.

- Capitan and pilot (2)
- Engineers (2)
- Deck officer/personnel (2)
- Deckhands (2)

Total towboat personnel (8)

<u>Note:</u> As indicated above deckhands may be assigned as shore personnel rather than vessel personnel.

[2] The design of a Yukon River towboat to handle loaded log barges would be similar to that shown. However, the Yukon vessel would be larger and more powerful, with full accommodations for the crew for long distance hauls.

Towboat costs:[3] Costs calculated based on Columbia River operating cost and increased with a 100 percent premium for higher Alaska costs and remote operating costs.

Daily operational cost: $7,868.18.

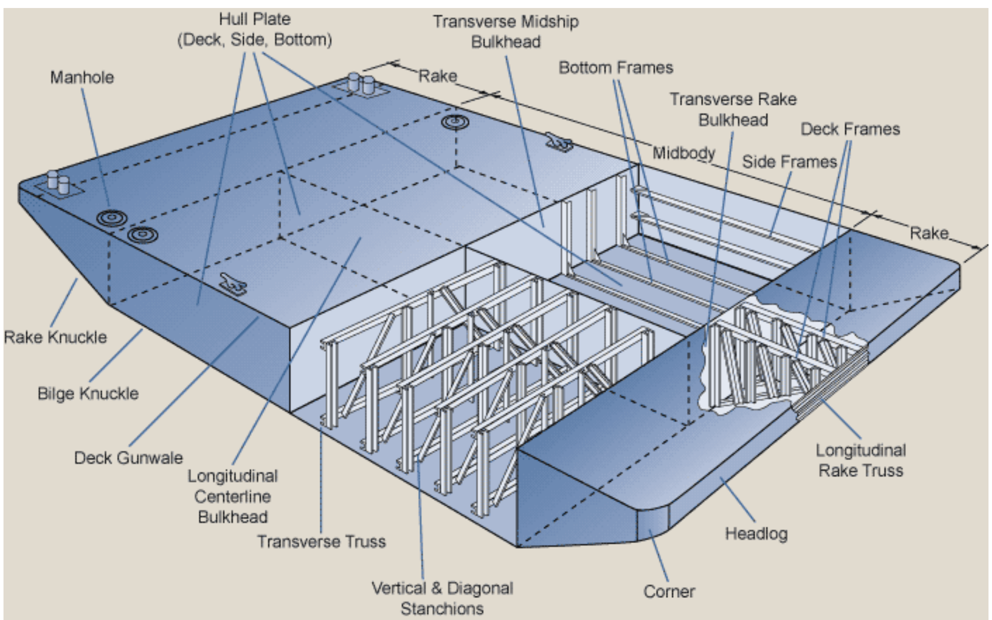
Seasonal operational cost: $786,817.54

Costs based on: 100 days operation, fuel costs, crew costs, replacement costs, 100 percent Alaska premium, and profit at 20 percent.

Note: In the event of significant towboat equipment breakdown backup equipment would likely be available from Yutana Barge Lines (Cowley Maritime subsidiary) operating out of Nenana.

Barges

Figure 4 - Common Features of an Inland Deck Barge



Number of barges (4): Required will be four inland river type deck barges. The size would measure 200 feet length by 40 feet beam, by 10.6 feet bottom to deck. At a 6-foot draft leaving 4 feet of free board, capacity loaded would be 1,160 short tons. (Courtesy McDonough Marine). This draft is not untypical of fuel barges negotiating the river downstream from Tanana to Galena, often in multi-barge tows.

3 Towboat Operation Costs does not include capital costs. These costs comport with the estimates presented in Table 4, Page 12 of the report "Timber Harvesting in Alaska's Mid-Yukon Basin – a Conceptual Analysis."

Estimated Barge Capital costs[4]

4 barges at $350,000 each – Total cost $1.4 million

Shore infrastructure

A noteworthy feature about operating along a river such as the Yukon is that building shore infrastructure should be avoided whenever possible. Rivers, especially northern rivers which freeze over, run ice at breakup, and experience frequent ice jams. These waterways do not respect fixed structures along their shores. The river changes, channels change, and cut banks erode and collapse into the river, introducing thousands of tons of dirt and trees annually. Other banks are 'beached" (sloped), but none-the-less fixed features may disappear in a season or contribute to altering the course of the river downstream.

There are two types of loading environments that will exist in wood harvest areas.

(1) One loading environment is from a cut-bank, a vertical bank where the river may, or may not any longer, be cutting underneath.

(2) The second environment is from a beach, which will most likely have a base of rocky material.

Cut-bank loading

The preferable cut-bank loading area will be in an area that is vertical, but where the river at normal water levels has pulled away and is no longer actively undercutting the bank. Some sweepers will have to be cut back, but not removed. The trimming of sweepers would only be to the extent need to allow the barge to get within reach of shore loading cranes. A loading area on top of the bank would have to be cleared. However, bank top vegetation would not be removed. The loading area would be covered with environment protecting matting, which oil companies are now using for access and for drilling pad areas to avoid rutting the surface. The goal would be to maintain the natural erosion of the bank, especially along banks active at high water.

The point here is that very little infrastructure investment would be required for the base of loading areas along these kinds of banks. The basic cost would be for purchased or leased matting, a product that would also be used at the sites to bridge soft areas of ground to avoid rutting.

- Infrastructure cost negligible.

Beach loading

[4] Barge Capital Costs are not included in the barge operating costs. Operating costs are limited to annual maintenance.

Beach loading can be more difficult because the barge must constantly be moved outward as load is added and barge draft increases. How this is accomplished depends on how steeply the depth increases from the shoreline.

The process would most likely use timbers from the barge to shore sockets to spar the barge out (hold the barge out from shore). This would be a continual process as draft increases with load. At these beach loading areas environmentally friendly matting would also be used, and removed at seasons end. This would keep the beach area as undisturbed as possible. Depending on the underwater gradient from shoreline, some sort of temporary supports may be needed to keep loading cranes in shallow water and to keep the barge within range of the crane.

The advice of old river operators is to work with the river not against it. The river is a creature of its own and should be respected. Each year the river takes millions of tons of soil into its waters, and probably more timber than this proposed harvest operation requires, especially in the Yukon Flats region and along the Tanana River.

- Loading infrastructure cost is negligible.

Galena unloading

The preferable unloading environment is a beach condition near the downriver end of the Galena community. Loading would be accomplished by crane with loading on trucks for transport to a wood yard. In the case of unloading the barge lightens and is pulled into shore as draft decreases. Like in loading areas mats would be used to minimize and serious disturbance of the beach by vehicles used for log transport.

- Infrastructure cost negligible.

Figure 5 – Tracked Cranes with Log Grapples for Loading-Unloading

River barge operation Kaltag/Galena

It is anticipated there would be 30 round trips per year of 200 miles each. Both the number of trips and mileage are conservative figures. The 30 round trips anticipate a 90-day season, while operation is possible for 120 days. Likewise the 200 miles is based on transport from the furthest harvest area.

Thirty round trips would require pushing a tow of 4 barges of 1,000 tons each, for a total of 4,000 short tons.

Thirty round trips of 3 days duration would deliver 121,734 short tons in a 90-day operational season.

If trips required four days then 30 trips would fit within a 120-day season and deliver the same 121,734 green short tons of harvest.

Turnaround time would be 3.1 days, allowing harvest area crews time to position logs for loading.

Four barge tows in recent years have been uncommon on the Yukon River, but because of lack of need, not feasibility. In steamboat days large lows of six to seven barges were negotiated all the way to Dawson, Yukon, territory. These vessels had considerably less power and maneuvering ability.

- Cost per short ton $9.91.[5]

Reality check

(Loaded upriver tows Tanana to Fort Yukon)

Upriver tows are uncommon on the Yukon except in the area above the confluence of the Tanana and Yukon Rivers. The M/V Tanana, powered with 1,000 h/p, a towboat draft of 3.6 feet, five bladed props of 36 inches (designed for the Tanana River) averages 4.4 mph pushing a two-barge tow of 872 tons between Tanana and Fort Yukon in spring water. The river in this entire length is swifter, including having to negotiate the Rampart Rapids.

The towboat in our design would have a six-foot draft, double the power, and larger propellers. The area of the river would also be easier to negotiate and have more moderate currents than in the upper river. In addition distances represent the maximum mileage.

[5] From Table 4, Page 12 of the report "Timber Harvesting in Alaska's Mid-Yukon Basin – a Conceptual Analysis."

Potential Upriver harvest

Upriver wood harvest would be supplementary to the main harvest in the region from Galena to Kaltag.

Transport would be by rafting from areas between Galena and Tanana.

Wood harvest would probably be by independent operators.

Each raft would be estimated to provide 1,500 short tons.

Nine rafts per season = 13,636 short

- Cost per ton $3.43.[6]

Transport of other harvest;

Harvest along the Tanana River would be possible, especially in the lower reaches of the river as far upriver as the Tolovana. Harvest in this region would be transported on board existing shallow draft river barges restricted to a draft of 4-feet.

Log barges could accompany barges with other cargos to Tanana, and then be picked up in a larger tow. Presently Yutana Barge lines shuttles smaller draft barge loads and smaller tows of barges down the Tanana using smaller towboats. Barges are often assembled in larger tows and with deeper draft for Yukon River transportation, pushed by the larger M/V Tanana.

As supplementary sources, at least in terms of river transport, wood could also be pulled out of the lower Tolovana and Kantishna rivers. Existing transporters on the Tanana River would be used for this transport.

It is also possible, given harvest sites, that wood product could be obtained above the confluence of the Tanana River with the Yukon. Existing freight haulers, when they return back downriver from upriver runs hauling freight load, would transport this wood product.

[6] From Table 4, Page 12 of the report "Timber Harvesting in Alaska's Mid-Yukon Basin – a Conceptual Analysis."

Figure 6 - Yutana Barge Lines Towboat at Nenana on the Tanana River

Present Yukon Barge Haulers

Yutana Barge Lines, Nenana, Alaska

The present day operator on the Tanana and Yukon Rivers is Yutana Barge Lines, a subsidiary of Yukon Fuel, both being part of Crowley Maritime.

Crowley maritime/Yukon Fuel
7941 Sandlewood
Anchorage, Alaska – 99507
(907) 832-5476
(Mark Smith, Corporate development office)

Yutana operates three towboats:

- M/V Rampart – predominantly used in the Tanana River.
- M/V Kantishna – predominantly used in the Tanana River.
- M/V Tanana – Used in both the Tanana and Yukon Rivers, and capable of larger tows.

Yutana operates a fleet of 5 barges, and 2 general freight barges.

Ruby Marine Inc.

A new entrant is entering Yukon and Tanana River service in 2007 under the name of Ruby Marine Inc. A vessel and barges are presently under construction. The principal of Ruby Marine is the former general manager and president of Yutana Barge Lines.

Ruby Marine Inc.
P.O. Box 81443
Fairbanks, Alaska 99708
(Principal: Matt Sweetsir)

APPENDIX 3

APPLYING FOR A FOREST STEWARDSHIP GRANT

Division of Forestry
Alaska Department of Natural Resources

Forest Stewardship/Landowner Assistance Program
Private Landowner Assistance
The Forest Stewardship Program is a federally-funded service that assists private landowners with forestry needs. In Alaska, landowners with seven or more acres of land capable of growing trees are eligible. The intent of the program is to:

- assist the management of forest resources.
- keep lands productive for present and future owners.
- increase economic and environmental benefits.

Upon requests from landowners, site visits will be made and forest conditions inspected. Forest measurements can be made to determine tree sizes, density, and other forest attributes. Conditions of spruce bark beetle and other insect and disease conditions will be recorded. Potential hazards in the event of wildfire will be noted. Observations about wildlife habitat and usage will be made.

Forest Stewardship Plans
Information collected from site visits can be incorporated into a Forest Stewardship Plan. The plan has a ten-year outlook and must state and follow the landowners goals. There are no land-use expectations-logging, road building, and public access are not required. Spruce bark beetle conditions and treatment options are covered. Recommendations for tree planting and care are provided. Suggestions for wildlife habitat improvements are provided. Information about compliance with Alaska's Forest Resources and Practices Act is furnished. There is no fee for Forest Stewardship Plans, but landowners are asked to sign the plan showing their intent to follow it.
Cost-Share Assistance
Limited cost-share assistance may be available to eligible landowners with approved forest management plans. Payments come from the USDA with inspections and approvals from the Alaska Division of Forestry. Landowners must agree to not destroy the practice for 10 years. Cost-share payments may be between 50% and 75% of the total practice cost. Landowners must present receipts or document their time in doing the practice. The following are possible cost-share practices:

- Machine scarification as site preparation for tree planting and browse enhancement.
- Tree seedling purchase and planting.
- Thinning of young, dense forest.
- Wildlife brush shelters.

ANCSA Corporation Grants
Alaska native corporations established pursuant to the Alaska Native Claims Settlement Act (ANCSA) are encouraged to seek assistance from the Forest Stewardship Program. The usual approach for Native

corporation assistance is through a grant. A professional natural resource advisory can then be retained as a consultant or employed by the corporation. Grant expectations include a general inventory of forest resources, land designations using mapping, and a ten-year plan for land designations. Native corporations interested in a grant should contact the program coordinator at (907) 761-6309.

Forest Stewardship Committee

The Division of Forestry is assisted by the Forest Stewardship Committee in implementing the Forest Stewardship Program. The Committee is comprised of landowners, organizations, and government agencies with experience and commitment to private forest stewardship. Individuals interested in participating on the Forest Stewardship Committee should contact the program coordinator at (907) 761-6309. The committee meets twice each year.

Jeff Graham
Forest Stewardship Coordinator
DNR--Division of Forestry
101 Airport Road
Palmer, AK 99645
Jeff_Graham@dnr.state.ak.us

Ole Andersson, Kenai Watershed Forum, Soldotna
Clare Doig, Forest Industry Representative, Anchorage
Doug Blossom, Forest landowner, Kenai
Jeff Graham, Alaska Division of Forestry, Palmer
Mike Green, Forest landowner, Fairbanks
Hans Klausner, Alaska Association of Conservation Districts
Jimmy LaVoie, USDA Farm Service Agency, Palmer
George Matz, The Audubon Society, Homer
Mitch Michaud, USDA Natural Resources Conservation Service, Kenai
John Mohorcich, Kenai Peninsula Borough, Soldotna
Steve Patterson, USDA Forest Service, Anchorage
Tom Paragi, Alaska Department of Fish and Game, Fairbanks
Erica Reith, USDI Bureau of Indian Affairs, Juneau
Jake Sprankle, Tanana Chiefs Conference, Fairbanks
Bob Wheeler, Alaska Cooperative Extension, Fairbanks

APPENDIX 4
Marketing opportunities from a Galena bio-fuels plant

Prepared by Alaska Information and Research Service
3037 S. Circle
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Authors:

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March 30, 2007

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Scope of marketing opportunities from a Galena-centered fuel source on the Yukon River

A fuels plant at Galena, on the middle Yukon River, presents certain advantages in terms of distribution of liquid fuels to communities along the river. Fuel is now transported by barge to the Yukon River from Nenana, on the Tanana River. Most liquid fuel now shipped from Nenana is delivered by truck from the Flint Hills Resources refinery at North Pole, near Fairbanks. Fuel is loaded from trucks to barges in Nenana, from where it is delivered downstream. When the new ultra-low sulfur (ULS) fuel requirements are extended to rural Alaska in 2010, the fuel will have to be trucked 500 miles to Nenana from the Tesoro Alaska Petroleum refinery at Nikiski near Kenai. Tesoro's refinery is the only plant in Alaska capable of making the ULS diesel. A diesel made at Galena through a Fischer-Tropsch biomass process, however, would be an alternate source of supply for this fuel. The fuel produced in a Galena plant would meet and even exceed the federal ULS requirements.

The Tanana River presents certain navigational challenges to barge operators. The river is a cut-bank river with narrow, often-shifting channels as well as flat, shallow crossings where the channel changes. As a result Yutana Barge Lines, the barge operator, must often run partially-loaded barges with light loads from Nenana to the mouth of the Tanana River on the Yukon River. Lighter loads reduce the draft of the barges and lessen the likelihood of groundings. At the mouth of the Tanana the fuel is transferred to other barges so that barges are filled to capacity for operation on the Yukon River, which is deeper and wider and does not present the navigation challenges posed by the Tanana. Alternatively barges are shuttled from Nenana and multi-barge tows of less volume each are made up for proceeding on the Yukon River.

Running half-loaded and/or transferring fuel at the Yukon imposes inefficiencies on the barge operation, which adds costs. A source of fuel at Galena, which is in a location where communities up and down the Yukon could be served, would allow the barge operator to reduce this problem, which is often referred to as the Tanana River bottleneck. Trips down the Tanana would still be made to deliver general cargo as well as gasoline and aviation fuel, but the overall operation might be more efficient if the largest volume of fuel delivered to the region – diesel – could be done from Galena. Carrying fuel from Galena would also avoid the need to truck fuel from the North Pole refinery to Nenana, which is now done, or to truck ULS diesel from Kenai to Nenana, which will have to be done after 2010. Moving fuel by truck, with multiple transfers and handlings, increases the change of spills.

Estimating the benefit of a Galena location, in terms of reduced transportation costs, is beyond the scope of this report. We feel it is likely, however, that the cost of delivering fuel would not be greater from Galena than it is from Nenana and the refinery near Fairbanks and at Nikiski.

Galena also presents opportunities for delivery of fuel by air to communities which do not have access to barge service. Fuel is now delivered by air from Fairbanks and sometimes Kenai to remote communities in northwest and western Alaska. Galena has a good airport, built and until recently operated by the Air Force. It has facilities which can service aircraft and is closer to many of the communities now supplied by air than Fairbanks or Nikiski. For example, Noatak, on the Noatak River north of Kotzebue, is totally dependent on fuel deliveries by air. Galena is half the distance (approximately 240 miles) from Noatak than is Fairbanks (450 miles). Even a preliminary analysis of this option, however, is beyond the scope of this report, but we point out the opportunity as an option that could be explored further.

Delivery of fuel by barge from Galena

The most efficient and larger volume market for fuels from a Galena plant is downstream on the Yukon River from Galena to communities within the Yukon Delta. The river in this region has a good channel of sufficient depth for any class of river towboats and barges. Deliveries of fuel upstream to as far as Fort Yukon are also feasible.

There are two main geographic market spheres for fuels shipped from a Galena facility by barge. The volume of fuels produced by the plant would meet demand in these regions. The combined population in the downriver and upriver market areas is approximately 7,500. The volume of fuel sold now in this market is proprietary information but the Alaska Energy Authority says that a good rule-of-thumb is that in rural Alaska the per-capita use of diesel and home heating oil works about to about 1,000 gallons per person per year. Using this rule-of-thumb, the demand in the Yukon region from the Galena plant could be roughly estimates at 7.5 million gallons per year, which would absorb the output of the plant at 500 barrels per day,.

Communities to be served include:
(1) Downriver from Galena to the Yukon Delta, to end-point communities in the vicinity of Emmonak in the South mouth of the Yukon Delta or Kotlik. In the North mouth of the delta.

(2) Upriver from the Galena plant in the middle Yukon River to an end-point at Fort Yukon, on the upper Yukon.

In regard to the downriver market, it should be noted that the current fuel distribution system, from Nenana, reaches as far downriver as St. Marys, roughly 100 miles upriver from Emmonak and Kotlik. The latter communities are now served mostly from the west with coastal-class barges supported by large ocean-going barges operating from Nikiski, near Kenai. However, if the inefficiency of the Tanana River segment were removed from the Yukon delivery system then deliveries by river could be made as far as Emmonak and Kotlik, in the opinion of barge operators with experience in the area.

Potential markets in coastal communities

It is also possible that fuel from a Galena plant could also serve coastal communities in or near the Yukon Delta, or Norton Sound. This would require shipments downriver from Galena to a bulk plant transfer site at Emmonak or Kotlik. A bulk storage plant in those locations could be used to fill coastal-class barges that would serve smaller Norton Sound communities to the north. Potentially, communities to the south could also be served as far as Hooper Bay. The north and nouth distances are roughly 150 miles along the coast, but with roughly 75-100 miles added for either direction, depending on whether the bulk fuel facility is located at Emmonak or Kotlik

Distribution upstream to Fairbanks

Distribution of the ultra-clean fuels on “backhaul” of barges to Nenana or even up the Tanana River to Fairbanks, is an interesting possibility that could also be considered. This could be an alternative to truck hauls of clean ULS diesel out of the Tesoro refinery on the Kenai Peninsula to Fairbanks. Fuel could be offloaded at Nenana for trucking to Fairbanks or fuel might be delivered directly to Fairbanks by barge.

Depending on decisions by Flint Hills Resources at Fairbanks regarding clean fuels, or the economics of trucking from Nikiski, near Kenai, it might prove economic to continue upriver on the Tanana with barged fuels from Nenana to Fairbanks. The Chena river joins the Tanana on the latter rivers downriver side of Fairbanks. Just within the Chena's mouth, or just upriver from the Chena on the Tanana there are possible sites for offloading and storage.

The river distance between Nenana and Fairbanks is much more manageable for barges doing an upstream push. A barge and vessel would return empty downriver over the 70 miles to Nenana.

Galena downstream on the Yukon River
(Galena to the mouth of the Yukon, communities with populations)

Galena	(654)	0 mileage point
Huslia	(265)	On the Koyukuk River roughly 100 miles upstream from the point where the Koyukuk River joins the Yukon 20 miles downstream from Galena.

Koyukuk (97)

Nulato (310)

Kaltag (227)

Grayling (171)

Anvik (99)

Holy Cross (205)

Russian Mission (329)

Marshall (370)	
Pilot Station (565)	
St. Marys (570)	470 miles from Galena (current end-point of the upriver delivery)
Mountain Village (786)	490 miles from Galena
Emmonak (740)	560 miles (south mouth)
Kotlik (609)	580 miles (north mouth)
Alukanuk (678)	(in the Yukon Delta)
Pilot Point (73)	(in the Yukon Delta)
Sheldon Point (161)	(in the Yukon Delta)

The downstream run south on the Yukon from Galena with loaded barges imposes no restrictions in terms of load, draft, or the number of barges. Barges could make village deliveries along the way and also make an "express run" to the mouth of the Yukon River to a bulk tank location at Emmonak or some other location in the delta for redistribution to coastal villages.

Galena upstream on the Yukon River

Galena to Fort Yukon, communities with populations

Ruby (204)	
Tanana (317)	162 miles from Galena
Rampart (unincorp.)	
Stevens Village (unincorp.)	

Beaver (Unincorp.)

Fort Yukon (553) 562 miles from Galena

The market upstream is limited by community size and demand, not restrictions imposed by the river. The end-point at Fort Yukon would be the largest fuel delivery. The river from Galena and Tanana is broader, with currents slower and channels that have room for vessels and their barge tows to run outside the main currents of the river.

The Yukon further upstream, between Tanana and Stevens Village, has a good channel but is narrower and presents stronger currents. This is the region of the river called the "Ramparts," referring to the confining mountains on both sides of the river. Between Stevens Village and Fort Yukon the river winds through the Yukon Flats and is braided with many islands and sloughs and with channels and currents that are more complex. Barge tows of freight and fuel now delivered from Nenana must come 192 miles downstream on the Tanana River and then negotiate a 400-mile upstream push on the Yukon from Tanana to Fort Yukon.

On occasion, during higher water and swifter currents, barge tows are broken to single barge units and ferried upstream through the Rampart Rapids between Tanana and Rampart. It should be noted that large multi-barge tows pushed by sternwheeler steam-powered vessels made the upriver trip regularly between St. Michael and Dawson, Yukon Territory, including the Ramparts Rapids, during the early years of the 20th Century.

In rough terms, the "ports of call" between Tanana and Fort Yukon are roughly 70 to 90 miles apart, the river segments being Tanana-Rampart, Rampart-Stevens Village, Stevens Village-Beaver, and Beaver - Fort Yukon.

Galena downstream to the Yukon Delta

The most efficient run on the Yukon would be the loaded downstream run from Galena to the Yukon Delta. The deltas and immediate upriver area is also the home of the larger Yukon villages and fuel consumers.

A secondary market to the Lower River/Delta region market may exist in Norton Sound and communities along the immediate Bering Sea coast. These are now served by small 1.2 million gallon coastal-class barges that fill from the much larger 3-million-gallon line-haul barges hauling fuel from the Tesoro Refinery at Nikiski. The line-haul barges serve larger primary destinations along the coast such as Bristol Bay, Nome and communities north of the Bering Straits such as Point Hope, Wainwright, and Barrow.

Communities to the North of the Yukon Delta

(Coastal region, Yukon Delta to Nome, communities with populations)

Stebbins (596)	55 miles from Kotlik (a possible bulk storage site just inside the north mouth of the Yukon.)
St. Michael (427)	70 miles from Kotlik (possible bulk storage site)
Unalakleet (710)	100 miles from Kotlik
Shaktoolik (224)	150 miles from Kotlik
Koyuk (350)	180 miles from Kotlik
Golovin (150)	Golovin/White Mountian are on the South coast of the Seward Peninsula, a 110-mile direct crossing of Norton sound northward from Kotlik
White Mountain (224)	(See above note White Mountain)

The four largest Norton Sound communities are just north of the north mouth of the Yukon. These are Stebbins, St. Michael, Unalakleet, and Shaktoolik, with a combined population of 2,156. The north mouth of the Yukon was extensively used in early years. Flat-bottomed sternwheelers used St. Michael as the coastal port and entered the Yukon through the north mouth.

Communities to the South of the Yukon Delta

(Coastal region: Yukon Delta south, communities with populations)

Scammon Bay (509)	90 miles from Emmonak

	(possible bulk storage site)
Hooper Bay (1,133)	120-plus miles from Emmonak
Chevak (916)	120-plus miles from Emmonak (vicinity of Hooper Bay).

Other communities in the Bering Sea

We would not consider St. Lawrence Island communities within the market reach of a Galena plant, but there is always the possibility that fuel could be sold there.

Here are the two communities on St. Lawrence Island:

Savooga (695)	200 miles across Norton Sound to the West (Both Savoonga and Gambell are on St. Lawrence Island)
Gambell (600)	200 miles across Norton Sound to the West (45 miles east to west on St. Lawrence Island)

Galena to Fairbanks
(Upstream on both Yukon and Tanana Rivers)

Presently Flint Hills Resources at North Pole, within the Fairbanks North Star Borough, does not have plans to refine ultra low-sulfur fuels. This fuel is now trucked by highway from the Tesoro refinery, at Nikiski on the Kenai Peninsula, to Fairbanks. This involves trucking fuel in 11,000-gallon truckloads from Nikiski to Anchorage and then from Anchorage to Fairbanks.

The economics of serving this market from Galena depends on the cost of trucking from Nikiski to Fairbanks and the cost of the alternative of “backhauling” fuels from Galena to Nenana, and then to Fairbanks. The economics of the upriver haul could be improved by the fact that tank barges, even if used to deck freight, today return from Galena or downriver points empty.

The river trip itself would involve a push on the Yukon between Galena and Tanana, and then 192 miles up the Tanana from Tanana to Nenana, and an additional push from Nenana to Fairbanks of 70 miles. The push from Galena to Tanana on the Yukon presents no problems of load or barge draft, except that more time is required for the upriver push with loaded barges.

The Tanana River segment, from Tanana to Nenana and Fairbanks, presents more channel difficulty. Currents are stronger and more channeled and there is less opportunity to run outside of the main current. Barge draft on the Tanana, in general, is usually limited to 3.5 feet to 4 feet, but this is for loaded downstream traffic. Running downriver, vessels must maintain steerage speed with loaded barges, and must often reverse power over shallow channel crossings to reach opposite sides of the river. Barge tows under these conditions, running downstream, are more difficult to control.

Going upstream presents different conditions, however. The push is slow against strong currents, but the tows are more controllable and groundings are less likely. In the first two decades of the 20^{th} century sternwheelers with heavily loaded multiple-barge tows made this push up the Tanana River routinely, returning downriver with lighter tows.

Tanana River upstream barging, slower but less hazardous

Barges being handled upstream on the Tanana might draw slightly deeper drafts, up to 4 feet 6 inches, especially between Tanana and Nenana. Channels above Nenana are adequate but narrower, and more difficult for faster-moving downriver loaded tows but not necessarily for slower-moving upriver loaded tows. Historically, large sternwheelers entered the Chena River, which flows into the Tanana River near Fairbanks. Today sloughs that carried water from the Tanana River to the Chena above Fairbanks have been closed off for flood control, which makes the Chena not suitable for deeper drafts except within a half a mile or so of the Chena mouth.

Lands on the Tanana upstream side of the Chena River mouth belong to the state and Fairbanks International Airport and could be a suitable location for offloading of fuel shoreside tanks and commercial redistribution. The Tanana River is navigable for a short distance upriver from the mouth of the Chena, but in general the Tanana River at Fairbanks becomes a complex of braided and shallow channels beyond this point.

Prior Fairbanks-to-Galena oil hauling

Weaver Brothers, using small tank barges, hauled oil, jet fuel and freight out of the lower Chena River to Galena in the 1960s, routinely handling barges at depths of 3 feet 6 inches fully loaded downstream. One vessel used was the M/V Rampart, a sizable towboat still in use by Yutana Barge Lines, a Crowley Maritime subsidiary.

Alternative ways of supplying fuel to the Yukon River region

Fuel moved from a biomass fuels plant at Galena offers certain efficiencies on the Yukon River, but there are other options for supplying the region. The inefficient Tanana River segment could be eliminated by extending the Fairbanks-Manley Hot Springs road roughly 40-55 miles to a point just upriver on the Yukon from Tanana. Bulk storage tanks and a dock could be built at this location. The capital cost of this plus the costs of trucking from Fairbanks would have to be weighed against the status quo of the present system or the option of delivery from Galena.

Another possibility that has been raised is a fuel-loading dock and bulk storage facility at the Yukon River bridge, where the Dalton Highway crosses the Yukon. This would require fuel to be trucked from Fairbanks to the Yukon River bridge and transferred to barges. A potential problem, however, is the difficulty posed in running loaded fuel barges downstream from the bridge through the Ramparts rapids area. Operating loaded barges upstream against currents is easily accomplished in this area, and with lightly-loaded or empty barges running downstream. However, operating fully-loaded barge tows through narrow channels at the rapids with swift downriver current, plus sufficient speed to maintain steerage, poses safety challenges.