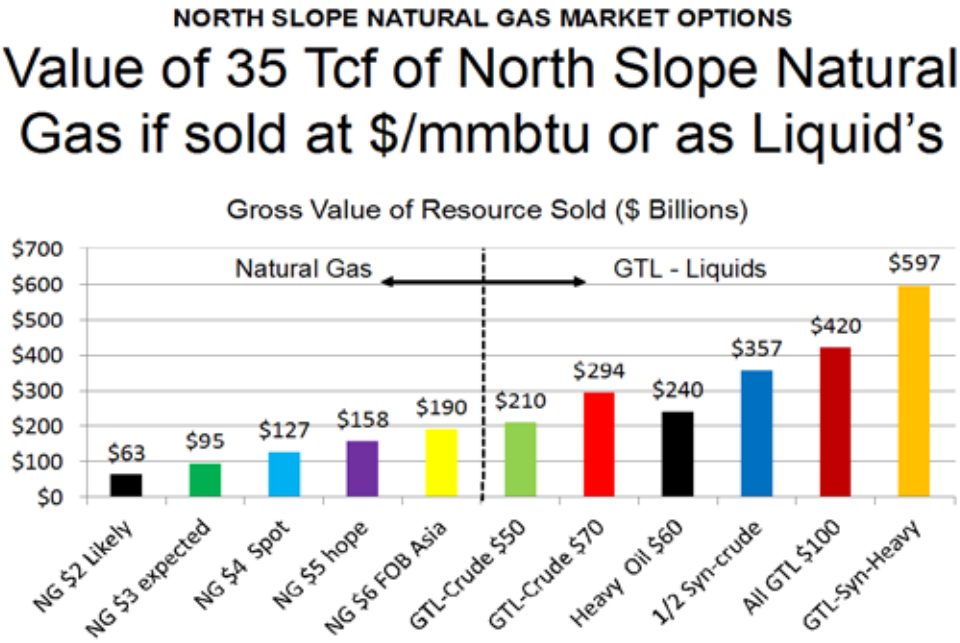
IS THE AK LNG PROJECT THE ONLY VIABLE OPTION FOR THE NORTH SLOPE?

The Administration says yes but reality says NO - there are other options

As a result of the August 24th and 25th Alaska Legislature's Joint Resources Committee hearings at the Anchorage LIO, ANGTL was asked to provide an assessment of the presentations made to the Joint Committee and its thoughts on moving forward.

1. *The Alaska LNG program is not competitive with other LNG projects around the world;*
2. *GTL's will sell for significantly higher prices on a $/mmbtu basis than natural gas;*
3. *TAPS, underutilized is a much lower cost option to get energy to the tidewater;*
4. *Higher revenues from the GTL program can pay for a smaller diameter in-state gas pipeline ASAP, satisfying the political promise to the people.*

This first chart shows the relative gross revenue streams that could be expected at various wellhead prices for natural gas and values for the liquid stream if sold as GTL's, syn-crude and diluent was used to help recover heavy crude oil.



TAPS is operating at 25% of capacity so each barrel of GTL's, syn-crude and heavy crude that flows to Valdez adds volume to TAPS and reduces the cost of transport. At $5.50/bbl TAPS transport rate the cost per mmbtu to get to the tidewater is $0.92/mmbtu. Far cheaper than the transport tariff for a new gas pipeline to tidewater.

ANGTL has been promoting a GTL option since 1998 so our opinion is somewhat biased towards GTL's. That said, ANGTL's opinion is based upon considerable effort in evaluating the issues that impact any project that will remove natural gas from the oil reservoirs and potentially impact the recovery of North Slope crude oil. It goes without saying that the value of the crude oil far exceeds the potential value of the current proven natural gas reserves. AOGCC has ruled that as much as 3.6

bcf/d can be removed from the Prudhoe Bay Unit (PBU). While removing PBU gas may not impact ANS crude recovery it may adversely affect recovery of the identified heavy crude oil.

We don't recall the AOGCC ruling limiting the total reserves that can be removed from the PBU so let's assume that 100% can be removed. Of the proven 35 Tcf of reserves discussed approximately 7 Tcf is assigned to the ExxonMobil operated Point Thomson Unit (PTU) leaving approximately 28 Tcf assigned to the PBU. The PBU natural gas today has approximately 12% CO_2. Thus from a gas pipeline quality point of view the 28 Tcf is really only 24.6Tcf. Therefore, the combined proven pipeline quality natural gas available for sale is 31.6 Tcf.

The revenue from the sale of these gas reserves will depend upon the netback to the wellhead of LNG delivered to market less all gas conditioning, transport in the gas pipeline, transport in the LNG tankers from Nikiski to market and the cost of turning the natural gas into LNG at the Nikiski facility. Today the spot market price for LNG delivered to Japan is in the $4/mmbtu range while the long term LNG contracts are still seeing prices in the $6/mmbtu range. Let's assume that the PBU wellhead price for natural gas will range from $2/mmbtu up to $6/mmbtu. Thus the total revenue one would receive for the sale of these gas reserves would range from $63 billion to a high of $190 billion. Remember a unit of sale for natural gas is 1,000 cubic feet or 1,000,000 Btu. Thus 31.6 Tcf is 31.6 Bcf when calculating revenue.

It is estimated that the North Slope has at least 3 billion barrels of recoverable ANS type crude and approximately 12 billion barrels in place of heavy crude. The recoverable volume of this heavy crude is a major point of discussion. Assuming a range of $50 to $100 per barrel for the ANS crude expected revenues would range from $150 billion to $300 billion. One has to assume that the value of crude oil will rise as the value of natural gas rises although there are many who believe that the abundance of shale gas across the world will tend to keep the value of natural gas compared to crude oil lower than normal, if there is a normal delta anymore.

A major cost associated with getting North Slope Natural gas into a pipeline quality form and delivered to Nikiski is the North Slope gas conditioning plant ($10 billion) and the approximate 800 miles of large diameter gas pipeline ($20+ billion). You still have to build a world scale LNG plant at Nikiski estimated at $15 billion.

There are several advantages that a GTL program has over the AK LNG program in getting products to market. First, a GTL program includes the cost of CO_2 removal plus if one uses a steam methane gas reformer (SMR) you can tolerate over 20% CO_2 in the inlet gas stream. In addition, the SMR can convert large percentages of this CO_2 into products thus your conversion rate is higher than with a pure methane feed. Second, the TAPS originally built to handle 2 million barrels per day of crude is currently operating at 500,000 bbl/d or 25% of capacity. Thus transport of products from the North Slope to tide water doesn't need a new pipeline.

Market is the next major issue. Historically one compares the value of crude oil to natural gas by dividing the cost of crude oil on a $/bbl basis by 6 to arrive at an equivalent value for natural gas on a $/mmbtu basis. Thus $60/bbl crude has an equivalent natural gas value of $10/mmbtu. $110/bbl crude oil has a natural gas equivalent of $18.33/mmbtu. This is the primary reason why Alaska North Slope (ANS) crude oil has a much higher value than PBU natural gas.

North America / US is net long on natural gas and has been for many years. This is why when LNG import terminals were built in the Gulf Coast they were never started up because the developers had the market 180 degrees out of phase. The big losers were two oil majors who guaranteed the LNG import terminal payout. While the US has increased its crude oil production primarily from shale development it still is a net importer of crude oil and to a lesser extent finished petroleum products. Thus any crude related products including synthetic products from the GTL process will reduce US imports of these crude / finished products. Some would say reducing the US trade deficit is important. While it is, it can't compare with the US sending billions each year to the Mid-East where large portions come back as terrorism financial support.

A second advantage of putting incremental products into TAPS is that it avoids a major capital cost of revising TAPS to work with lower throughput volumes. Every dollar spent to upgrade TAPS is a dollar deducted from the revenue the State receives from the ultimate sale of ANS crude oil.

Across the North Slope at a shallower level than the typical ANS crude is a vast supply of heavy oil. Unfortunately, much of this heavy oil is shallow enough that traditional methods used to produce this heavy oil, heat is not an option due to the overlying perma frost. BP in 2011 experimented with a process called CHOPS in one reservoir but determined that the costs were too high for economic recovery. In other heavy oil reservoirs around the world others have used a diluent to recovery this heavy oil. BP did not use this process possibly because it did not have access to large volumes of diluent on the North Slope. BP may not have realized that the GTL process can make different grades of products. One is called Fischer-Tropsch (F-T) naphtha. We would recommend that up to 50% of the output of a GTL plant be used to aid in the extraction of this heavy oil. Without the use of a diluent it may be impossible to recover this 12-billion-barrel heavy crude oil resource.

The advantage of using the F-T naphtha as a diluent is twofold. If you let the F-T naphtha (diluent) stay with the heavy oil it will aid in its transport in TAPS to Valdez. When this crude stream reaches the refinery the F-T naphtha is recovered and one would expect to receive an ANS crude price as a minimum. In addition, if one uses batch pigging to move the ANS, GTL's and heavy crude oil to Valdez it will be possible to receive the highest value for each product.

Batch pigging in TAPS is not without cost. Years ago ANGTL worked with the Explorer Pipeline to see if batch pigging was possible in TAPS. Explorer Pipeline in its beginning years moved crude oil and a full range of finished products from Texas to Chicago. Their recommendation said yes but you would require modifications to TAPS like electrifying the pump stations (already done) and modifying the piping to allow by-pass of each pump station as the pig train moves south. The biggest issue was and may still be today is that no one makes a pig that will last the full distance from Prudhoe Bay to Valdez. Not an insurmountable issue but one that still needs to be addressed.

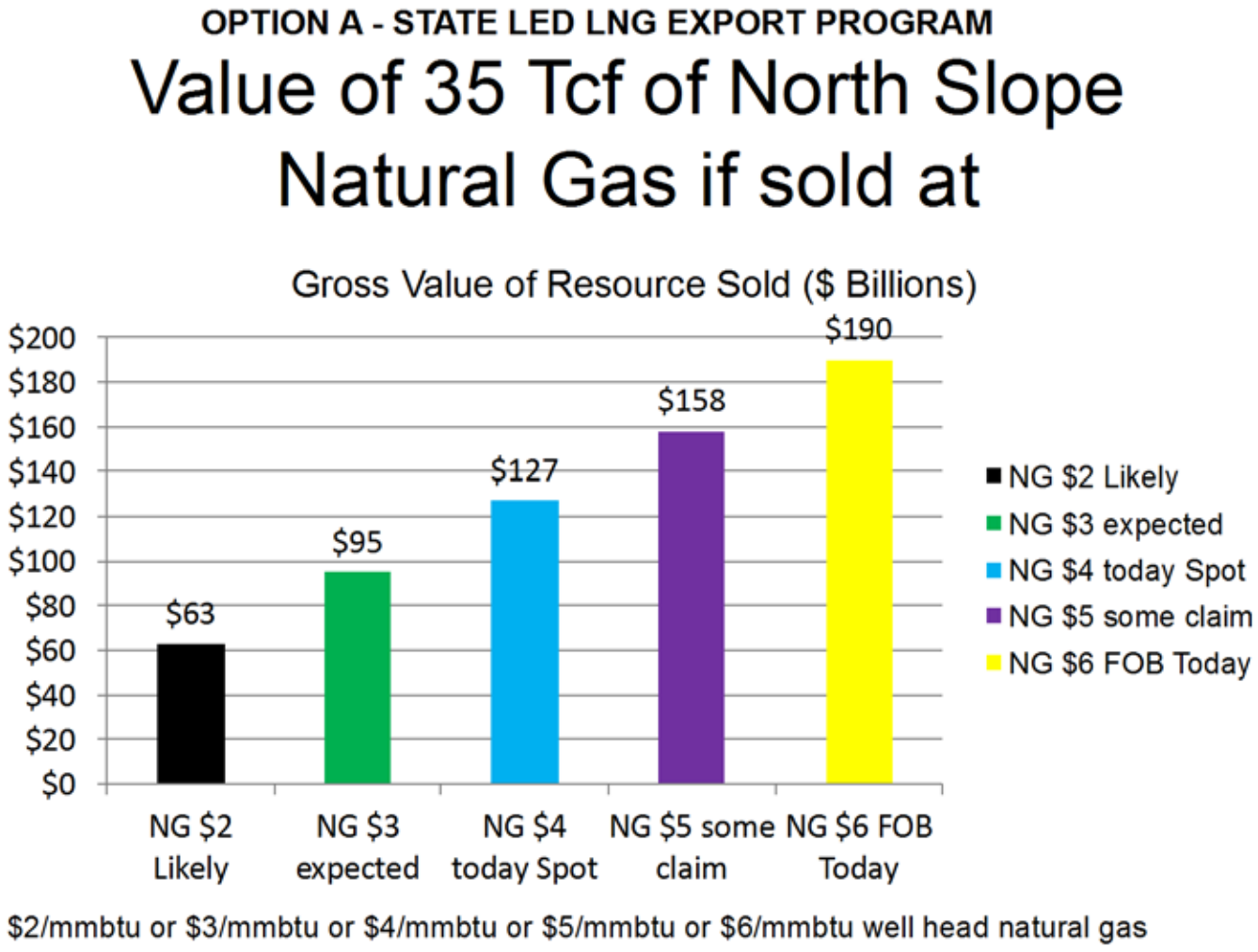
ANGTL has created 7 graphs showing the relative max revenues one could expect to receive under different scenarios. Clearly making products on the North Slope and sending them down TAPS generates more revenue than sending natural gas to Nikiski to make LNG for export. One would think that the Administration and Legislature would look at this option then use some of the additional revenue to support a smaller in state gas line running down the rail belt - ASAP.

OPTION "A" STATE LED LNG PROGRAM

35 Tcf of natural gas sold at the wellhead to support an LNG program. Netback value to the wellhead of $3/mmbtu to $6/mmbtu requiring approximately $45 to $55 billion of infrastructure. Even though we say 35 Tcf because the Prudhoe Bay North Slope gas has 12+% CO_2, the 35 Tcf is only 31.6 Tcf of saleable methane.

Note that even at $6/mmbtu wellhead price for Alaska North Slope natural gas gross revenue $190 billion is $20 billion less than selling the natural gas as lower value crude oil ($210 billion) at $50/bbl almost the price of crude oil today (see Option B).

Note that today September 2016, the Spot price for LNG in Japan is in the $4/mmbtu range and the long-term LNG price for Japan and Korea is in the $6/mmbtu range. These are delivered LNG prices and the chart below is for these prices at the wellhead on the North Slope. ***Today*** the wellhead netback for spot and long term ***natural gas*** (***LNG) prices would be negative on the North Slope.***

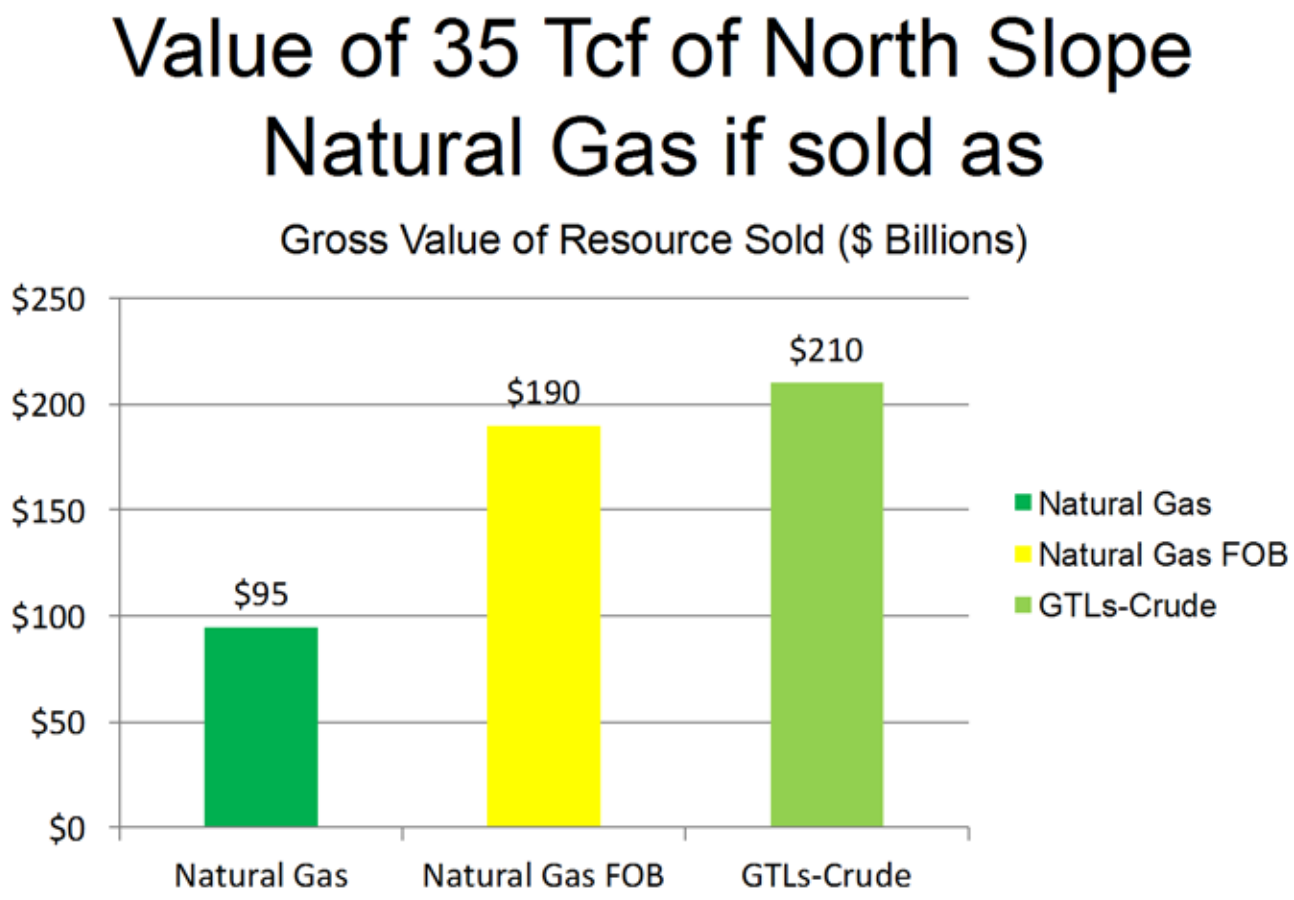


OPTION "B" BASE GTL's AT LOW ANS CRUDE PRICE

35 Tcf of natural gas sold at the wellhead to support an LNG program. Even though we say 35 Tcf because the Prudhoe Bay North Slope gas has 12+% CO_2, the 35 Tcf is only 31.6 Tcf of saleable methane. Netback value to the wellhead of $3/mmbtu requiring approximately $45 to $55 billion of infrastructure vs converting that same natural gas into approximately 4.2 billion barrels of GTL products of which 100% would be low syn-crude worth $50/bbl.

GTL plant costs under $40 billion and the increase use / throughput of TAPS to transport to market at Valdez.

OPTION B – GTL LOW CASE WITH GTL's SOLD AS $50/BBL SYN-CRUDE

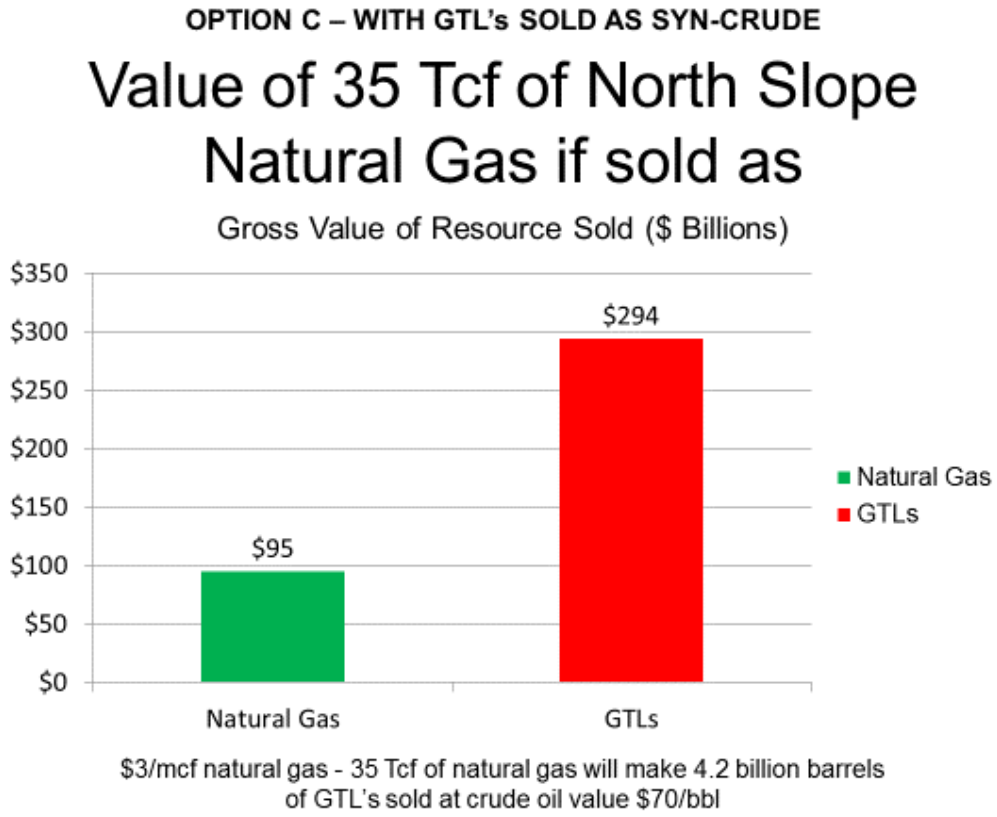


Well Head $3/mmbtu and $6/mmbtu natural gas - 35 Tcf of natural gas will make 4.2 billion barrels of GTL's sold at low crude oil value $50/bbl

OPTION "C" BASE GTL's AT $70/BBL ANS CRUDE PRICE

35 Tcf of natural gas sold at the wellhead to support an LNG program. Even though we say 35 Tcf because the Prudhoe Bay North Slope gas has 12+% CO_2, the 35 Tcf is only 31.6 Tcf of saleable methane. Netback value to the wellhead of $3/mmbtu requiring approximately $45 to $55 billion of infrastructure vs converting that same natural gas into approximately 4.2 billion barrels of GTL products of which 100% would be syn-crude worth $70/bbl.

GTL plant costs under $40 billion and the increase use / throughput of TAPS to transport to market at Valdez.

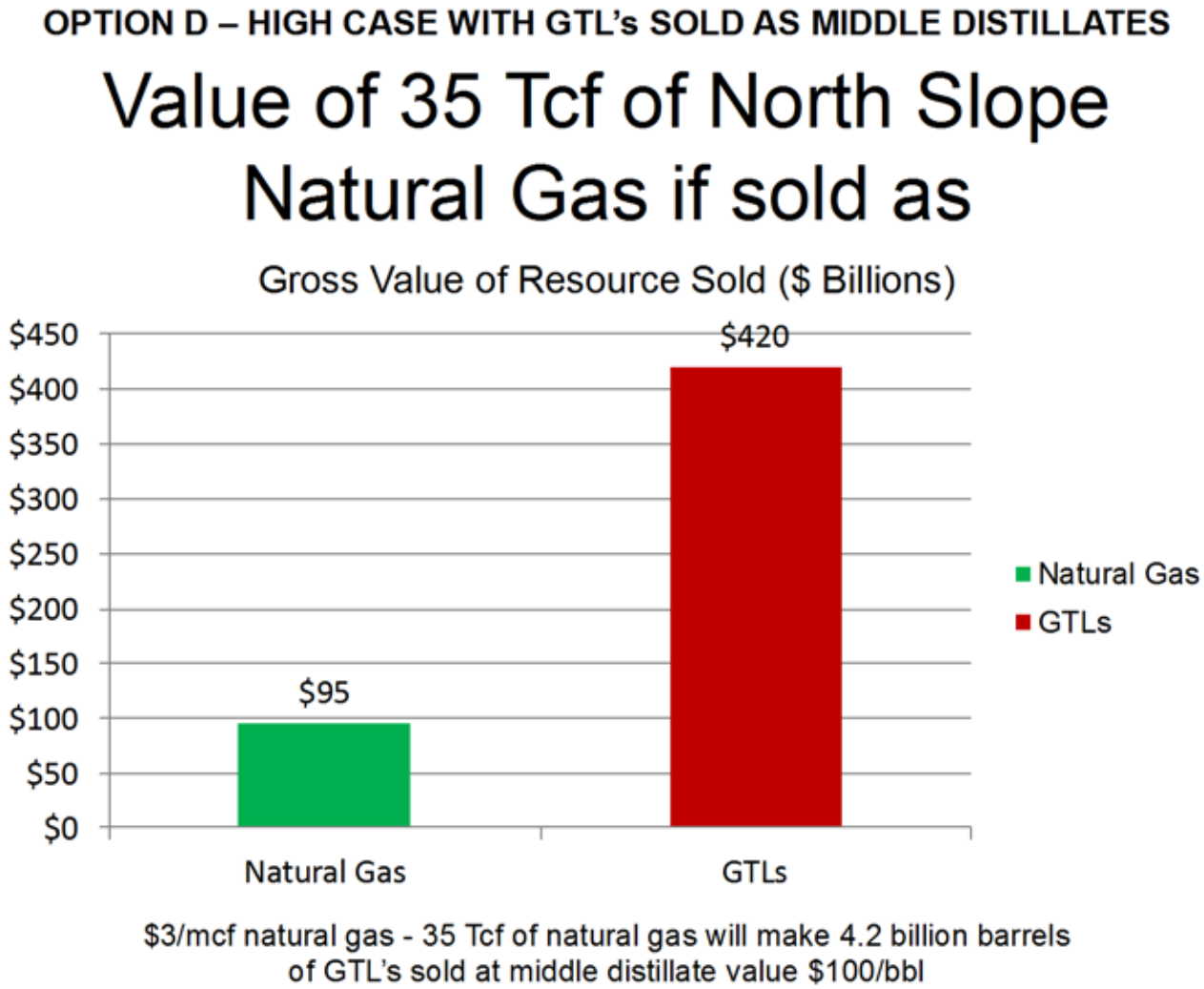


OPTION "D" GTL's BATCHED PIGGED TO VALDEZ

35 Tcf of natural gas sold at the wellhead to support an LNG program. Even though we say 35 Tcf because the Prudhoe Bay North Slope gas has 12+% CO_2, the 35 Tcf is only 31.6 Tcf of saleable methane. Netback value to the wellhead of $3/mmbtu requiring approximately $45 to $55 billion of infrastructure vs converting that same natural gas into approximately 4.2 billion barrels of GTL products sold at a high value middle distillate products worth $100/bbl.

GTL plant costs under $40 billion and the increase use / throughput of TAPS to transport via batch pigging products to market at Valdez.

Note: To receive the highest value for the GTL's you will have to batch pig in TAPS which may require a capital investment in TAPS to bypass each pump station with the pig train.

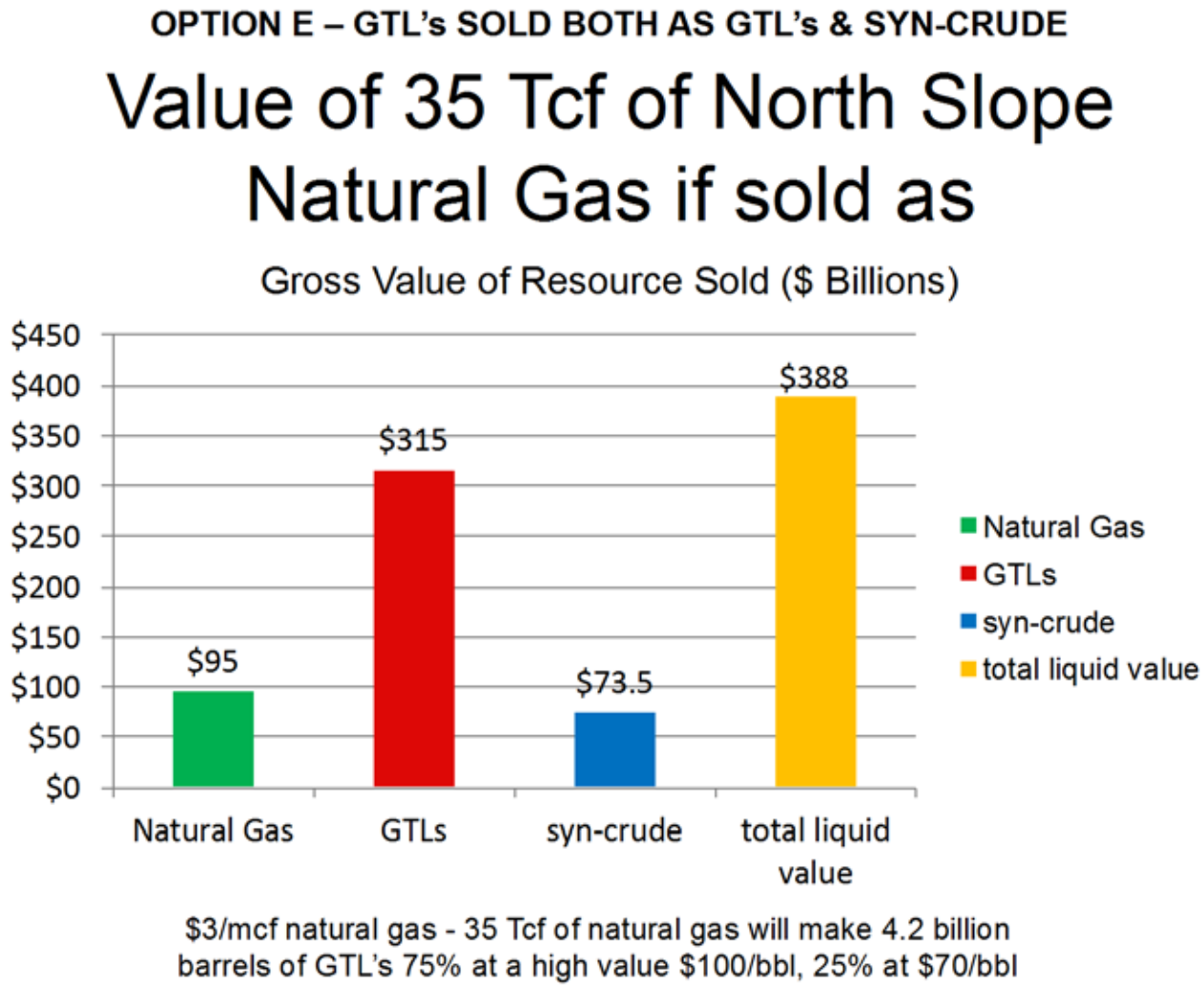


OPTION "E" BATCH PIGGING 75% GTL's

35 Tcf of natural gas sold at the wellhead to support an LNG program. Even though we say 35 Tcf because the Prudhoe Bay North Slope gas has 12+% CO_2, the 35 Tcf is only 31.6 Tcf of saleable methane. Netback value to the wellhead of $3/mmbtu requiring approximately $45 to $55 billion of infrastructure vs converting that same natural gas into approximately 4.2 billion barrels of GTL products of which 75% would be high value middle distillate products worth $100/bbl and 25% would be syn-crude worth $70/bbl.

GTL plant costs under $40 billion and the increase use / throughput of TAPS to transport high value middle distillate via batch pigging products to market at Valdez.

Note: To receive the highest value for the GTL's you will have to batch pig in TAPS which may require a capital investment in TAPS to bypass each pump station with the pig train.



$3/mcf natural gas - 35 Tcf of natural gas will make 4.2 billion barrels of GTL's 75% at a high value $100/bbl, 25% at $70/bbl

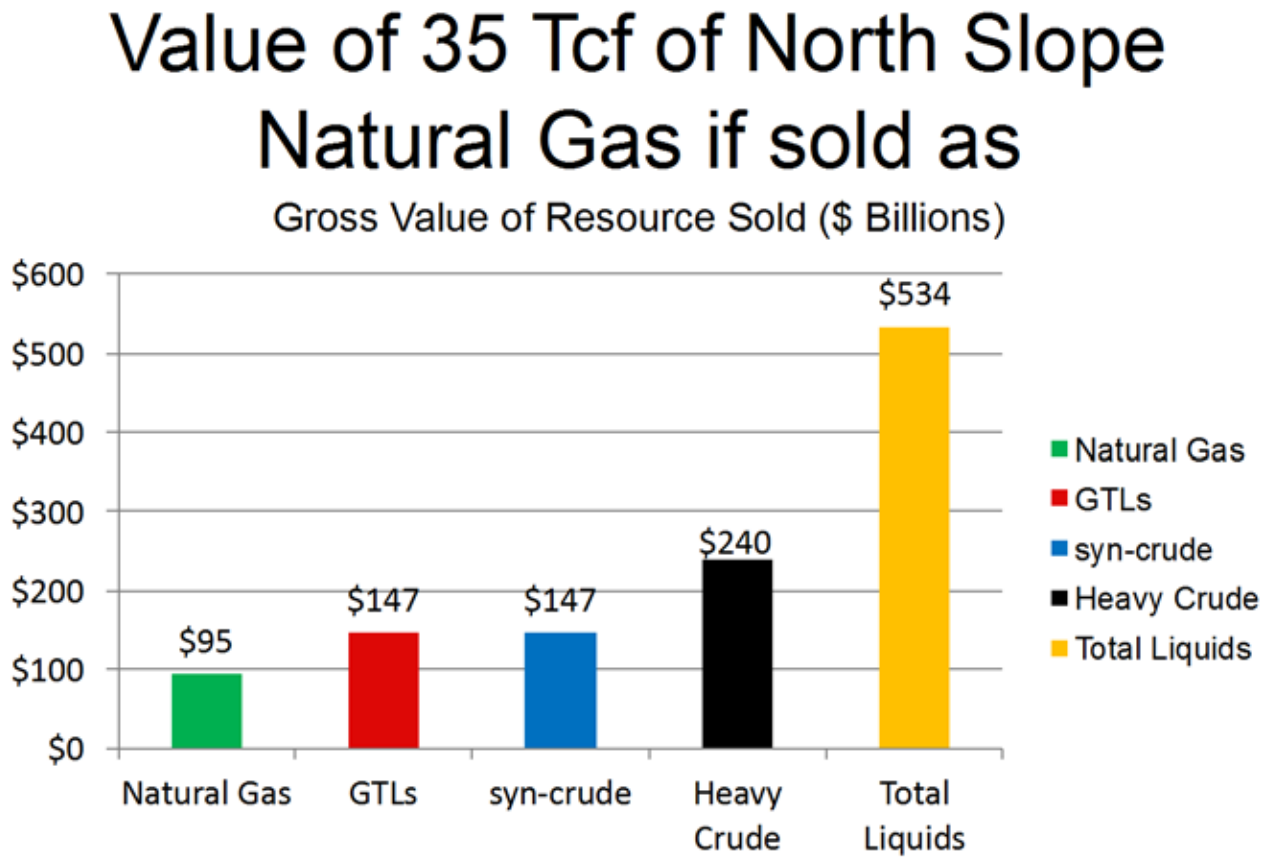
OPTION "F" REALISTIC OPTION FOR ALASKA

35 Tcf of natural gas sold at the wellhead to support an LNG program. Even though we say 35 Tcf because the Prudhoe Bay North Slope gas has 12+% CO_2, the 35 Tcf is only 31.6 Tcf of saleable methane. Netback value to the wellhead of $3/mmbtu requiring approximately $45 to $55 billion of infrastructure vs converting that same natural gas into approximately 4.2 billion barrels of GTL products of which 50% would be high value middle distillate products worth $70/bbl and 50% is used as a diluent to extract up to an additional 4 billion barrels of heavy crude oil at a value of $60/bbl.

The diluent is recovered at the refinery at crude oil prices of $70/bbl. GTL plant costs under $40 billion and the increase use / throughput of TAPS to transport high value middle distillate via batch pigging products to market at Valdez.

Note: To receive the highest value for the GTL's and ANS crude oil you will have to batch pig in TAPS which may require a capital investment in TAPS to bypass each pump station with the pig train.

OPTION F – GTL's SUPPORT HEAVY CRUDE & SOLD AS SYN-CRUDE & GTL's



$3/mcf natural gas - $70/bbl crude oil - $60/bbl heavy crude - 35 Tcf of natural gas will make 4.2 billion barrels of GTL's - 50% is a diluent used to recover an additional 4 billion barrels of heavy crude oil and is recovered at the downstream refinery at full value- 50% is valued at $70/bbl

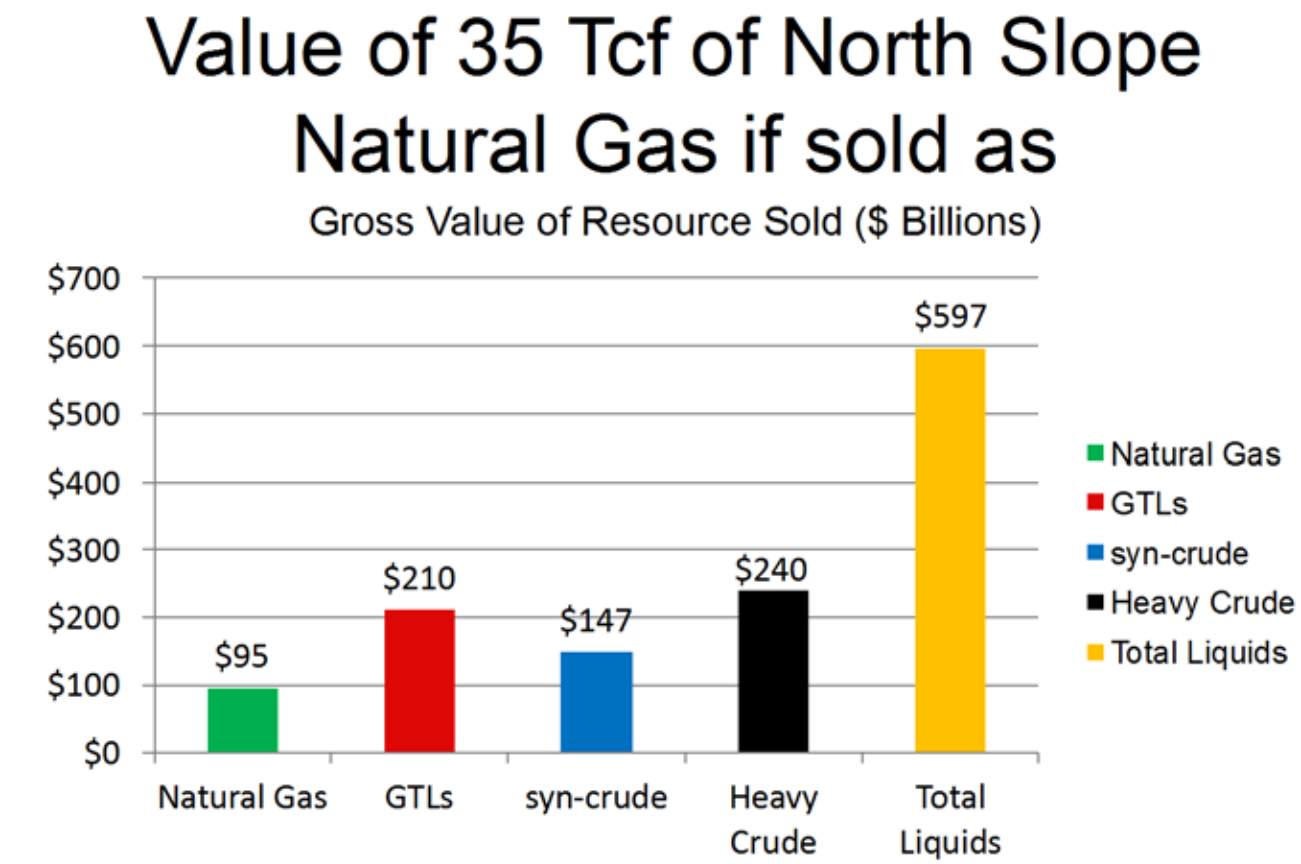
OPTION "M" BEST OPTION FOR ALASKA

35 Tcf of natural gas sold at the wellhead to support an LNG program. Even though we say 35 Tcf because the Prudhoe Bay North Slope gas has 12+% CO_2, the 35 Tcf is only 31.6 Tcf of saleable methane. Netback value to the wellhead of $3/mmbtu requiring approximately $45 to $55 billion of infrastructure vs converting that same natural gas into approximately 4.2 billion barrels of GTL products of which 50% would be high value middle distillate products worth $70/bbl and 50% is used as a diluent to extract up to an additional 4 billion barrels of heavy crude oil at a value of $60/bbl.

The diluent is recovered at the refinery at crude oil prices of $70/bbl. GTL plant costs under $40 billion and the increase use / throughput of TAPS to transport high value middle distillate via batch pigging products to market at Valdez.

Note: To receive the highest value for the GTL's and ANS crude oil you will have to batch pig in TAPS which may require a capital investment in TAPS to bypass each pump station with the pig train. Keeping the ANS and heavy crude separate will not reduce the value of ANS crude oil.

OPTION M – GTL's SUPPORT HEAVY CRUDE & SOLD AS SYN-CRUDE & GTL's



$3/mcf natural gas - $70/bbl crude oil - $60/bbl heavy crude - 35 Tcf of natural gas will make 4.2 billion barrels of GTL's - 50% is a diluent used to recover an additional 4 billion barrels of heavy crude oil and is recovered at the downstream refinery at $70/bbl - 50% is high value $100/bbl

SUMMARY

Alaskan's have dreamed of a gas pipeline to market for over 30 years but the cold cruel facts are that this gas is poor quality, high CO2 and located a minimum of 800 miles from any potential market. People talk of 35 trillion cubic feet of natural gas and it sounds like a giant number until you realize that the single North field in Qatar has over 900 trillion cubic feet. There are numerous gas fields around the world with greater gas reserves in less hostile environments with lower labor costs to develop and can be operated at a fraction of the costs of the Alaska North Slope.

Many in the LNG camp argue that GTL's are inefficient in the conversion process. This simple picture illustrates that at the end of the day the value of the products in the market is more important.

GTL vs LNG

VALUE ($) VS EFFICIENCY

IS THE LNG PROCESS MORE EFFICIENT - WITH 80 % OF THE WELL HEAD ENERGY REACHING THE MARKET ?
IS THE GTL PROCESS LESS EFFICIENT - WITH 65 % OF THE WELL HEAD ENERGY REACHING THE MARKET ?

TECHNICALLY, LNG IS A MORE EFFICIENT PROCESS IF YOU JUST LOOK AT DELIVERED ENERGY TO THE MARKET
IT IS HOWEVER TOTALLY FALSE IF YOU LOOK AT THE VALUE ($) OF THE DELIVERED ENERGY IN THE MARKET

LNG BEGINS LIFE AS NATURAL GAS AND ENDS LIFE AS NATURAL GAS

GTL BEGINS LIFE AS NATURAL AND ENDS LIFE AS A REFINED PRODUCT SUCH AS DIESEL

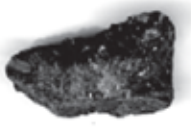
WHILE BOTH ARE CARBON BASED, THEIR VALUES ($) ARE TOTALLY DIFFERENT

AS AN EXAMPLE:
A LUMP OF COAL AND A DIAMOND ARE BOTH CARBON BASED. UNDER TREMENDOUS PRESSURE AND HEAT (A MANUFACTURING PROCESS), A LUMP OF COAL CAN BECOME A DIAMOND. WHICH HAS MORE VALUE, A LUMP OF COAL OR A DIAMOND? DOES IT MATTER THAT A DIAMOND IS A FRACTION OF THE SIZE OR WEIGHT OF THE ORIGINAL LUMP OF COAL?

IF GTL PRODUCED DIESEL IS MORE VALUABLE THAN LNG DERIVED NATURAL GAS SHOULD YOU CARE IF THE GTL PROCESS IS LESS EFFICIENT IN CONVERTING ENERGY SO LONG AS THE VALUE RECEIVED FOR THE ORIGINAL ENERGY IS GREATER.

WHICH WOULD YOU PREFER ?

A LUMP OF COAL



OR A DIAMOND

LNG PRODUCED NATURAL GAS **OR GTL PRODUCED DIESEL**

THE CHOICE SHOULD BE SIMPLE
GO FOR THE HIGHER NETBACK VALUE ($)

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Pigs can't fly and you can't make the Alaska Gas Line and LNG export plant competitive with other LNG projects around the world. If there was a shortage of natural gas you could net back a reasonable value for the North Slope natural gas but shale gas at a minimum will keep that from happening for the next 25 to 50 years.

Alaskan's were lucky that the Prudhoe Bay field had so much associated natural gas. Because of the ability to use this natural gas to maintain the pressure in the oil reservoir for the past 30 years' billions of barrels of incremental ANS oil have been produced. It may be that this same natural gas or at least some portion of it can be used to help recover the billions of barrels of heavy oil overlying the traditional North Slope oil reservoirs. Maybe AOGCC should lead the way in recommending using some of this same natural gas to help in the recovery of the heavy crude oil

A gas pipeline to tidewater or to lower 48 gas markets has never penciled out despite the State of Alaska and North Slope oil majors spending over $1 billion working on the problem. **Maybe it's time to look at a "Plan B or possibly Plan M"**.

Gas to Liquids has been an option for the past 20 years. It's not necessarily the favorite of the fully integrated oil company as GTL's are far superior in quality than petroleum based products. It's never been the favorite of Alaska Administration's from Tony Knowles forward because it's not a gas pipe line down the rail belt. However, the same 35 Tcf of proven gas reserves can be converted into over 4.2 billion barrels of liquid products using existing technology. Even if you sold the liquids as crude oil at $50/bbl, you would generate more revenue than selling natural gas at the wellhead on the North Slope for $6/mmbtu, a natural gas price one would only see if crude oil was well north of $100/bbl.

Some people say that a GTL plant is prohibitively expensive but at $45 to $55 billion an Alaskan LNG project is far more expensive than a 250,000 bbl/d GTL plant. Sasol, Shell or even ExxonMobil could take 2 bcf/d of available North Slope natural gas and produce approximately 250,000 barrels per day of liquids. A portion of these liquids can be used as a diluent to recover heavy crude oil adding to the revenue one would receive from producing GTL's.

It's time to stop the madness and begin looking in earnest at other possible alternatives for North Slope natural gas resources.