Northern Economics

Memorandum

Date: June 21, 2013

To: Project Team

From: Leah Cuyno and Pat Burden

Re: Estimated Natural Gas Demand for the NS LNG Project

This memorandum summarizes the demand estimates as specified in the revised Scope of Work (SOW) dated May 2, 2013 sent by Mark Gardiner (see attachment). A brief description of the data sources and methodology is also provided. This memorandum is submitted as an attachment to the deliverable--"modular" FNSB demand model (Excel file).

Note: Following the IEP team meetings held on June 18 and 19, further information regarding the demand estimates was requested as follows:

- Demand growth presented monthly using the existing quarterly demand growth inherent in demand model and the normalized monthly HDD.
- A chart that shows the monthly distribution for residential demand. Presenting it as a monthly % of total demand would be good.

The Demand Model was updated to incorporate these requests.

Potential Residential and Commercial Sector Demand

Figure 1 shows the total estimated natural gas demand (in MCF) by sector (or type of customer) by year starting in 2015, through 2030. This represents the projected total system demand for the piped natural gas distribution system in the medium and high demand zones in the Fairbanks region.

As shown in the Figure, total natural gas demand starts at about 0.800 BCF in 2015 and peaks at about 8.6 BCF in 2026.

It should be noted that FNG is currently supply constrained. There are a number of residential structures that are located within the current distribution system's service area but are not yet connected to the system. In addition, there are several small and large commercial sector customers that have interruptible service given the gas supply situation. Given this, the projected 2015 demand (816,296 MCF) as shown in the figure above, could be higher, up to over 1 BCF, assuming demand by interruptible customers will be fully met and that residential customers not yet connected but are within the service area will have converted by the beginning of the 4th quarter of 2015.

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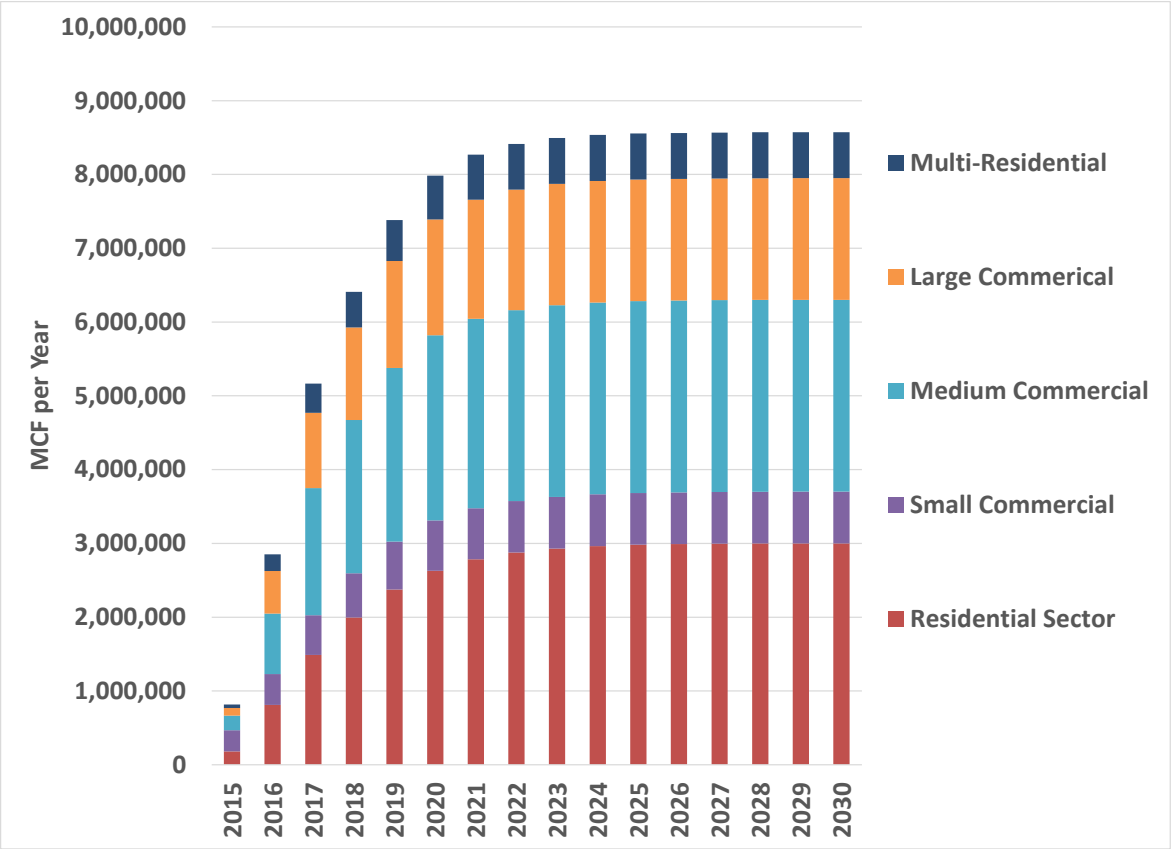
Figure 1. Projected Natural Gas Demand by Type, MCF by Year



The projections are based on the following assumptions:

1. Liquefied natural gas (LNG) from the North Slope LNG plant will become available for distribution in the Fairbanks area starting in the 4th quarter of 2015.

2. Construction Schedule

   Expansion of the Fairbanks natural gas distribution system will occur over a 6-year period starting in 2014, through 2019 (see Table 1). The expansion will cover the high and medium demand areas in the Fairbanks region, with expansion in the high priority area occurring in 2014 and 2015, followed by expansion in the medium priority area from 2016 through 2019. Note that the North Pole is considered a high priority area in this analysis.

Table 1. Construction Schedule for Expansion of the Natural Gas Distribution System in the Fairbanks Region

Construction Schedule	Priority Area	Percent Piped
2014	High	50%
2015	High	50%
2016	Medium	25%
2017	Medium	25%
2018	Medium	25%

2019	Medium	25%

3. Total Potential Residential, Commercial, and Multi-Residential Structures

Table 2 shows the estimated number of customers by type to be served by the expanded distribution system, including current FNG customers.

Table 2. Total Potential Number of Natural Gas Customers by Type

Customer Type	Number
Residential Customers	15,720
Small Commercial Customers	1,078
Medium Commercial Customers	670
Large Commercial Customers	210
Multi-Residential Units	638

Note: Information regarding annual customer count by sector by year is provided in the demand model.

4. The demand volumes as shown in Figure 1 include existing FNG customers and the projected additional customers that will be served starting in year 2015.

5. Average Demand by Customer Type

The annual demand projections were calculated based on the following average annual consumption by customer type:

- Residential: 190 MCF per year
- Small Commercial: 650 MCF per year
- Medium Commercial: 4,000 MCF per year
- Large Commercial: 8,000 MCF per year
- Multi-Residential: 1,000 MCF per year

These average consumption rates are consistent with the assumptions contained in responses to AIDEA's request for LOI. Note that in 2011 and 2012 the average annual residential sector consumption was only 120 and 130 MCF, respectively. It is anticipated that average consumption would increase as delivered natural gas prices become more affordable and it is also anticipated that homeowners would convert more appliances to natural gas, thereby increasing not only heating load but also the base load.

6. Conversion/Market Penetration

Table 3 shows the assumed market penetration by type of customer. These conversion rates and the construction schedule shown in Table 1 affect the annual demand projections shown in Figure 1.

While the expansion of the distribution system starts in year 2014, and 50 percent of the high priority area will already have pipes on the ground that year, natural gas will not be available until the 4th quarter of 2015. Therefore, it is assumed that most potential customers will wait until

the gas is available and until they are part of the distribution system's service area before converting their systems to natural gas.

As shown in Table 3, only 10 percent of the potential customers in Year 1 of having access to gas and having a distribution line to connect to will convert that year. Subsequently, entry of new customers each year occurs after the winter season, therefore the demand for these customers are less than the average annual demand of 190 MCF per customer.

Table 3. Assumed Cumulative Conversion Rates/Market Penetration by Year and by Customer Type

	Year									
Market Penetration	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Residential	10%	50%	70%	85%	90%	91%	92%	93%	94%	95%
Commercial	10%	60%	80%	90%	100%					
Multi-Residential	10%	60%	80%	90%	100%					

7. The analysis also assumes no change in number of residential and commercial structures in the region in the future (number of total potential customers is constant).

Seasonal Swing Curves and Current Interruptible Volumes

To inform optimal design of the LNG plant, AIDEA requested information regarding seasonal swing curves, baseload/firm volumes, and interruptible volumes.

Figure 2 shows the seasonal swings for the residential sector for years 2011 and 2012. Actual numbers are provided in the Excel file.

Figure 2. Average Monthly Consumption of Current Residential Customers

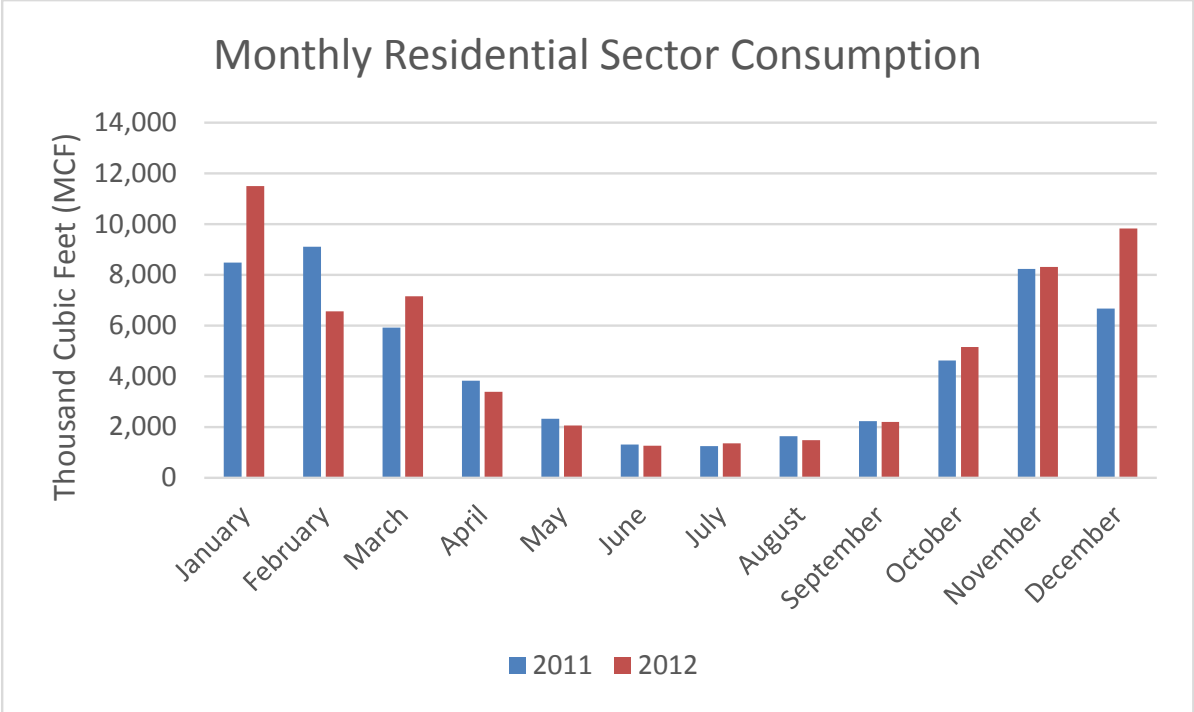


Figure 3 and Figure 4 show the seasonal swings for the commercial sector for years 2011 and 2012, respectively.

Figure 3. Average Monthly Consumption of Current Commercial Sector Customers in 2011

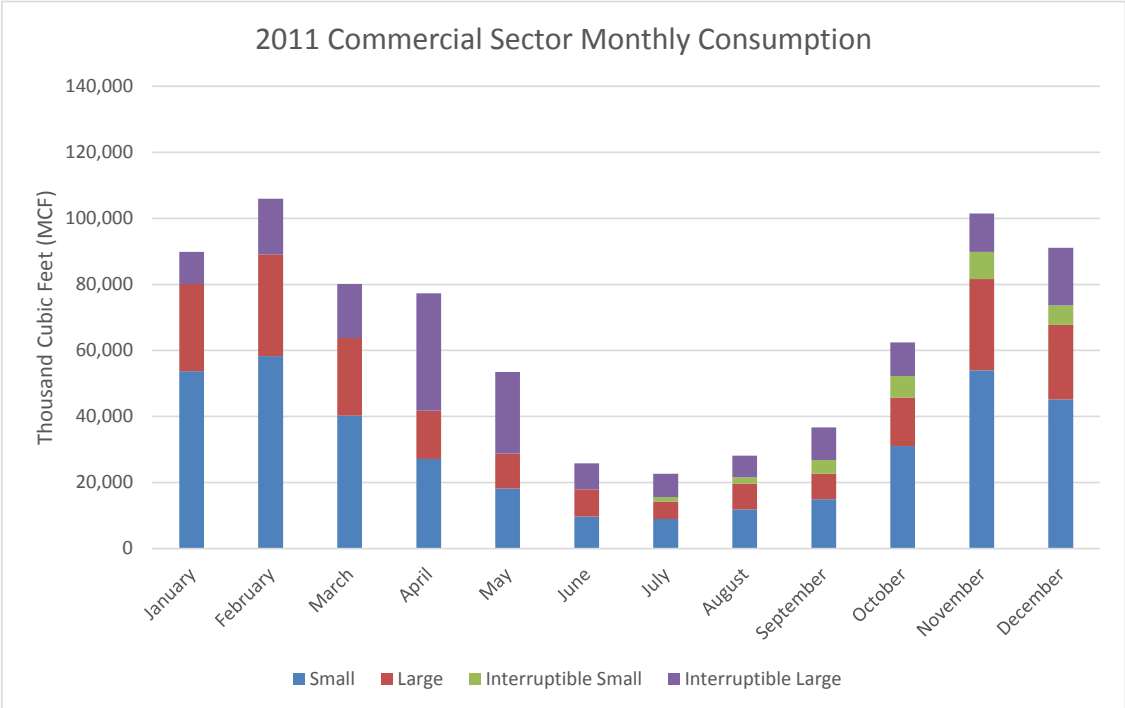


Figure 4. Average Monthly Consumption of Current Commercial Sector Customers in 2012

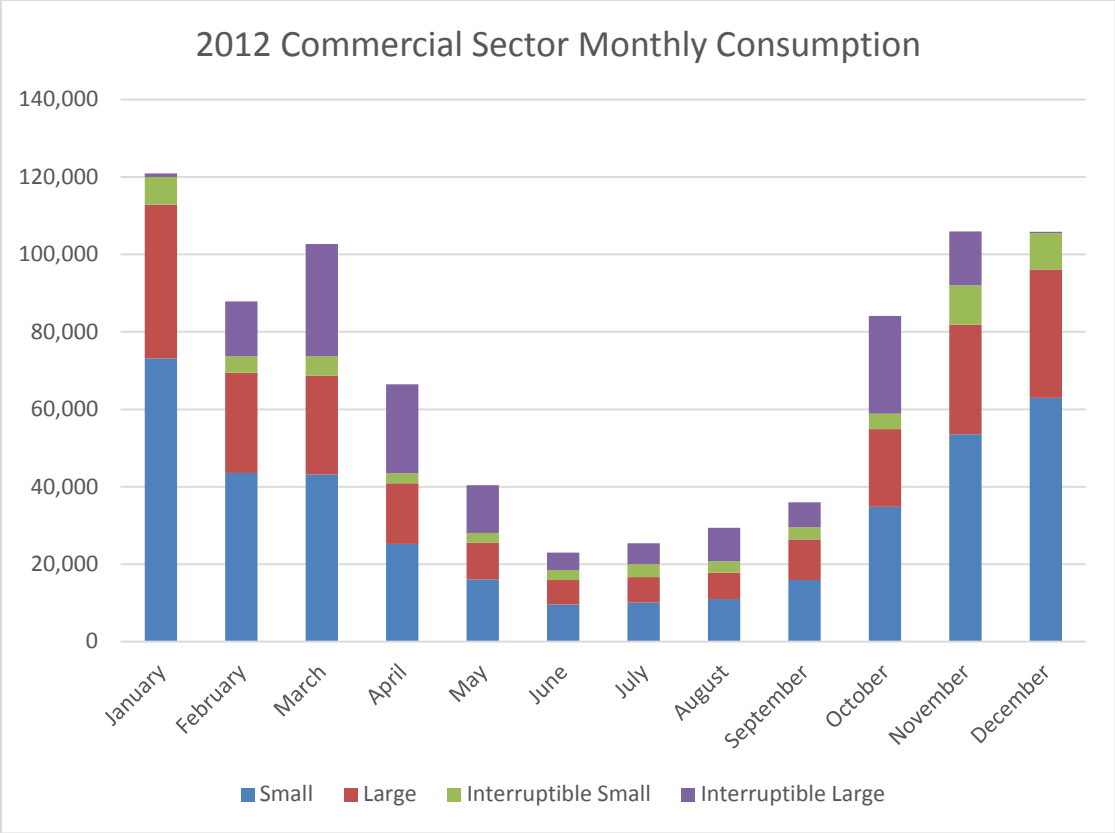
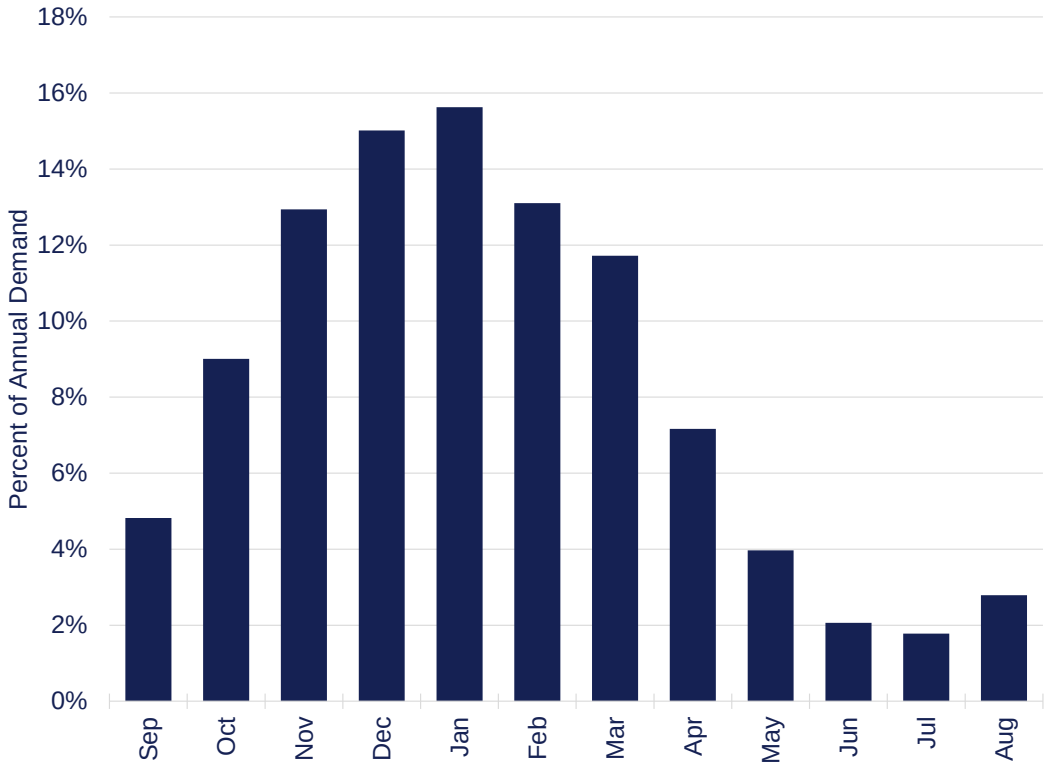


Figure 5 presents the estimated space heat demand as a percent of the total annual demand. Information on historical average heating degree days were used to derive the percentages shown in the chart.

Figure 5. Monthly Space Heat Demand as Percent of Total Annual Demand



Potential Institutional Demand: Hospital, Schools, and the University

In addition to the residential and commercial sector demand, it is anticipated that public schools in the area, the University of Alaska, and the hospital will also require natural gas for heating. Table 4 shows the estimated annual demand by various institutions.

Table 4. Estimated Natural Gas Demand by Institutions in the Fairbanks Region

Institution	Estimated Natural Gas Requirements, MCF per Year
Schools	25,937
University	1,216,998
Hospital	130,000
Total	**1,372,935**

The estimated heating requirements for the schools are based on data provided by the schools regarding heating requirements. The estimated potential natural gas requirements for the University are based on information provided by staff at the University's power plant. This volume assumes that the generation facility will convert from coal and oil use to natural gas. Data are shown in the Excel file.

Potential Industrial and Power Sector Demand

The following shows the estimated natural gas demand for potential industrial and electric utility customers in the Fairbanks North Star Borough region:

1. Electric Utility: 3.1 BCF per year

Power sector demand is estimated to be about 3.1 Bcf per year. The demand estimate reflects 20 percent of the total existing generation capacity of GVEA.

GVEA is the primary utility that provides electricity in the region and it utilizes a diverse mix of fuel including oil, naphtha, coal, natural gas, and hydroelectric. The utility serves about 44,000 customers in the Fairbanks, Delta Junction, Nenana, Healy, and Cantwell areas.

The GVEA combustion turbine (GT3) at their North Pole facility is the most likely to convert to natural gas (IIC, 2009). The GT3 is a 60 MW LM6000 combined cycle unit that currently fires naphtha, a clean burning fuel, produced at the Flint Hills refinery located nearby. The GT3 unit consumes 24.2 million gallons of fuel per year. Given a heat content of 127,500 Btu per gallon of naphtha, the estimated natural gas requirement for GT3 is about 3.1 Bcf per year.

Note that the steam turbine generator at the North Pole expansion facility is double-sized to prepare for a possible power plant expansion. Adding another 60 MW of generating capacity could double the power sector natural gas demand to 6.2 Bcf per year.

2. Flint Hills Refinery: 4.5 BCF per year

Flint Hills Resources' North Pole refinery is located southeast of Fairbanks in North Pole. The refinery is the largest in Alaska with a crude oil processing capacity of 220,000 barrels per day. The facility consumes about 64,000 barrels of North Slope crude oil per day to produce various petroleum products including gasoline, jet fuel, heating oil, diesel fuel, gasoil and asphalt for supply to Alaska markets. The refinery uses a portion of the crude stream to fire boilers and the distillation tower for the production of liquid fuels. (IIC 2009)

It is estimated that the refinery will require about 4.5 BCF per year of natural gas. This demand is based on the continuation of production at roughly 25 percent facility capacity.

Note that Flint Hills Refinery recently announced that it will be closing its No. 1 crude oil refining unit due to challenging economic conditions faced by the refinery (Alaska Journal of Commerce, April 2012). The company will continue operating its remaining No. 2 crude unit to produce jet fuel, gasoline, asphalt, and other products to meet all its contractual commitments. The company noted that the refinery faces the problem of burning crude oil, which is costly at current prices, to provide energy for its refining operations. This study assumes that availability of cheaper natural gas in the future would bring the refinery operations back to 2011 levels.

3. Petro Star Refinery: 0.3 BCF per year

The Petro Star refinery is also located in North Pole. This refinery has a capacity of 22,000 barrels per day, producing kerosene, diesel, and jet fuels. The refinery uses both crude oil and non-condensable gases to fuel its crude oil refining process. (IIC 2009). The estimated potential natural gas demand for the refinery is 0.3 BCF per year.

Potential Trucked LNG and Propane Demand

In addition to estimating the potential demand for LNG in the Fairbanks North Star Borough, the scope of work also identified the need for a demand estimate of LNG or propane that could be trucked to communities in Interior Alaska, and the subsequent effect of a natural gas pipeline on the demand for trucked LNG or propane. The traditional definition of Interior communities has been expanded in this analysis to include Valdez and other communities on the road system in the Valdez-Cordova census area which could receive LNG at much lower prices than their current heating fuel cost.

The effect of a pipeline on the demand for trucked LNG and propane will vary depending on the alignment of the pipeline along the Parks Highway (Alaska Stand Alone Pipeline [ASAP] and potentially the Southcentral LNG project) or the Richardson Highway (potentially the Southcentral LNG Project). The ASAP project has committed to an alignment along the Parks Highway while the Southcentral LNG project has not made a decision on the tidewater location for the LNG plant which will affect the highway alignment decision.

In addition, to the alignment issue, the demand for trucked LNG and propane to other Interior Alaska communities will be affected by the location of the LNG plant that is proposed in the Interior Energy Plan. The LNG plant could remain on the North Slope and continue producing LNG and propane to be trucked south to Interior communities with the surplus available for other users, or the plant could be moved to Fairbanks where it could be used to make LNG and potentially propane. The ASAP line is currently proposed as a methane-only pipeline which means that propane would not be available in the pipeline so propane production would not occur if the plant is moved to Fairbanks and the ASAP project is subsequently built.

In developing the trucked LNG and propane estimates shown in Table 5 we have made an assumption that LNG is not an option for the smaller communities due to the complexity of LNG regasification and propane demand is estimated for communities under about 200 households. The potential annual propane demand (8.75 million gallons) is much larger than the anticipated propane production (3.65 million gallons) from the LNG plant so an allocation system may be necessary. The potential demand for trucked LNG is estimated at about 3.58 BCF before a natural gas pipeline is built and about 0.98 to 1.45 BCF after a pipeline is available.

Table 5. Estimated Demand for Trucked LNG and Propane Pre- and Post-Pipeline

	Parks Highway Alignment				Richardson Highway Alignment			
	Propane (MM Gallons)		LNG (BCF)		Propane (MM Gallons)		LNG (BCF)	
Pre/Post Pipeline Cases	**Communities**	**Industrial**	**Communities**	**Industrial**	**Communities**	**Industrial**	**Communities**	**Industrial**
Pre-Pipeline Estimates	8.75	0.00	1.06	2.52	8.75	0.00	1.06	2.52
Post-Pipeline Alternatives								
1. ASAP								
1a. LNG plant remains on ANS	8.75	0.00	0.88	0.10	NA	NA	NA	NA
1b. LNG plant moved to Fairbanks	0.00	0.00	0.88	0.10	NA	NA	NA	NA
2. Southcentral LNG Project								
2a. LNG plant remains on ANS	8.75	0.00	0.88	0.10	8.75	0	0.40	1.05
2b. LNG plant moved to Fairbanks	8.75	0.00	0.88	0.10	8.75	0	0.40	1.05