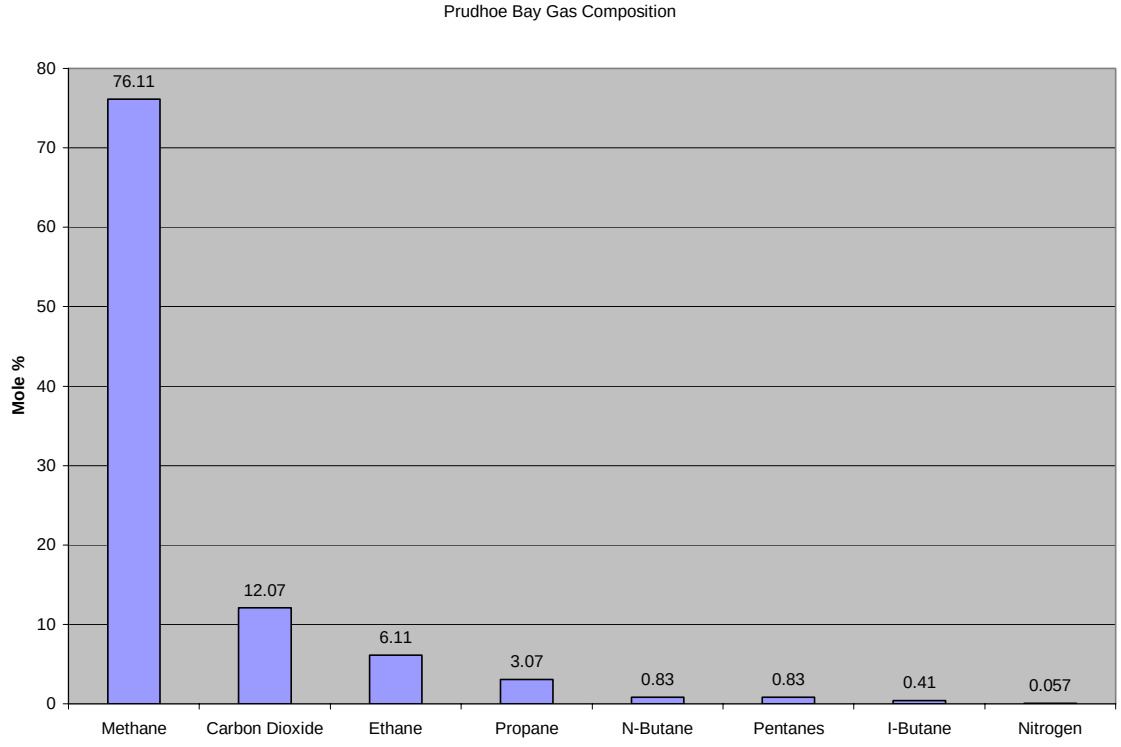
Commercializing Alaska North Slope Gas will be a monumental project by almost any standard. In order to understand the issues at play and make educated decisions on policy issues it is important to have a firm grasp of some basic concepts such as: natural gas composition, gas pricing and value, natural gas reserves, and the supply and demand balance of natural gas.

Natural Gas Composition

At various stages of production and distribution "natural gas" may mean or include a variety of things. Most simply, natural gas as we know and experience it in heating our homes is primarily methane gas (CH_4). However, "natural gas" is often used as a generic term to refer to methane and associated byproducts it is found with. In the real world natural gas is often found in mixtures containing **ethane** (C_2H_6), **butane** (C_4H_{10}), **propane** (C_3H_8), **pentane** (C_5H_{12}), **carbon dioxide** (CO_2), **hydrogen sulfide** (H_2S), and sometimes oil all in varying amounts.[i] This is primarily the case for **Thermogenic gas**. Thermogenic gas is gas created through high temperature and pressures and can be contrasted with another major source of gas: **Biogenic gas**, which is created by the breakdown of natural materials. Understanding the two major mechanisms for the creation of natural gas is important because Thermogenic gas is often found in association with other elements such as **natural gas liquids (NGLs**) or oil; whereas Biogenic gas is often almost pure methane.

In reality, the specific makeup of "natural gas" is vitally important from an economic and engineering standpoint. From an economic standpoint for example, the different elements often found associated with methane gas have varying values, uses and properties. While the specific composition of Alaska North Slope (ANS) natural gas is not public and **natural gas composition does vary widely by field and over time** there are some things we know about ANS gas. Specifically, existing ANS gas reserves appear to have higher than average amounts of ethane relative to other Natural Gas Liquids (NGLs). According to a report commissioned by the Alaska Natural Gas Development Authority (ANGDA) the makeup of ANS gas is illustrated below.[ii] As the diagram



indicates, the vast majority of "natural gas" on the ANS is methane. However, the gas will have to be "treated" for impurities such as Hydrogen Sulfide (H_2S), Water (H_2O) and Carbon Dioxide (CO_2) before it is "pipeline-quality gas" and can be moved into a major pipeline.

Hydrogen Sulfide is removed because of its corrosive properties.[iii] Carbon Dioxide doesn't burn and thus reduces the value of the gas, is corrosive when combined with oxygen, and is useful for increasing oil production through reinjection into reservoirs. Water is removed to maintain well pressure through reinjection, to reduce risk of corrosion, and because saleable commercial gas does not include water.

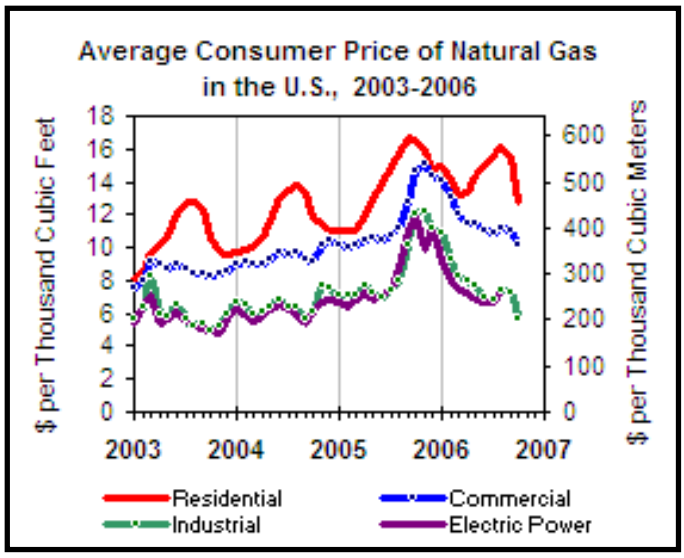
In terms of pricing, typically, the **lighter NGLs such as ethane track prices of methane (pure natural gas) very well**.[iv] The **heavier NGLs such as butane and propane tend to track crude oil more closely.**[v] Additionally, Carbon Dioxide is often used to increase production of oil fields through reinjection and thus has value of its own. Occasionally more exotic chemicals such as helium are found in conjunction with methane gas but that does not appear to be the case on the ANS.

After removing the water, NGLs, and impurities the treated "natural gas" is primarily methane and is often described as "dry natural gas." Some different types or stages of natural gas are:

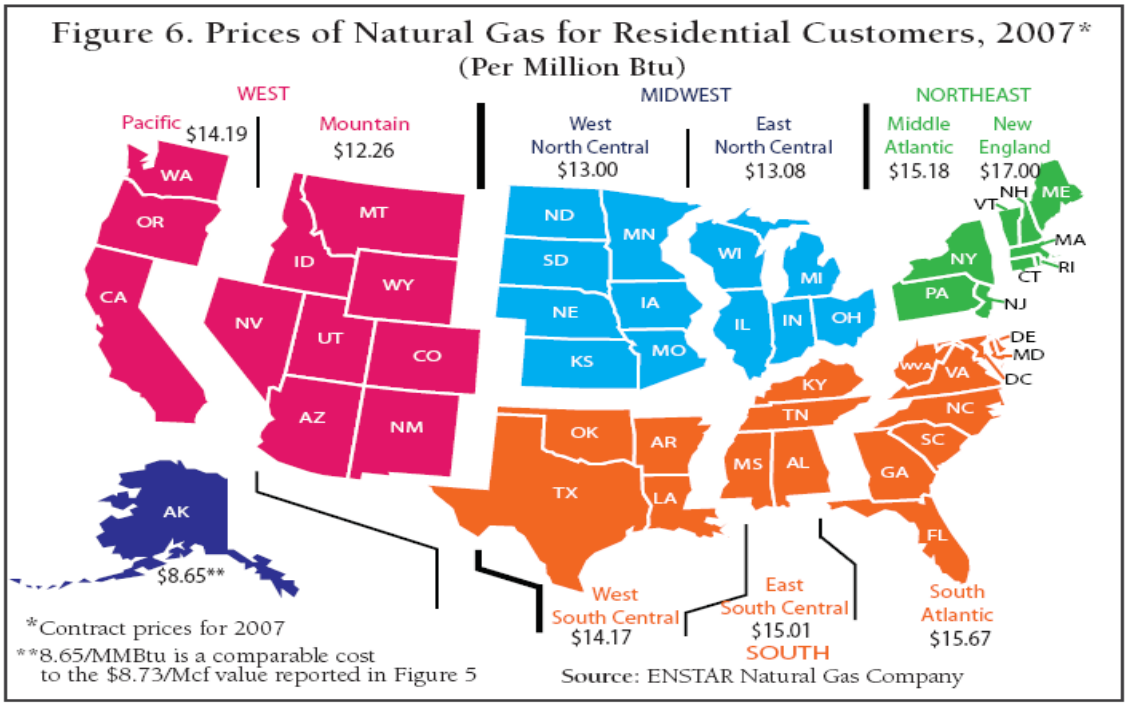
"Acid Gas" – Methane with Carbon Dioxide
"Sour Gas" – Methane with Hydrogen Sulfide
"Sweet Gas" – Methane without Hydrogen sulfide
"Wet Gas" – Methane with liquid hydrocarbons that condense when produced
"Dry Gas" – Pure methane [vi]

Natural Gas Pricing

Natural Gas prices are volatile, cyclical, vary by region, and by content. In fact natural gas is so volatile that according to Rick Harper with Econ One, ""….natural gas is traded on the New York Mercantile Exchange (NYMEX), and, over the last decade, has been the most volatile commodity traded."[vii] The cyclical nature of natural gas pricing is directly related to the cyclical demand for natural gas as a heating fuel. The diagram below was produced by the EIA and illustrates the cyclical nature of natural gas



pricing as well as the fact that different users pay different prices for gas, typically based on the volumes consumed. Variation by region occurs on an international scale (variation between the US and Asian markets) and within different regions of the US. The following diagram produced by Enstar Natural Gas Company illustrates regional variation in natural gas pricing within the US.



Alaska clearly has the lowest price for natural gas by a substantial margin. In addition to variations in gas prices between different regions of the US, natural gas prices vary between US markets and other nations, specifically, Asian markets. Traditionally natural gas prices have followed crude oil prices closely. Over the past several years this trend has started to diverge in the US. In Japan however, the price of natural gas still follows crude oil prices closely as natural gas prices are based on a formula commonly referred to as Japan Crude Cocktail (JCC).[viii]

Natural Gas Conversions and Terms

- **BOE** – Barrels of oil equivalent. Gas is converted to Barrels of Oil Equivalent (BOE) by roughly dividing Mcf by 6.[ix]
- **Mcf** - Thousand cubic feet. A measure of gas volume.[x]
- **MMcf** - Million cubic feet.
- **Bcf** - Billion cubic feet.
- **Tcf** - Trillion cubic feet also sometimes called a “Quad” for one quadrillion BTU’s represented.
- **BTU** - British Thermal Unit. Measure of the quantity of heat. Energy required to raise the temperature of one pound of water one degree Farenheit.
- **Therm** - 100,000 BTU

- **LNG -** Liquid Natural Gas. LNG is methane gas cooled below -260 degrees Farenheit. Chilling to this temperature transforms the gas to a liquid state compressing it's volume by a factor of 600.

- According to the EIA: **"One cubic foot of natural gas has about 1031 Btu."**[xi] This figure typically varies from 1015 to 1031 with the atmospheric pressure, temperature, and specific composition of the gas.[xii]
- **1 million tons of LNG = roughly 48 BCF**.[xiii]
- Heating values by compound in Btu per Standard Cubic Foot[xiv] See below:

Table 3.1: Higher Heating Values (HHV) of Natural Gas Components

Hydrocarbon	HHV (btu/scf)
Methane (C_1)	1010
Ethane (C_2)	1769.6
Propane (C_3)	2516.1
i-Butane (I-C_4)	3251.9
n-Butane (N-C_4)	3262.3
i-Pentane (I-C_5)	4000.9
n-Pentane (N-C_5)	4008.9
n-Hexane (N-C_6)	4755.9
Nitrogen (N_2)	0
Carbon dioxide (CO_2)	0

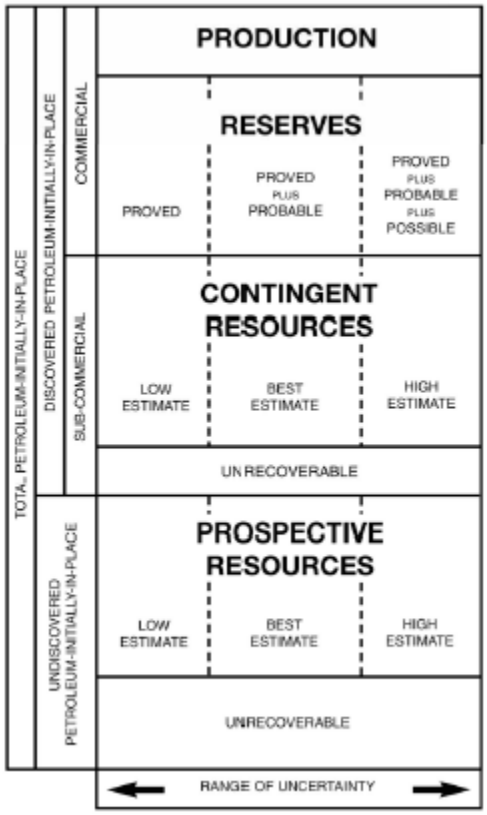
Natural Gas Reserves

Alaska has roughly 33-35 Trillion Cubic Feet (Tcf) in proven reserves on the ANS. What exactly does this mean though? Technically, reserves are estimates of the discovered, commercial, resource at three different levels of confidence.

- **Proved Reserves -** The highest level of confidence. "Reasonably certain" to produce. Sometimes referred to as P90 for 90% probability of being produced given existing current technology, prices, and legal framework. Sometimes further broken down into "Proven Developed" and "Proven Undeveloped."
- **Probable Reserves -** "Reasonably probable to produce." Sometimes referred to as P50.
- **Possible Reserves** - "Having a chance of being developed under favorable circumstances." Sometimes referred to as P10.

The SEC regulates reserves statements and only allows proved reserves to be stated in filings. However, they do include cautionary language for companies choosing to state other confidence levels of reserves based on probabilistic evidence.[xv] The diagram below

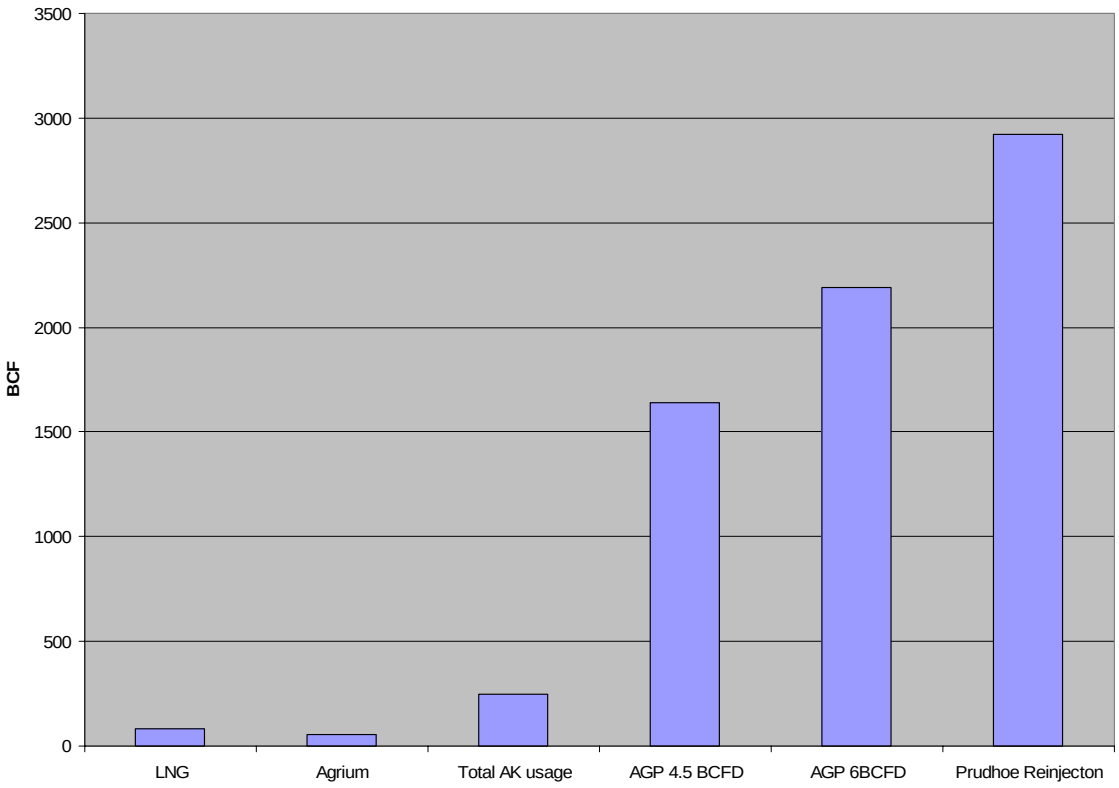
from a document by the Society of Petroleum Engineers and the World Petroleum Congress illustrates the multiple levels of confidence associated with resource estimates.[xvi]



Understanding the types of reserves allows for a more accurate understanding of the resource base in Alaska. The division of Natural Resources lists the **known (proved) gas resource on the ANS as 35.417 Tcf**.[xvii] In terms of undiscovered resources (prospective) the estimates vary substantially based on the assumptions but the mean technically recoverable estimate for natural gas for the central ANS (between the NPR-A and ANWR) according to the USGS is 37.5 Tcf as of 2005.[xviii] This figure could be substantially higher if NPR-A, ANWR, or gas hydrates are included. **35 Tcf of known proved reserves on the ANS would fill a 4.5 Bcf/d pipeline for roughly 18-20 years** meaning additional gas is required if the proved reserves estimates are correct.[xix]

Supply & Demand Balance

Alaska has vastly more natural gas then we can currently use. The rest of the nation, however, is facing a gas shortage caused by rapidly declining production and steadily increasing demand. In Alaska we currently do several things with our natural gas: we reinject gas at Pruduhoe Bay, we use gas to heat homes and businesses (primarily in the Anchorage area and some parts of Fairbanks), we export LNG to Japan, and we use natural gas for production of fertilizer in Kenai. The following diagram is an estimate that illustrates the relative volumes associated with each activity. It is important to note that "Total AK Use" includes LNG, Agrium and residential and commercial heating usage. AGP represents the potential volume of an Alaska gas pipeline.



Most experts predict a growing gap between gas supplies in the US and gas demand. **The predictions for the exact size of the gap vary, but none appear to be less then double the volume of a 6 Bcf/d Alaska gas pipeline.**[xx] This suggests there may be a substantial market for Alaska gas. Despite the size of the predicted supply shortage some experts suggest that Alaska gas may be at risk of being displaced or undercut by foreign LNG imports.[xxi] At this point that seems unlikely based on the fact that there are only a total of five permitted and operational LNG regasification terminals in the US (four onshore and one offshore) and they are operating substantially under capacity.[xxii] Because long term contracts for LNG do not account for full capacity of US regasification facilities the remainder of US LNG regasification capacity must be filled with short term or "spot-price" gas. The need for short term contract or "spot-price" gas combined with the fact that the US has superior gas storage abilities relative to many other LNG importing nations, may explain why LNG imports actually declined over the last year as other importing nations offered higher spot prices.[xxiii] Despite the evidence from this year's LNG shipments, total LNG imports are widely expected to rise substantially over the next 10 years.

References

[i] Rebecca L. Busby, "Natural Gas in Nontechnical Language" Institute of Gas Technology 1999, Pg. 1.
[ii] Michael Baker Jr. Inc., "Transport of North Slope Natural Gas to Tidewater" Prepared for ANGDA April 7, 2005 Pg. 36.
[iii] Rebecca L. Busby, "Natural Gas in Nontechnical Language" Institute of Gas Technology 1999, Pg 2.
[iv] Lesa Adair with Muse Stancil, LB&A Minutes September 2, 2004. Pg. 5
[v] Lesa Adair with Muse Stancil, LB&A Minutes September 2, 2004. Pg. 5
[vi] Rebecca L. Busby, "Natural Gas in Nontechnical Language" Institute of Gas Technology 1999, Pgs. 40-41
[vii] Rick Harper with Econ One Research, LB&A Minutes August 31, 2005. Pg. 13
[viii] Jeff Brown with Merrill Lynch, LB&A Minutes September 1st 2004. Pg. 6
[ix] Roger Marks, DNR, LB&A minutes from June 17th, 2004. Pg. 21
[x] http://www.eia.doe.gov/neic/a-z/a-z_abbrev/a-z_abbrev.html#ms
[xi] http://www.EIA.doe.gov
[xii] http://www.EIA.doe.gov ; http://www.aga.org/Content/NavigationMenu/About_Natural_Gas/How_to_Measure_Natural_Gas/How_to_Measure_Natural_Gas.htm ; http://www.fngas.com/calculate.html ; http://www.naturalgas.org/overview/background.asp ;
[xiii] http://www.EIA.doe.gov
[xiv] Michael Baker Jr. Inc., "Transport of North Slope Natural Gas to Tidewater" Prepared for ANGDA April 7, 2005 Pg. 31.
[xv] http://www.sec.gov/divisions/corpfin/guidance/cfactfaq.htm#P279_57537
[xvi] Society of Petroleum Engineers, "Guidelines for the evaluation of petroleum reserves and resources" 2001, Pg. 139. http://www.spe.org/specma/binary/files/4675179GuidelinesEvaluationReservesResources05Nov.pdf
[xvii] http://www.dog.dnr.state.ak.us/oil/products/publications/annual/2006_annual_report/Akoilgasdivisionrpt_2006.pdf
[xviii] http://pubs.usgs.gov/fs/2005/3043/fs2005-3043.pdf ; http://www.eia.doe.gov/pub/oil_gas/natural_gas/feature_articles/2007/ngimpexp/ngimpexp.pdf Pg. 3
[xix] Mark Myers with DNR, LB&A Minutes September 2, 2004. Pg. 91

[xx] Richard Guerrant with Exxon Mobil, LB&A Minutes September 1st 2004. Pg. 27 ; John Carruthers with Enbridge, LB&A Minutes September 1st 2004. Pg. 41; Robert Milius with Lehman Brothers, LB&A Minutes October 13, 2004. Pg. 55 ;
[xxi] Charles Davis with UBS Investment Bank, LB&A Minutes October 13, 2004. Pgs. 27-29
[xxii] Energy Information Administration, "Short-Term Energy Outlook Supplement: U.S. LNG Imports –The Next Wave" January 2007. By Damien Gaul and Kobi Platt. Pg. 1
[xxiii] Energy Information Administration, "Short-Term Energy Outlook Supplement: U.S. LNG Imports – The Next Wave" January 2007. By Damien Gaul and Kobi Platt. Pgs. 3-6