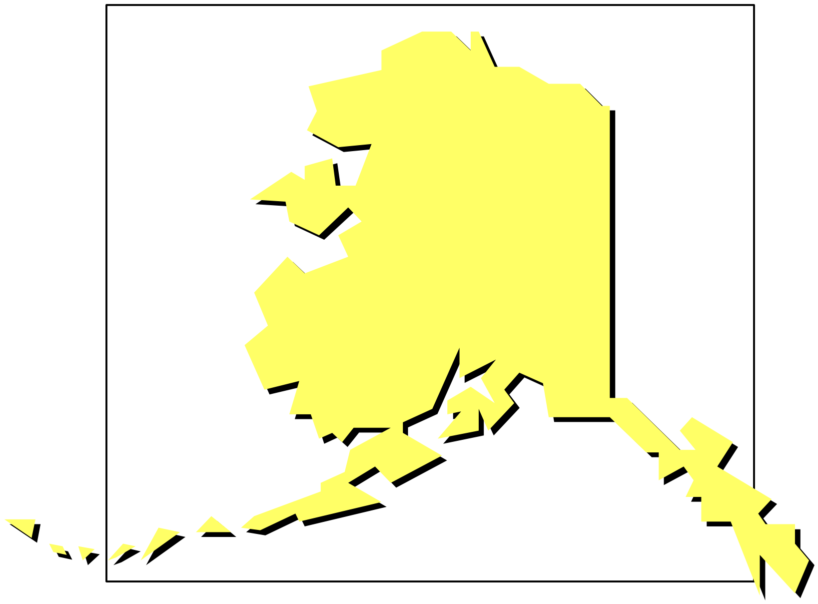

FEASIBILITY STUDY of Propane Distribution throughout Coastal Alaska

(In conjunction with gas spur line to Southcentral Alaska)

For
Alaska Natural Gas Development Authority (ANGDA)

August 2005

By

P | N | D
Incorporated

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Abbreviations

ANGDA	Alaska Natural Gas Development Authority
Bbl	Barrel(s)
Bbbl	Billion barrels
Bbpd	Barrels per day
Bcf	Billion cubic feet
BOPD	Barrels Of Oil Per Day
BOEPD	Barrels of Oil Equivalent Per Day
Btu	British thermal unit
CDC	Certain Dangerous Cargo
CFR	Code of Federal Regulations
DOT	Department of Transportation
EGSP	Enriched Gas Small Pipeline
FERC	Federal Energy Regulatory Commission
Ft	Foot (feet)
G/L	Gas/Liquid
Gal	Gallon
In	Inch
ISER	Institute of Social and Economic Research
ISO	International Organization for Standardization
LPG	Liquid Petroleum Gas (primarily propane, butanes, propylene and butylenes)
LNG	Liquefied Natural Gas
MCF	1,000 cubic feet
MCFD	Thousand Cubic Feet Per Day
MLLW	Mean Lower Low Water
MM	Million
MMbls	Million Barrels
MMBtu	Millions of British thermal units
MMscfd	Million Standard Cubic Feet per Day
MOU	Memorandum of Understanding
M/V	Motor Vessel
NGL	Natural Gas Liquid
PCE	Power Cost Equalization
POA	Port of Anchorage
PPG	Pounds per gallon
PSI	Pounds per square inch
SCR	Selective Catalytic Reduction
SCF	Standard Cubic Feet
Scfd	Standard Cubic Feet per Day
Tonnes	Metric ton (1,000 kg = 2,204 lbs)
USCG	United States Coast Guard

Facts About Propane and Safety

Propane Facts

Energy comparison of diesel fuel vs. propane by volume

Propane	92,000± Btu/gallon
Diesel Fuel	138,000± Btu/gallon

1.6 gallons of propane are required to equal the energy of 1.0 gallons of diesel
Propane is 270 times more compact in its liquid state than it is as a gas

Traditional LPG shipping methods and capacities

ISO containers	DOT-approved tanks (6,500 gallons to 13,000 gallons) with integral rigid steel frame – same size/shape as typical shipping containers. Shipped along with other bulk freight. ISO containers are the most common LPG transportation vessel used in Alaska coastal communities. ISO is an abbreviation for International Organization for Standardization.
Rail tanker	30,000± gallon capacity
Barges	100,000 to 1.3 million ± gallon capacity, currently used in the U.S. on the Midwestern river system
Tankers	Currently used for world market trade (100,000 bbls to 500,000 bbls)

Advantages of Propane

- Portability – Propane can be stored, easily transported and used virtually anywhere and is not dependent on fixed infrastructure or grid. Large quantities of propane are currently transported in small containers (100 pounds or less) in remote areas of Alaska by airplane, four-wheeler, boat etc. Propane is not a "new" fuel to coastal Alaska.
- Clean-Burning – Propane is less harmful to the environment because it burns cleanly without smoke or residual particulate matter and with relatively low pollutant and greenhouse emissions.
- Reliability – Propane-burning power generation equipment is more reliable and requires less maintenance than diesel generators. Existing diesel power generation equipment could be used for reliable backup electrical production.
- Availability – Because propane has been used since 1912, its properties are well understood. As a result, transportation procedures are in place, tanks required for storage are available, and appliances and equipment that provide heat and power are currently produced and available.
- Convertibility – The availability of low-cost propane will enable remote communities to initially convert cooking and heating devices and progress later to more sophisticated equipment such as power generation equipment.

Disadvantages of Propane

- Density – Propane is heavier than air. Undetected leaks can collect in low areas, which can lead to dangerous quantities of propane that can asphyxiate or explode. Similar to natural gas, propane is odorized to easily detect the presence of propane. Nonetheless, safety precautions and education must be used to reduce risks.
- Lower energy volumetric content compared to diesel fuel will require a larger storage tank to equal the same energy output. The propane tank would also have to be heavier because it has to withstand the propane storage pressure (~266 psi).

Executive Summary

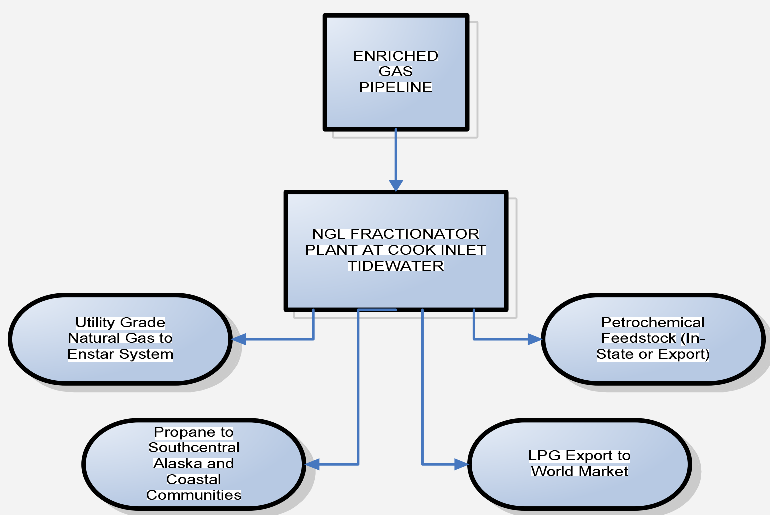
The Alaska Natural Gas Development Authority has contracted with PND Inc. Consulting Engineers to determine the feasibility and economics of the distribution of liquid propane gas throughout coastal Alaska for electrical power generation and domestic heating. PND has contracted with Northern Economics, The Marine Exchange of Alaska and Conam Construction Company to provide technical support and details. This study assumes that a pipeline provides a highly enriched gas stream to Southcentral Alaska from Alaska's North Slope; several different pipeline scenarios are possible - a spur line from a larger gas line or a "bullet line" directly from the North Slope.

Distribution of propane to Alaska coastal communities appears feasible and economic for certain uses and in more accessible communities when compared to current distillate-based systems. Propane supply not used in-state would be exported with other LPGs to the world market via tanker. The economic analysis indicates that ISO container delivery of propane would be less expensive than electricity for cooking. In larger and more accessible communities, propane is less expensive than distillate-based systems for water and space heating.

This report focuses on logistics, required infrastructure and economics of propane distribution within coastal Alaska.

Delivery of propane to communities should "start small" using currently available shipping means and methods such as ISO containers shipped along with other bulk freight. Trucks or other vehicles fitted with propane tanks can be used to distribute to residences. As demand increases, storage, transfer facilities and shipping methods will adjust to efficiently meet the increased demand.

Electrical power generation requires substantial quantities of propane and special barges would be required for bulk delivery. Compared to diesel fuel, larger volumes of propane are needed for the equivalent amount of energy, and pressurized tanks are required. Consequently, tankage is a large portion of the cost of a propane-based system. Electric power generation is cost effective in communittes that have year-round barge access and do not require extensive storage capacity, or if tankage costs are grant-funded as with many distillate systems.



Most rural Alaskans are already familiar with propane. It is typically used for cooking, drying clothes, portable heaters, etc.

As shown in the diagram above, the methane would be extracted and introduced into the existing gas system at any convenient location along the Enstar pipeline system for distribution and for electrical power generation. The remaining liquid petroleum gas (LPG) components would be segregated at a fractionation facility at a Cook Inlet tidewater location into 1) Propane for local and intra-state distribution; 2) petrochemical feedstock for local industry and/or export production and 3) the remaining LPG components would be exported to world markets. This feasibility report focuses on only the logistics, required infrastructure and economics of propane distribution from within Cook Inlet to Alaska coastal and riverine communities. Eight communities were selected to represent a mixture of large and small populations, geographic diversity, and river and remote locations:

Bethel	Dillingham
Gambell	Juneau
Kotzebue	McGrath
Unalaska	Yakutat

Communities in Interior Alaska that might receive propane manufactured at a small fractionation facility located near the Yukon River were not included in this report.

Purpose

The Alaska Natural Gas Development Authority (ANGDA) has requested a study of the concepts for transportation and distribution of propane to marine-accessible Alaska communities. The proposed point of supply is at tidewater in Cook Inlet, such as Point Mackenzie or Kenai. This study will focus on how bulk propane could be transported economically for distribution to rural communities, estimated costs to distribute the propane, and how to distribute effectively to rural communities with varying marine access conditions. The costs will be compared to those for conventional delivered fuels.

The purpose of this study is to gain a broad understanding of the required infrastructure, logistics and economics of the distribution of propane to marine-accessible communities from an enriched gas pipeline stream. If economics are positive, market forces would likely cause Alaska communities to supplement or replace diesel and home heating fuel with propane for electrical power generation and home heating. Information developed through this feasibility study will be used to determine whether a project of this type could be beneficial to Alaska communities and warrants further investigation.

Communities will be required to comply with new EPA low-sulphur emission standards by 2007.

Related to the cost comparison of propane to diesel fuel for electrical power generation are new EPA low-sulphur emission regulatory changes which communities will be required to comply with by 2007. Typical diesel power generation facilities will require major component changes, reducing efficiency, which in turn will reduce the economics of diesel generator systems significantly. These potential reductions in efficiency are not included in this analysis because it is uncertain how communities will ultimately respond to this requirement. Propane is considered a clean-burning fuel and produces significantly less pollutants than combustion of diesel fuel; meeting regulatory emission requirements is typically much easier.

Communities will be required to comply with new EPA low-sulphur emission regulatory changes by 2007. Propane is considered a clean burning fuel and produces significantly less pollutants than combustion of diesel fuel, thus meeting regulatory emission requirements is typically much easier.

The potential exists to provide a fractionation plant in Interior Alaska on the Yukon River and provide propane to interior communities via truck if they are on the road system, or via barge service on the interior river systems. This potential distribution system is not within the scope of work for this project and is not addressed here.

ISO Containers

The most efficient method to introduce significant quantities of propane to rural Alaska is through the expanded use of ISO propane containers transported on the deck of existing freight or fuel barges. This scenario minimizes startup costs for transport and fully utilizes the current system of existing infrastructure and the transportation industry. Supply of large quantities of propane as would be needed for electrical power generation, requires the construction and use of special built ocean going multi-product or single-product barges. In addition, the development of strategic distribution hubs for propane would allow more efficient transport to smaller rural communities. Because of its location and significant existing infrastructure, Unalaska would likely be a good candidate as a distribution depot. Barges would be used to distribute the propane and other fuel products to smaller communities.

Figure 1. Tank Solutions, Inc. of Houston, Texas, is among manufacturers of 20- to 40-foot long ISO tanks (intermodal containers) for lease and purchase. ISO containers could be produced in Alaska if sufficient demand develops.

This report provides current thinking on intrastate distribution of propane and export of LPG delivered by a future pipeline to Southcentral Alaska. After fractionation at tidewater, Intermodal ISO containers and/or propane barges would be used to distribute propane to coastal and riverine communities within Alaska. LPG tankers would transport the remaining natural gas liquids (NGLs) to world markets The petrochemical feedstock would be piped to a nearby facility or exported. It is not the intent of this report to provide design of the pipeline, facilities, terminals or vessels, but rather determine the logistics and facility requirements to provide estimates of cost for an evaluation of the viability of this concept.

NGL Use

The anticipated flow of NGLs from the pipeline at tidewater in Cook Inlet is estimated to provide approximately 50,000 bbls per day of propane. Current in-state propane demand is approximately 1,000 bbls per day, with about half of this amount consumed in Southcentral Alaska. If a propane-based energy system was developed in coastal Alaska, substantially greater quantities of propane would be consumed. For example, Kotzebue Electric would consume about 57,000 barrels of propane on an annual basis if it used propane rather than diesel for power generation. Since many Alaska communities can only be supplied by barge during summer months, the summer shipping season would see peak demand from in-state consumers. This would require a decrease in export volumes during this period. Winter domestic demand would decrease due to reduced marine accessibility of remote communities while exports would increase to compensate.

The anticipated flow of NGLs from the pipeline at tidewater in Cook Inlet is estimated to provide approximately 50,000 bbls per day of propane.

All communities examined would benefit from a lower cost supply of propane for household uses (cooking, space heating, and water

Current (June 2005) Fuel Prices ($ per Gallon)

	Utility	Residential	
Community	Distillate	Distillate	Propane
Bethel	2.90	3.38	5.90
Dillingham	1.65	3.41	4.24
Gambell	2.03	3.46	4.26
Juneau	1.65	2.45	2.41
Kotzebue	1.98	2.62	4.66
McGrath	2.31	3.97	6.69
Unalaska	1.73	2.25	4.12
Yakutat	2.24	2.91	3.80

heating) when delivered by barge. These savings assume that a dedicated barge service is utilized. However, if propane is delivered in ISO containers, only households in a few communities can achieve savings in their total energy costs. Cooking is the only use where propane remains more cost effective than alternatives in all communities when ISO containers are used.

Household Energy Costs

Table 1 shows total energy costs for a typical household for each type of fuel (distillate or propane) and by delivery mode for propane. The shaded estimates represent communities and delivery modes where propane provides cost savings to that community under the assumptions used in this analysis. More accessible communities achieve benefits when ISO containers are used for shipping to coastal Alaska. Propane could be cost competitive with diesel fuel in all situations when the storage tank construction costs are funded separately by grants or other means, as is common for the diesel fuel tanks and equipment in many communities. Power generation costs in the vast majority of communities reflect only the cost of fuel and maintenance; substantial costs associated with financing tankage and equipment are heavily subsidized or paid by grants.

Table 1. Typical Annual Household Energy Cost

Community	Distillates	Propane	
		ISO Container	Barge
Bethel	$ 3,811	$ 4,342	$2,082
Dillingham	$ 4,352	$ 5,159	$2,870
Gambell	$ 3,820	$ 5,415	$3,019
Juneau	$ 2,372	$ 2,291	$1,063
Kotzebue	$ 3,111	$ 5,383	$2,912
McGrath	$ 4,832	$ 8,749	$4,102
Unalaska	$ 2,828	$ 3,392	$1,805
Yakutat	$ 3,565	$ 2,923	$1,876

More accessible communities will also benefit from propane used in electrical power generation. Table 2 compares the cost of electricity generation in each of the eight example communities with the two fuel types, and the delivery mode for propane.

Propane could be cost competitive with diesel fuel in all situations when the storage tank construction costs are funded separately by grants or other means, as is common for the diesel fuel tanks and equipment in many communities.

Table 2. Electric Utility Power Generation Cost

	Distillates	Propane	
		ISO Container	Barge
Bethel	$9,293,000	$ 10,779,000	$4,817,000
Dillingham	$2,101,000	$ 4,283,000	$1,831,000
Gambell	$ 286,000	$ 580,000	$ 299,000
Juneau	$ 319,000	$ 372,000	$ 194,000
Kotzebue	$2,953,000	$ 6,125,000	$3,051,000
McGrath	$ 512,000	$ 1,418,000	$ 573,000
Unalaska	$3,702,000	$ 5,074,000	$2,261,000
Yakutat	$1,037,000	$ 889,000	$ 482,000

The estimates provided in the previous two tables reflect assumptions that the wellhead value of the propane on the North Slope is $1.00 per million British thermal units (MMBtu), and that zero interest loans are available for constructing the required propane tankage in each community. This allows a relatively consistent comparison since, in many smaller communities, diesel storage tanks and power plants are constructed with grants and the substantial capital costs are not incorporated into the cost of service calculations for such diesel-based systems.

Conversion and/or replacement of power generation facilities and storage tanks from diesel fuel to propane will not be immediate – planning, funding, construction and conversion as well as development of bulk propane ocean barges will take time.

Conversion and/or replacement of power generation facilities and storage tanks from diesel fuel to propane will not be immediate – planning, funding, construction and conversion as well as development of bulk propane ocean barges will take time. However, use of ISO containers to provide propane for home cooking, and heating in some communities could be implemented as soon the propane source is available.

The cost of the ISO container delivery scenario is significantly impacted by the cost of the ISO containers themselves. Grant funding would further improve the realized cost savings.

Use of ISO containers to provide propane for home cooking, and heating in some communities could be implemented as soon the propane source is available.

Low-cost energy is fundamental to sustaining communities and economic development in rural Alaska. Based upon this study, propane distribution could provide an efficient, stable, lower cost alternative to diesel and heating fuel in some Alaska coastal communities. If grants presently used for distillate-based systems are also available for propane-based systems, the economic viability of propane-based systems appears positive. Implementation of this project would help to address the long-term problem of access to affordable power and heat, allowing value-added industries to develop in remote areas, enhancing community economic development and benefiting all Alaskans.

Background

The North Slope of Alaska contains immense reserves of natural gas and natural gas liquids. Efforts are under way to bring these resources to market. Alternatives being discussed include large-diameter pipelines to the U.S. Midwest, and liquefaction of the gas in Alaska and shipment to the U.S. West Coast. The Alaska Natural Gas Development Authority is engaged in evaluating spur line concepts which would tap into any of the main pipeline alternatives or a smaller diameter "bullet line" directly from the North Slope to provide Southcentral Alaska with access to this gas resource. A sufficient and reliable gas pipeline would result in lower prices for electricity and heating, save jobs on the Kenai Peninsula, and spur new industry growth along the pipeline route.

ANGDA is interested in providing similar benefits to other regions of Alaska, possibly by providing an alternative to existing fuels.

ANGDA is the Alaska Natural Gas Development Authority, a public corporation formed by voter approval of a ballot measure in the 2002 General Election, with the goal of bringing North Slope natural gas to market via the existing trans-Alaska pipeline corridor to Valdez. ANGDA started its work in 2003. A board of directors is appointed by the Governor to set the authority's policies and appoint its chief executive officer. ANGDA maintains a minimal staff and operates largely through contracts with the private sector.

ANGDA is interested in providing similar benefits to other regions of Alaska, possibly by providing an alternative to existing fuels. Most Alaska communities rely upon distillates for power generation (diesel fuel) and heating (heating fuel). These fuels are expensive and contribute to a high cost of living, particularly in low-income regions.

Gas pipeline options being discussed would be high-pressure lines capable of transporting large quantities of NGLs, such as propane, ethane and butanes. A pipeline tapping into the major gas pipeline, terminating in Cook Inlet, could provide a number of benefits:

- Sufficient natural gas to replenish the dwindling supply and meet the needs of Southcentral Alaska industrial and utility customers
- A large volume of natural gas liquids, including a substantial volume of propane, to be transported to coastal communities as an alternative to expensive diesel and home heating fuel
- A petrochemical industry could be developed at tidewater to use a portion of the NGLs for petrochemical feedstock
- Export of the balance of unused NGLs to world markets would provide funding for the capital, operating, and maintenance costs of the pipeline and Cook Inlet terminal facilities

The following sections of this report provide:

- A summary of the findings from the analysis
- Additional details on the various components of the propane distribution concept and the cost that the components contributes to the total delivered cost in a community
- A description of the model used to evaluate the concept
- Benefits of the concept
- An estimate of current and future demand for propane
- Profiles of each example community
- A discussion of the LPG export component
- A description of the intra-state marine transport system envisioned, and
- Appendices

Findings

This section summarizes the findings of this study to assess the competitive position of propane supplied from Cook Inlet to the existing power system that uses diesel and fuel oil for electric power generation and heating in the coastal and riverine communities of Alaska. The findings indicate where a propane-based system works, where it doesn't work, and what major factors affect the feasibility of a propane-based system. The findings presented here are derived from the information presented in Tables 3 through 8, and the community profiles presented later in this report.

- On a Btu basis, the cost of propane delivered by dedicated barges to coastal communities would be less than the current (2005) cost of diesel or fuel oil.
- However, the cost of storage and shipping large volumes of propane to remote communities that are only accessible during the short summer shipping season generally makes propane a more expensive alternative than diesel in those communities.

ISO containers appear to be viable options in very small communities or for meeting household or seasonal demands.

- In comparison to diesel/fuel oil, the lower Btu value of a gallon of propane means that a larger volume of propane must be stored. Propane tanks are pressure vessels so they are also more expensive to manufacture than diesel storage tanks.
- The larger storage volumes and the higher manufacturing costs result in tankage being a larger cost component in a propane system than in diesel-based systems.
- A propane-based system is most competitive in communities that have year-round barge service (e.g., Juneau, Unalaska, Yakutat) and consequently do not need large storage requirements for propane.
- The high cost of propane storage tanks in communities where 12 months of storage is required results in less competitive propane-based systems than subsidized diesel/fuel oil tank farms.
- A propane-based system that incorporates all of the capital and operating costs into its rate structure is not competitive in smaller communities where grants are used to build diesel/fuel oil tank farms and diesel power plants.

If two major communities (e.g., Unalaska, Juneau) could realize significant savings from power generation with propane delivered by barge, that level of demand may be sufficient to justify construction of two propane barges..

- If 20- or 30-year, zero interest loans are available to build propane-based tank farms, propane-based systems can deliver substantial cost savings to communities that have year-round barge access, or where the shipping season might extend to five or more months.
- ISO containers appear to be viable options in very small communities or for meeting household or seasonal demands. However, they are not economic for large-scale, year-round storage that would be required for most community-level power generation fuel requirements.
- Rural communities readily accept propane as a fuel of choice because of ease of use, portability, and clean burning properties.
- Rural communities most often use propane for cooking where propane is delivered to rural communities at lower costs than electricity can be supplied.
- The benefit of using propane in other domestic uses such as water and space heating is not as consistent and depends on the price competitiveness of propane relative to diesel or fuel oil.
- The more propane is used, the lower the demand for electricity with a subsequent reduction in the cost of importing diesel fuel to the community.
- At 2003 oil prices, benefits from a propane-based system are marginal at best for electric power generation; propane continues to provide savings to households although at much lower levels.

- In communities such as Unalaska where air emissions from power generation facilities are a concern, propane offers a much cleaner burning alternative to diesel. Avoided costs for air pollution mitigation (e.g., taller smoke stacks, fuel additives) are not included in these calculations. This issue has been identified as a major concern in the community of Unalaska.
- If two major communities (e.g., Unalaska, Juneau) could realize significant savings from power generation with propane delivered by barge, that level of demand may be sufficient to justify construction of two propane barges. Availability of the barges would enable other users in those communities, as well as other nearby coastal communities, to benefit from propane-based systems.

Tables 3 through 7 document the potential uses in each community where a propane-based system can provide savings compared to distillate-based systems. The uses include cooking, household water heating, household space heating, and electric utility energy costs (including propane storage). The shaded numbers represent the communities and type of delivery where savings appear to be achievable.

Table 3. Typical Annual Household Cooking Cost

Community	Electricity	Propane	
		ISO Container	Barge
Bethel	$ 365	$ 146	$ 65
Dillingham	$ 544	$ 146	$ 62
Gambell	$ 347	$ 179	$ 92
Juneau	$ 130	$ 83	$ 43
Kotzebue	$ 337	$ 179	$ 89
McGrath	$ 552	$ 279	$ 112
Unalaska	$ 344	$ 103	$ 45
Yakutat	$ 413	$ 83	$ 45

Table 4. Typical Annual Household Water Heating Cost

Community	Heating Fuel	Propane	
		ISO Container	Barge
Bethel	$ 473	$ 425	$ 188
Dillingham	$ 477	$ 425	$ 180
Gambell	$ 484	$ 520	$ 267
Juneau	$ 343	$ 242	$ 125
Kotzebue	$ 367	$ 520	$ 257
McGrath	$ 556	$ 811	$ 326
Unalaska	$ 315	$ 299	$ 132
Yakutat	$ 407	$ 242	$ 130

Table 5. Typical Annual Household Space Heating Cost

Community	Heating Fuel	Propane	
		ISO Container	Barge
Bethel	$ 2,282	$ 2,713	$1,203
Dillingham	$ 2,302	$ 2,713	$1,150
Gambell	$ 2,333	$ 3,317	$1,704
Juneau	$ 1,654	$ 1,545	$ 798
Kotzebue	$ 1,769	$ 3,317	$1,643
McGrath	$ 2,680	$ 5,176	$2,082
Unalaska	$ 1,519	$ 1,907	$ 840
Yakutat	$ 1,964	$ 1,545	$ 829

Table 6. Typical Annual Household Energy Cost

Community	Distillates	Propane	
		ISO Container	Barge
Bethel	$ 3,811	$ 4,316	$2,056
Dillingham	$ 4,352	$ 5,134	$2,845
Gambell	$ 3,820	$ 5,390	$2,992
Juneau	$ 2,372	$ 2,262	$1,034
Kotzebue	$ 3,111	$ 5,359	$2,887
McGrath	$ 4,832	$ 8,723	$4,076
Unalaska	$ 2,828	$ 3,366	$1,780
Yakutat	$ 3,565	$ 2,896	$1,850

Table 7. Annual Electric Utility Energy Cost

Community	Diesel	Propane	
		ISO Container	Barge
Bethel	$9,293,000	$ 10,779,000	$4,818,000
Dillingham	$2,101,000	$ 4,283,000	$1,831,000
Gambell	$ 286,000	$ 580,000	$ 299,000
Juneau	$ 319,000	$ 372,000	$ 194,000
Kotzebue	$2,953,000	$ 6,125,000	$3,051,000
McGrath	$ 512,000	$ 1,418,000	$ 573,000
Unalaska	$3,702,000	$ 5,074,000	$2,261,000
Yakutat	$1,037,000	$ 889,000	$ 482,000

Component Costs

In an effort to evaluate the feasibility and cost of propane distribution to coastal Alaska, eight communities were selected for the study based on their various locations, population bases and unique transportation requirements:

- BETHEL
- DILLINGHAM
- GAMBELL
- JUNEAU
- KOTZEBUE
- MCGRATH
- UNALASKA
- YAKUTAT

Based upon the results of the analysis for these communities, other coastal Alaska communities can evaluate the cost of propane delivery to their location.

Cost Component	*Price per MMBtu*
Wellhead	$1.04
Pipeline	$1.55
Terminal	$0.76
Loaded at Cook Inlet	$3.35

Four basic components of the proposed propane distribution system – pipeline, terminal facilities, transportation system and community facilities – are described in this section as well as assumptions used in the evaluation.

PIPELINE. This component anticipates a 24-inch-diameter routed directly from the North Slope to Cook Inlet. This pipeline is commonly referred to as the "bullet line." At the pipeline terminus in Southcentral Alaska the natural gas would be separated and placed into Enstar's pipeline system. Another pipeline would carry the remaining NGL components to Cook Inlet tidewater where a fractionation facility would refine the NGLs into individual products including the propane needed for distribution to coastal Alaska.

ASSUMPTIONS (includes conditioning plant, compressors, NGL plants)

- Raw gas for Gas Conditioning Plant can be purchased for $1/MCF, or about $1.04 per MMBtus
- The cost of service (COS) to deliver propane, ethane, and butane are estimated in the model
- Assumptions from the Michael Baker report for Enriched Gas Small Pipeline (EGSP) medium-flow project were used for "bullet line" to Nikiski. These include: capital costs, operating costs, timing of construction, ratio of equity to debt, life of project and energy balances.
- Capital and operating costs for a pipeline to Palmer to deliver utility gas to Enstar, and NGLs to a new smaller pipeline for transport to Point MacKenzie, were estimated by subtracting the cost of 214 miles of 24-inch pipeline from the values in the Michael Baker report for the 800 mile EGSP medium flow project and adding back in the costs of a small pipeline to Point MacKenzie, provided by PND from estimates by H.C. Price/Conam.

The estimated cost per MMBtu of propane delivered to the terminal, including the assumed wellhead cost of the gas, is $2.59.

TERMINAL FACILITIES. This component includes docks capable of accommodating deep draft tanker ships that will transport LPG to world markets, and tug-and-barge complements for transporting propane to coastal communities. Facilities will also include sufficient pressurized storage for propane and NGLs, loading booms and other equipment for loading the vessels with the various NGL products. It is anticipated that a new dock capable of accommodating tug-and-barge complements would be required at all locations but Point MacKenzie or the Agrium facility at Kenai.

ASSUMPTIONS

- Propane storage capacity required is equal to 20 days of production, which is the anticipated round trip time between Cook Inlet and Pacific Rim markets.
- Cost of new barge dock is $6 million
- Cost to retrofit deep draft dock for LPG vessels is $1 million

PND

The estimated cost per MMBtu for the amortization, operations, and maintenance costs of the terminal facilities is $0.76.

TRANSPORTATION SYSTEM. The transportation system includes tug and barge sets for delivery to Alaska coastal and river communities. Two tug-and-barge sets are necessary to deliver the required amounts of propane - within the seasonal shipping constraints - to the eight communities selected for evaluation. The 30,000-barrel ocean going barges would be specially constructed for propane transportation. The export market was estimated to be served by two 78,500-cubic-meter ships specially designed to transport LPG products, these types of vessels are fairly common throughout the world. These ships are as described in Transport of Natural Gas to Tidewater (Michael Baker, Jr., Inc., 2005).

ASSUMPTIONS

- Propane barge costs are $7 million for a 15,000-Bbl capacity and $10 million for a 30,000-Bbl capacity. Ship costs are high due to the need for a pressurized vessel
- Two 30,000 Bbl barges will be dedicated to delivery of propane
- Tugs are not dedicated to the project; both tugs are required in the summer and one of the tugs when not needed in the winter will be available for work on other routes
- Export costs do not include destination port costs

The estimated cost of transporting propane from Cook Inlet to the eight selected communities using the dedicated barge system described is shown in Table 8.

Table 8. Transportation Cost to Selected Communities (by Barge)

Community	$ per MMBtu
Bethel	$3.73
Dillingham	$3.69
Gambell	$5.87
Juneau	$2.59
Kotzebue	$5.35
McGrath	$8.92
Unalaska	$2.93
Yakutat	$2.87

The lower transportation costs shown above are primarily the result of of shorter transportation distances *(See Figure 4 on page 30 for sea voyage distance from Cook Inlet to the communities)*. The higher transportation costs are a function of greater distances, and in the case of McGrath, the necessity to transfer propane from ocean-going barges to river barges with shallower draft requirements.

Table 9 shows the total delivered cost (transportation, terminal, and pipeline costs) of propane to each of the communities by barge or ISO container, compared to 2005 distillate prices paid by the local utility. The data in the table do not include costs for propane storage, inventory cost, and similar items in the community. The shaded numbers indicate those communities and shipping modes where propane delivered to the community costs less than distillates on a per MMBtu basis.

Table 9. Delivered Cost to Selected Communities ($ per MMBtu)

Community	2005 Distillate	Propane	
		ISO	Barge
Bethel	$21.19	$22.20	$ 7.08
Dillingham	$12.06	$22.20	$ 7.04
Gambell	$14.83	$27.14	$ 9.22
Juneau	$12.06	$12.65	$ 5.94
Kotzebue	$14.47	$27.14	$ 8.71
McGrath	$16.88	$42.36	$ 12.27
Unalaska	$12.64	$15.61	$ 6.28
Yakutat	$16.40	$12.65	$ 6.23

Yakutat is the only community where propane can be delivered with ISO containers at a cost lower than the existing diesel price paid by the local utility. This is likely a function of market forces; Yakutat had the third highest price for diesel among the eight communities, and is the closest community to Cook Inlet, which would result in the lowest delivered price for propane, excluding the cost of community facilities (discussed in the next subsection), and any markup by the local distributor.

COMMUNITY FACILITIES. These facilities include the tankage and transfer piping necessary to store propane as needed in each Alaska coastal or riverine community. Communities north of the Alaska Peninsula have short shipping seasons when the ocean and rivers are ice-free, hence constructed diesel storage facilities are typically capable of meeting an entire year of fuel consumption. As a result, the propane tank volumes, and subsequent cost for these pressurized vessels, are substantial.

Although weather delays typically hinder winter schedules, communities south of the Alaska Peninsula can receive shipments year-round. Consequently, storage requirements are less and associated costs are significantly lower. Community facilities also include construction of piping to transfer the propane from barge to propane tanks, and other ancillary facilities for distribution in the community. Existing dock facilities can be used in most cases. The cost estimates do not include a piped distribution network in any community at this time. Propane is assumed to be distributed in the communities by truck or similar methods. The estimated cost of the community facilities on a per MMBtu basis is shown in Table 9.

ASSUMPTIONS

- Wharfage and mooring costs are not included in the estimates
- Existing docks will not require major renovations beyond construction of storage capacity and transfer piping
- Propane storage capacity costs $7.25 per gallon based on recent Denali Commission studies on bulk fuel tank farm construction, and small diameter piping is $35 per foot; ancillary equipment and other construction costs for tank pads, and other civil works are included in the $7.25 per gallon cost.
- The conversion costs assume installation of new electrical generating and heating equipment are included in this analysis.

- Less than a mile of piping will be required

Propane storage capacity as a percent of annual estimated demand by community and the number of deliveries per year are shown in Table 10.

Table 10. Propane Storage as Percent of Annual Demand and Number of Propane Barge Deliveries

Community	Percent of Annual Demand	Number of Annual Deliveries
Bethel	100	2
Dillingham	100	2
Gambell	100	1
Juneau	15	10
Kotzebue	100	1
McGrath	100	1
Unalaska	15	10
Yakutat	15	10

The more remote communities have fewer deliveries because it is very difficult to access these communities at the beginning of the summer barge season and the end of the season with the two sets of tug and barge equipment. A single delivery may require more than one call by the tug and barge equipment. For example, Kotzebue would require several consecutive trips by a tug and barge to obtain enough propane for the entire year. These consecutive trips are counted as one delivery in Table 10. Current guidelines for bulk fuel tank farms call for a year of storage capacity for communities with limited barge access in case there is difficulty in reaching the community after spring breakup. This guideline is used for those communities that do not have year-round barge access.

Table 11 shows the estimated cost of these community facilities on a per MMBtu basis for propane delivered to each community. ISO containers function as both transportation and storage units requiring minimal community facilities.

Table 11. Estimated Cost of Community Facilities (Bulk Tankage) for Propane

Community	$ per MMBtu
Bethel	$2.77
Dillingham	$2.37
Gambell	$4.73
Juneau	$0.59
Kotzebue	$4.74
McGrath	$4.77
Unalaska	$0.60
Yakutat	$0.56

Communities that have year-round barge access require less storage and have lower costs for community facilities. Communities that have limited barge access and fewer deliveries have higher costs for community facilities.

TOTAL COST. The estimated total cost of propane, excluding any markup by the local distributor, is presented in the following table. The cost per MMBtu for propane is compared with the energy cost of diesel delivered to the local electric utility. The utility diesel fuel cost may be the closest proxy to the potential delivered cost of propane to a local distributor.

Table 12. Estimated Total Cost of Energy

Community	Distillate	Propane ISO	Propane Barge
	($ per MMBTU)		
Bethel	21.19	22.20	9.85
Dillingham	12.06	22.20	9.41
Gambell	14.83	27.14	13.95
Juneau	12.06	12.65	6.53
Kotzebue	14.47	27.14	13.45
McGrath	16.88	42.36	17.04
Unalaska	12.64	15.61	6.88
Yakutat	16.40	12.65	6.79

The results of this analysis indicate that dedicated barge systems can deliver propane to many communities at a cost-competitive price to distillate fuels. However, the cost estimates for this analysis are preliminary and incorporate a number of assumptions. The expected range of error for the estimates would indicate that prices between distillates and propane should be considered comparable if the price differential between distillate and propane is less than $1.00. As discussed previously, Yakutat has a very high distillate price for a community with year-round barge access and the local fuel distributor might reduce its margin to compete against propane delivered by ISO containers, unless the distributor sold both fuels.

Table 13 summarizes the cost of service for delivery of propane by barge to the eight communities, and the annual energy savings for households and the electric utility using propane. The typical household could save money by using propane as well as electric utilities in communities with year-round barge service. However, electric utilities in remote communities with limited barge service are not likely to achieve savings with a propane-based system.

Table 13. Propane Delivery Costs and Savings to Communities

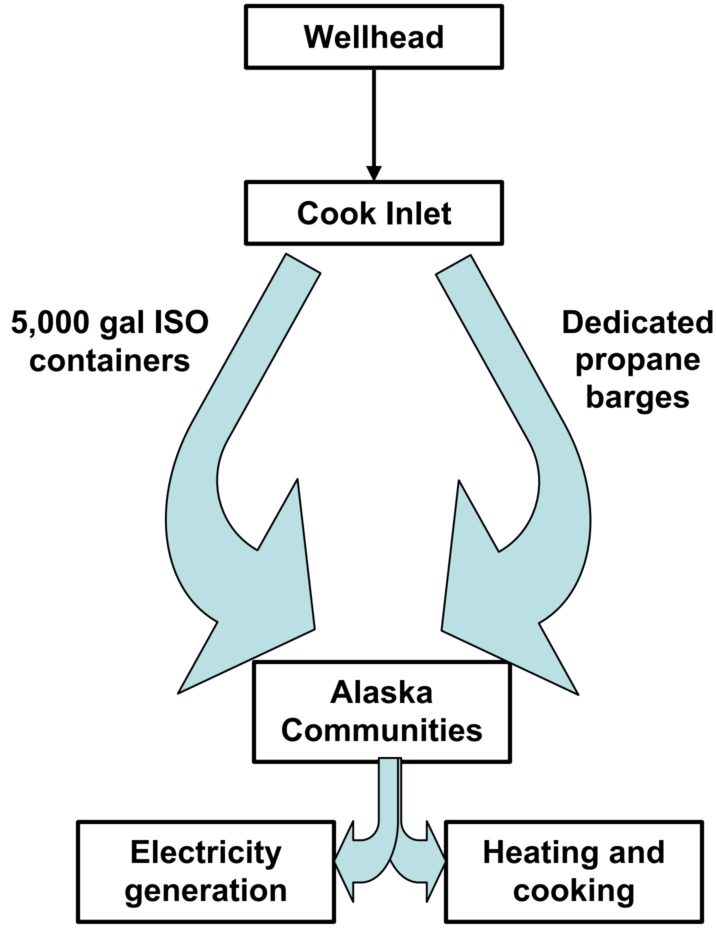
	Wellhead to Cook Inlet	Cook Inlet to Community	Community Facilities	Total Cost	Household Energy Savings	Electric Utility Energy Savings
	($ per MMBtu)				($ per year)	
Bethel	3.35	3.73	2.76	9.84	1,755	4,544,000
Dillingham	3.35	3.69	2.36	9.41	1,507	297,000
Gambell	3.35	5.87	4.72	13.95	828	(10,000)
Juneau	3.35	2.59	0.59	6.53	1,338	129,000
Kotzebue	3.35	5.35	4.74	13.45	224	(66,000)
McGrath	3.35	8.92	4.77	17.04	756	(57,000)
Unalaska	3.35	2.93	0.59	6.88	1,048	1,487,000
Yakutat	3.35	2.87	0.56	6.79	1,715	565,000

Model

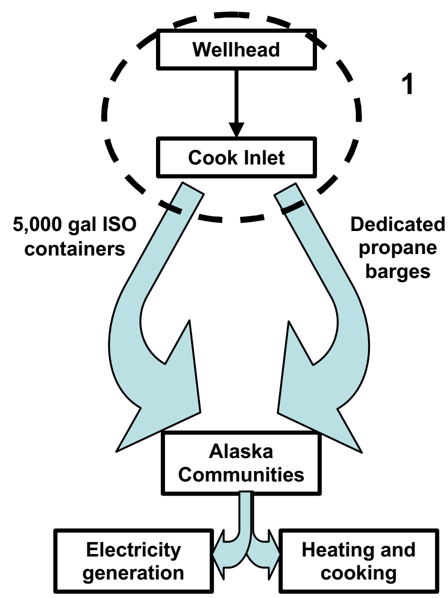
A spreadsheet model was developed to aid in the analysis of the costs of moving propane from the North Slope to Alaska coastal communities and the potential cost savings to be obtained by using propane. The model comprises these cost modules:

1. Cost of transporting LPG from the North Slope to a dock at Cook Inlet
2. Cost of transporting propane to coastal communities by using either dedicated barges or ISO containers
3. Cost of storage and handling propane at selected Alaska coastal communities
4. Potential fuel cost savings from substitution of propane for diesel power generators
5. Potential fuel cost savings from substitution of propane for heating oil or electricity for home space heating, water heating and cooking

A schematic diagram of the model is presented in the adjacent figure. Each of the modules is described in the following text.



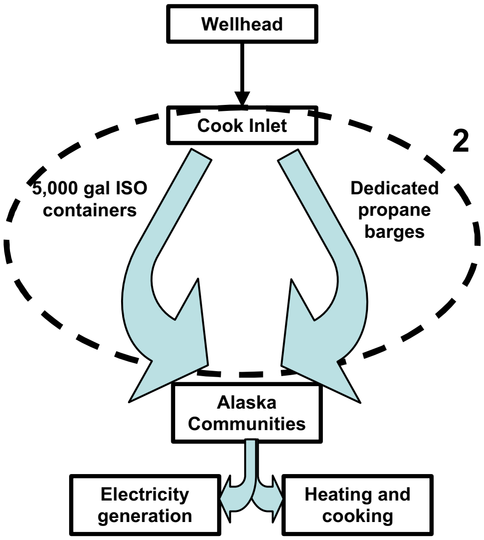
1. Cost of Transporting Propane to Cook Inlet



A model previously developed by Northern Economics for ANGDA was adapted to estimate the cost of service for moving propane by pipeline from the North Slope to storage facilities on Cook Inlet. In the model, the capital and operating costs for movement of natural gas to Cook Inlet are allocated to propane and the other components on the basis of their energy content (Btu/SCF). Initially, the propane would be mixed with methane and other natural gas liquids (NGLs, e.g., butane, pentane, and ethane). Utility gas, primarily methane, and other NGLs would be extracted for use in the Cook Inlet area. The propane would be stored at a facility in Cook Inlet to await shipment to Alaska communities or foreign markets.

Capital and operating costs for the conditioning plant, pipeline, and separation facilities were taken from the Michael Baker study. Cook Inlet port facility capital costs, including capital costs for propane storage were estimated by PND. The Michael Baker study contained capital and operating cost estimates for ships capable of transporting the propane to Pacific Rim markets. While not a major component of this study, the cost of transporting propane to Asia was estimated.

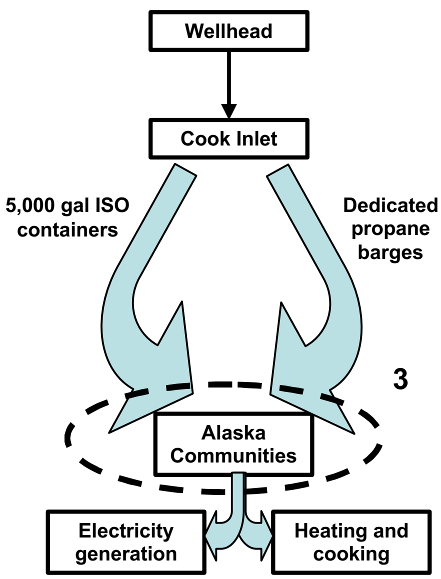
2. Cost of transporting propane to coastal communities



Propane would move by barge from Cook Inlet utilizing either 6,500 gallon ISO containers (has an effective capacity of about 5,000 gallons of propane to allow for product expansion) or a set of specially built propane barges. Barge shipping companies serving Alaska provided information on current rates for moving ISO containers to Alaska communities.

Daily tug costs for a dedicated barge service were estimated using 2005 Corps of Engineers guidance adjusted for current fuel costs. These costs were verified by a fuel distribution company operating such equipment. Barge construction costs were based on estimates obtained from barge construction firms. The costs for a double-hulled barge vary significantly among builders. This is due in part to a large number of orders that must be filled as the deadline approaches for compliance with federal regulations requiring double-hulled crude oil and petroleum product vessels and barges.

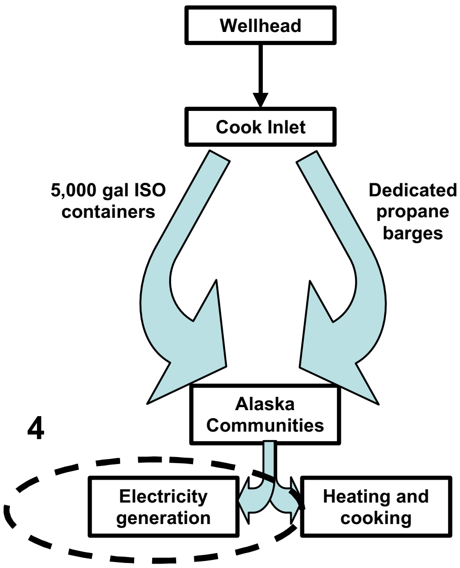
3. Community costs of handling and storage



ISO containers can function as storage units and require only a flat surface for placement, and piping or other delivery means to users in a community. ISO containers are amortized over 25 years at 0% interest.

Costs for dedicated propane tanks were calculated using Denali Commission sponsored studies of the cost of construction of diesel storage facilities in rural Alaska communities. The anticipated markup by propane distributors in each community for residential and commercial users is calculated as the actual cost for 500 gallons of diesel or heating fuel delivered to a customer, compared to the estimated delivered cost of the fuel, including storage costs.

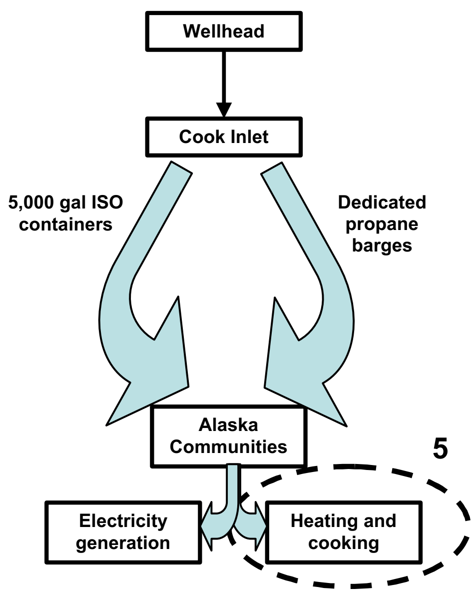
4. Potential savings from electrical generation



Capital costs for comparable diesel and propane generators were assumed to be equal. To calculate potential savings from electrical generation:

- Estimate gallons of diesel to generate a kWh of electricity using most efficient technology
- Obtain or estimate the cost of diesel in the community
- Divide community electrical requirements in kWh by diesel efficiency factor and multiply by price of diesel to obtain total cost
- Estimate gallons of propane needed to generate a kWh of electricity with generators or turbines
- Estimate the cost of propane using data from previous modules
- Divide community electrical requirements in kWh by propane efficiency factor and multiply by price of propane to obtain total cost
- Calculate the cost savings per kWh and multiply by the annual number of kWh.

5. Potential savings from home use



Estimates of home usage of electricity for cooking and home usage of fuel oil and diesel for home and water heating were based on the Rural Energy Plan (MAFA and Northern Economics, 2004) Estimates of gallons of propane required for cooking and water and home heating were derived from manufacturers' specifications available through the Internet. Capital costs estimates for propane appliances were based on conversations with local suppliers.

Benefits

Benefits to state and community from propane development and use center on three primary elements:

- Savings to households and utilities
- Savings to the State of Alaska
- Environment

Households and Utilities

Propane is presently used in most if not all coastal Alaska communities. Its primary function at the household level is for cooking, although water heating, and to a lesser extent space heating also use propane. The delivery system described in this report would reduce the cost of propane in coastal communities compared to its current price, and residents using propane would experience immediate savings. It is probable that other residents would convert to propane for cooking and heating needs with lower prices and subsequent savings (See Tables 3, 4, and 5).

Propane can be delivered into most coastal communities at substantially less cost than diesel on a per million Btu basis.

Power generation typically consumes more fuel than other uses in most coastal communities. Diesel-fired generators are the system of choice in most communities although some of them have hydroelectric facilities. In many small coastal communities the existing diesel-fired power generation system can be considered a sunk cost; it is in place and primarily paid for with grants from state and federal sources. Converting to a new propane-based system where capital costs would have to be amortized and incorporated into electrical rates is not very competitive with the existing subsidized system, which typically has little if any debt service. A propane-based system would be very competitive if a community needed to replace its existing diesel-based system, assuming that both systems would have similar levels of debt financing or subsidies.

The largest savings for power generation will accrue to larger communities that can receive barge deliveries of propane on a year-round basis.

The largest savings for power generation will accrue to larger communities that can receive barge deliveries of propane on a year-round basis. These savings can be substantial at current oil prices, but savings will not occur at oil prices below $30 per barrel, which existed in 2003, except for a few communities. Communities that are ice-bound for much of the year must construct new storage facilities for propane to hold 9 to 12 months of consumption and will experience lower levels of savings with a propane system. The storage facilities are expensive because the tanks are pressure vessels (1.6 gallons of propane are required to equal the thermal energy content of one gallon of diesel) and, due to the combustion characteristics of propane, propane-fired generators and turbines require about 10 percent more Btu's than diesel- or methane-fired systems to generate the same amount of power. This higher expense for propane storage facilities in comparison to diesel tank farms offsets some of the savings associated with lower delivered fuel price based on a per MMBtu basis for propane. At lower oil prices similar to those experienced in 2003, a propane-based system in ice-bound communities is not competitive if propane costs $3.50 per MMBtu at tidewater in Cook Inlet.

Diesel and gasoline will still continue to be required in communities that have switched to a propane-based system but the volume and frequency of deliveries could be reduced, thereby reducing the potential for spills of these petroleum products.

State of Alaska

The State of Alaska provides a substantial number of grants and other subsidies to smaller communities to maintain their diesel-based heating and power generation systems. Potential savings to the State would consist of lower Power Cost Equalization (PCE) payments, and potentially fewer grants if the capital costs are amortized into a propane-based system which can generate electric rates comparable to the existing subsidized system.

Other benefits to the State include the availability of natural gas for consumers in Southcentral Alaska, the potential for a petrochemical facility at tidewater in Cook Inlet and, depending on the timing of the availability of North Slope gas in Cook Inlet, the potential for maintaining the Agrium and LNG plants at Nikiski.

Air Quality

Propane is a clean burning fuel and generates significantly fewer air emissions compared to diesel-fired equipment. This attribute is particularly important in communities where air quality is an issue, such as Unalaska. The availability of large volumes of propane could also be a benefit to the Red Dog Mine and other resource development activities that face constraints of permitting additional power generation facilities due to air quality concerns.

The potential for displacing diesel and heating fuel will result in lesser quantities of these fuels being transported in the marine and river environments.

The availability of propane in coastal Alaska and the potential for displacing diesel and heating fuel will result in lesser quantities of these fuels being transported in the marine and river environments, and a lower risk of petroleum product spills. Diesel and gasoline will still continue to be required in communities that have switched to a propane-based system but the volume and frequency of deliveries could be reduced, thereby reducing the potential for spills of these petroleum products.

Current and Future Energy Demand

Current diesel and heating fuel usage in Alaska (domestic demand), excluding the North Slope, private construction contractors and the military, is approximately 310 million gallons (20,000 bbpd) of liquid fuels per year. Approximately 50 percent of that amount is used in transportation and other equipment (air transportation, fishing vessels, trucks, etc) that cannot be easily or efficiently converted to use LPG. The remaining 155 million gallons per year represents the Alaska energy demand that could be converted to LPG if economically feasible. This volume represents about 16,000 barrels of propane per day.

LPG

Current in-state LPG demand is approximately 15 million gallons per year (1,000 bbpd). This demand is currently met by approximately 500 bbpd of in-state production from the Tesoro refinery, and approximately 500 bbpd imported via hydrorail and truck from Canada *(see diagram on page 30)*. The May 2005 cost of diesel and propane varies widely throughout the state, as shown below:

Regional Area	Diesel $/Gallon	Propane $/Gallon
Southcentral Alaska	$2.00	$2.50
Southwest Alaska		
Dillingham	$3.00	$4.25
Unalaska	$1.90	$4.50
Southeast Alaska	$2.30	$2.50
Northwest Alaska	$3.50	$4.50

Developing propane sales in rural Alaska presents a significant challenge to ANGDA and fuel suppliers due to unknown future demand. For this reason, "starting small" is recommended. In communities historically dependent upon traditional fuels, that means converting appliances to use propane or replacing them with new appliances. As expectations are met, familiarity increases and price stability is observed, additional appliances can be converted if desired.

Propane

Table 14 shows the estimated demand for propane by community. Based on current population estimates, this is the potential demand that would exist in the selected communities given the assumptions made in this analysis. Propane demand represents 37 percent of the total energy demand in these communities with propane delivery in ISO containers and 91 percent in those communities with barge delivery.

Juneau has by far the largest demand for propane among the communities studied in the report. If Juneau is removed from the group studied, the resulting propane demand may be more representative of Alaska communities in general where propane might provide six percent with delivery by ISO containers and 49 percent with barge delivery.

Table 14. Total Household and Utility Propane Demand (Gallons)

	ISO Container	Barge
Bethel	378,000	7,761,000
Dillingham	234,000	3,638,000
Gambell	5,000	280,000

P | N | D

Juneau	9,277,000	9,595,000
Kotzebue	28,000	1,533,000
McGrath	5,000	259,000
Unalaska	107,723	4,228,590
Yakutat	1,208,759	1,208,759
Total Gallons of propane	**11,242,809**	**28,502,781**

It is reasonable to assume that if LPG economics are positive, approximately 50% of the Alaska demand that could be economically converted from diesel fuel to LPG would occur within 10 years.

LPG Usage

It is reasonable to assume that if propane economics are positive, approximately 50% of the Alaska demand that could be economically converted from diesel fuel to propane would occur within 10 years. Approximately 116 million gallons per year (2.761 million barrels) would be needed to meet this in-state demand, without including significant population growth. This total yields 318,000 gallons or 7,500 barrels per day, based on 365 days in a year. Summer exports may reach 15,000 to 20,000 bbpd to replenish remote community storage tanks during the shipping season in preparation for winter.

Assuming that the balance of the supply would be exported, on average more than 40,000 bbls per day would be available for export to world markets. This volume equals 3,200 tonnes of LPG per day. Typical LPG export vessels have a capacity of 50,000 tonnes, which on average would require a ship call approximately every 15 days. Ship calls would be more frequent in winter months than in summer months. Twenty days' tank storage (about 960,000 bbls) should be sufficient to preclude interruption of service anywhere within the supply system.

Sixty days of tank storage (2.4 MMbbls) should be sufficient to preclude interruption of service anywhere within the supply system.

Community Demand for Propane

The demand for propane – expressed in millions (MM) of British thermal units (Btus) – is equal to the total Btus provided by diesel or heating fuel used for power generation and heating, plus an estimated loss of 10 percent efficiency due to propane's combustion characteristics. An average Btu basis (between diesel number 1 and diesel number 2) is used for this evaluation. The demand for total diesel and heating fuel is derived from a regression equation developed by Northern Economics, Inc. from Preliminary Design Reports for bulk fuel tank farms, which were on file with the Alaska Energy Authority as of February 20, 2004. The amount of diesel required for power generation is based on Power Cost Equalization data for those communities that participate in the program, or from reports submitted to the Federal Energy Regulatory Commission (FERC), as reported by the Institute for Social and Economic Research (ISER), at the University of Alaska Anchorage (2003). The demand for heating fuel is the balance of total demand less demand for power generation.

LPG Export

The purpose of the enriched gas pipeline is to subsidize the delivery costs of the lower value methane to Southcentral with the export of higher value LPG. The export of LPG not utilized within Alaska is an important component system because it provides the financing vehicle for construction and operation of the pipeline to Southcentral Alaska and related facilities.

Almost all of the natural gas liquids must be separated from the methane to ensure that the utility gas is within allowable limits of thermal energy (approximately 1,030 Btu's per cubic foot). The ethane, butanes, and pentane were assumed by Baker to be sold to a local petrochemical firm as a feedstock for $2.50 per MMBtu. This price was considered to be low enough to ensure the long-term economic viability of a local manufacturer and a means to dispose of the ethane, butanes, and pentane. If a plant were not developed to use this feedstock, the components could be exported to markets in Asia or the U.S. Information developed by Jacobs Consultancy suggests that Alaska gas liquids could be delivered into U.S. markets at typical U.S. feedstock pricing. Competition with Middle Eastern suppliers in Asia would be more difficult but Alaska can deliver propane into Japan at prices lower than the premium price that has been paid in the past *(See Figure 1 and Figure 2.)*

The export of LPG not utilized within Alaska is an important component system because it provides the financing vehicle for construction and operation of the pipeline to Southcentral Alaska and related facilities.

The analysis presented in *Transport of North Slope Natural Gas to Tidewater* by Michael Baker, Jr., Inc., indicates that using methane (natural gas) as a transport medium for substantial volumes of non-methane hydrocarbons, such as propane, ethane, and butanes is a technically and financially feasible option. The higher thermal energy content of the non-methane hydrocarbons subsidizes the cost of delivering methane to Cook Inlet, resulting in much lower costs to natural gas consumers in Southcentral Alaska than could be achieved with economies of scale using larger diameter pipelines. Table 15 compares the percentage of the components of the volumetric output of the plant that would separate the natural gas liquids (NGL plant) from the methane (also called utility gas when it is destined for a natural gas distribution system), with the thermal value of the components that would be transported through the system. Utility gas accounts for 81 percent of the volume but only 66 percent of the thermal value.

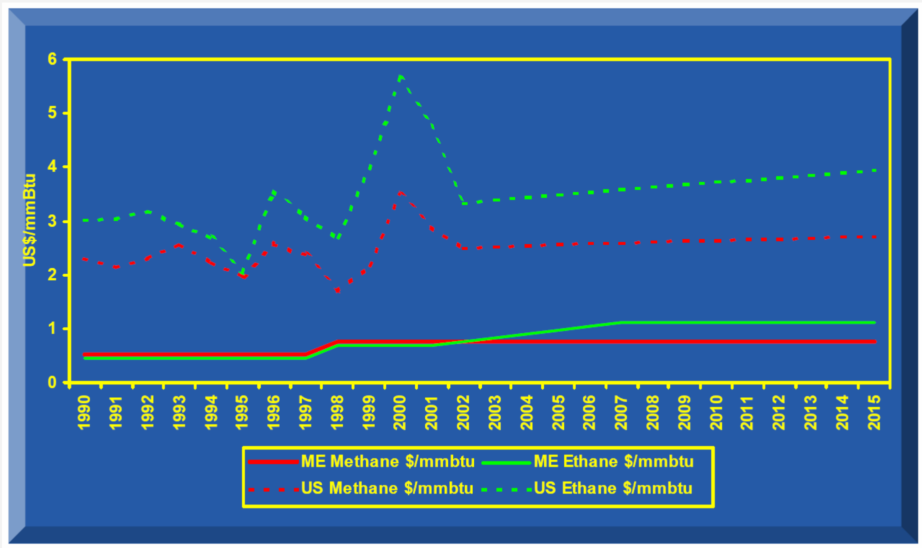
Table 15. Comparison of Volumetric and Thermal Composition of EGSP Project Scenario, Medium Case

Component	Volume (MMscfd)	Percent	Thermal (TBtu/Year)	Percent
Utility Gas (Methane)	623.9	81	234.7	66
Ethane	57.5	7	33.6	9
Propane	69.2	9	63.5	18
Butanes	18.9	2	24.2	7
Total	769.5	100	356	100

Source: Baker, Michael, Jr., Inc., 2005. *Transport of North Slope Natural Gas to Tidewater*. Table 7.1 medium case. Notes: MMscfd is Millions of standard cubic feet per day; TBtu/Year is trillions of British thermal units per year.

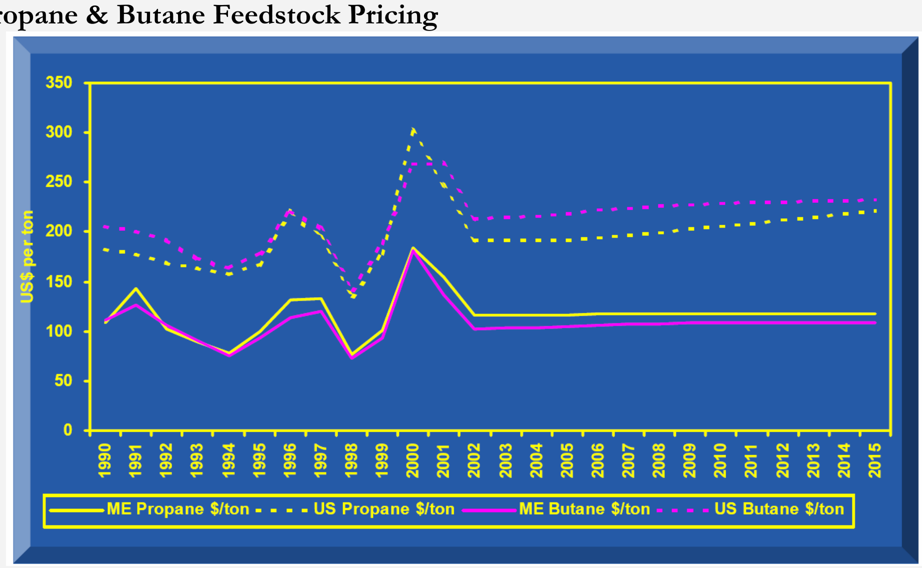
Pipeline tariffs are based on the thermal value of the components being transported so the non-methane hydrocarbons are assessed a greater portion of the tariff than their volumetric equivalent. The Baker report estimated that the wholesale price of utility gas sold at the NGL plant would range from $2.51 to $2.91 per MMBtu, depending on the financing assumptions, and assuming that the hydrocarbons could be purchased on the North Slope at $1 per MMBtu. If the tariff were assessed on a volume basis, the utility gas would cost about $3.08 to $3.57 per thousand cubic feet (roughly 1.03 million Btu's per thousand cubic feet).

Figure 2. Methane and Ethane Feedstock Pricing



Source: Newenham, Roger, 2002. Jacobs Consultancy. 1st International Conference Development of Gas Markets in the Gulf, Petrochemical and Fertilizer Projects in the Gulf: a short, medium and long term perspective. Accessed at http://www.jacobsconsultancy.com/pdfs/ibc_gg_pres_rwwn_3.pdf on June 5, 2005.

Figure 3. Propane & Butane Feedstock Pricing



Source: Newenham, Roger, 2002. Jacobs Consultancy. 1st International Conference Development of Gas Markets in the Gulf, Petrochemical and Fertilizer Projects in the Gulf: a short, medium and long term perspective. Accessed at http://www.jacobsconsultancy.com/pdfs/ibc_gg_pres_rwwn_3.pdf on June 5, 2005. Note: A price of $200 per short ton is approximately $4.25 per MMBtu of propane.

As reported in the Baker report, propane, selling as LPG in Japan, has commanded a premium to methane. Mitsubishi provided information to ANGDA that showed LPG selling at a 40 percent premium to LNG (methane) on a thermal basis from 1998 through 2002. The premium may be due to the variety of petrochemical products that can be produced from LPG feedstock, rather than its heating value. This premium subsidizes the price of methane delivered to tidewater under the assumptions used in the Baker financial model by about $0.44 per MMBtu. In other words, if the premium were to disappear and the LPG exports to Japan were sold on its energy basis, the cost of methane delivered to tidewater for use by residents of Southcentral Alaska would increase to about $2.92 to $3.32 rather than $2.51 to $2.91 per MMBtu. In a similar manner, the Japanese premium paid for propane results in lower propane costs for communities in coastal Alaska.

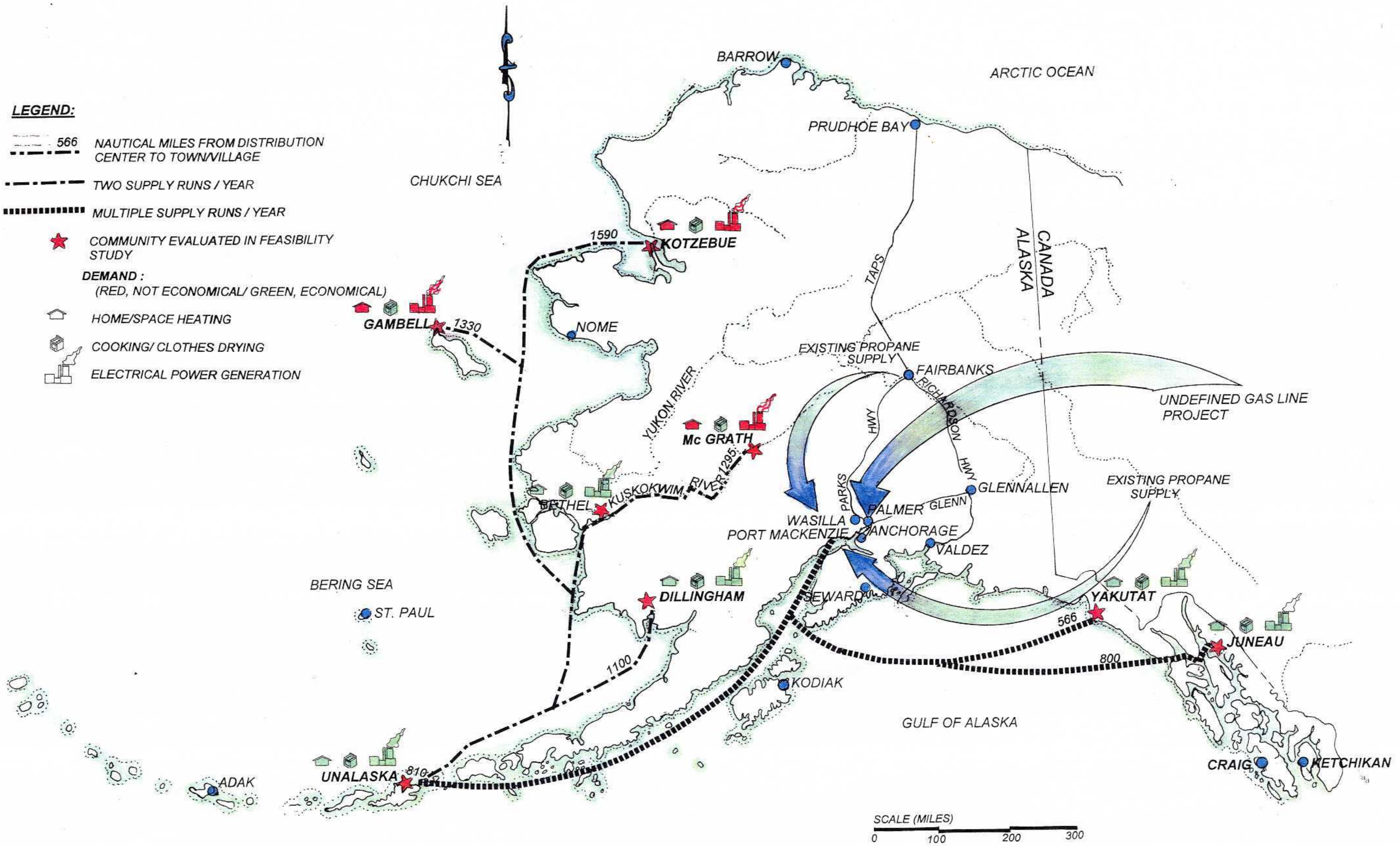


DIAGRAM OF PROPANE SUPPLY AND DEMAND

PROPANE DISTRIBUTION TO COASTAL ALASKA COMMUNITIES