Alaska Energy Authority
Discussion about LNG
Southeast Conference
March 13, 2014
## Annual Generation by Region

<table>
<thead>
<tr>
<th>AEA Energy Region</th>
<th>Net MWHs per Year</th>
<th>Percent of Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aleutians</td>
<td>65,340</td>
<td>1%</td>
</tr>
<tr>
<td>Bering Straits</td>
<td>55,362</td>
<td>1%</td>
</tr>
<tr>
<td>Bristol Bay</td>
<td>55,145</td>
<td>1%</td>
</tr>
<tr>
<td>Copper River/Chugach</td>
<td>116,700</td>
<td>2%</td>
</tr>
<tr>
<td>Kodiak</td>
<td>150,503</td>
<td>2%</td>
</tr>
<tr>
<td>Lower Yukon-Kuskokwim</td>
<td>96,625</td>
<td>1%</td>
</tr>
<tr>
<td>North Slope</td>
<td>82,544</td>
<td>1%</td>
</tr>
<tr>
<td>Northwest Arctic</td>
<td>35,549</td>
<td>1%</td>
</tr>
<tr>
<td>Railbelt</td>
<td>5,075,507</td>
<td>77%</td>
</tr>
<tr>
<td>Southeast</td>
<td>785,190</td>
<td>12%</td>
</tr>
<tr>
<td>Yukon-Koyukuk/Upper Tanana</td>
<td>31,175</td>
<td>0%</td>
</tr>
<tr>
<td>Total</td>
<td>6,549,640</td>
<td>100%</td>
</tr>
</tbody>
</table>

- Southeast Alaska consumes more energy than any other energy region outside the Railbelt.

- Hydro generation meets ~95% of Southeast electric demand. The remaining is met with diesel. (About 2.7 million gallons annually, 32,000 MWh)

- Heating demand is generally equal to electric demand.
Why LNG Now?

Comparative Commodity Costs, \$/MMBtu

- #2 Heating Oil (NY Harbor)
- Natural Gas (Henry Hub)
Can LNG Work for Coastal Communities?

- AEA-commissioned a screening level analysis with goal to assess opportunity and identify potential constraints of the ISO container delivery model

- Study Framework:
  - Assumes WesPac model
  - Screening level
  - Includes electric utility loads only
  - Coastal communities
  - ISO containers

- Not included
  - “Fatal flaw” assessment - Issues may have solutions outside of analysis framework
  - Independent assessment of “true” project economics
    - Many potential optimization (cost reduction) and complications (cost increases)
Can LNG Work for Coastal Communities?

Assumptions:
- Fortis British Columbia Tilbury liquefaction $4.50/MMBtu
- WesPac container and shipping cost assumptions:
  - 10,000 MMBtu/day (72,500 gallons/DEG)
  - 168 containers on site to meet demand
  - $125,000 per container
- Note that assumptions are a moving target

General Outcomes:
- Benefits depend on significant non-utility loads
- Benefits depend on what is aggregated
  - Each addition/subtraction effects economics
- Benefits might be substantial
Utility Demand and Industrial Customers

Can Southeast and Southwest Alaska utility demand satisfy WesPac LNG Model?

- Annual diesel demand for 46 PCE-eligible communities in Southeast and Southwest is ~4,000 MMBtu/day
  - 50% of this annual demand met by three communities:
    - Unalaska/Dutch Harbor
    - Naknek, South Naknek and King Salmon
    - Dillingham
  - Large Southeast electric loads are met by hydro
- If 10,000 MMBtu/day is required, then industrial demand is necessary.
Container pricing

- Coastal Utility ISO Demand is not Flat
  - Seasonality in year-round access communities
  - Iced-in communities have no winter delivery
  - Efficient ISO container requires smoothing demand
  - Inefficient use increases cost

- Ice-Free Communities:
  - 99 total containers driven by high demand in April
  - Average price $3.19
  - Coincident peak pricing range $1.90 to $6.47

- Ice-Bound Communities
  - Between 5 and 90 containers
  - Pricing ranges from $12.99 to $23.80
  - Removing Dillingham and Naknek/S. Naknek/King Salmon tightens range to 50 to 28 containers
    - For Naknek and Dillingham costs reduced by ~50% by using 6,000 m³ storage containers and bulk transport ships
Power Plant and Facilities Upgrades

- **Power Plant Conversion Costs:**
  - Average $0.75/MMBtu – cost of conversion ranges $0.41 to $2.32
    - Assumes private financing 11% ROI and 10 year term
    - Public financing 0% ROI and 10 year term results in $50/MMBtu

- **Port Facilities and Barge Landings:**
  - Most Southeast communities have adequate landing facilities
  - Five Southwest communities have known need for upgrade, many unknowns

- **Thermal Build Out:**
  - Distribution pipe capital cost highly variable
  - ENSTAR (Southcentral) ~$120,000/mile Fairbanks North Star Borough estimated ~$200,000/mile
  - Does not include connection cost or building conversion cost
LNG vs Diesel

- Compare to 2010 and 2012 diesel cost
- Assume:
  - $4.50 for liquefaction
  - $2.50 for shipping
  - $0.50 for regasification
  - Calculated ISO container cost
  - Calculated power house retrofit
  - $125,000/container CapEx

![Average estimated cost/MMBtu chart]

- Liquefaction
- Shipping
- ISO container
- Regasification
- Conversion
Break-Even Natural Gas Prices for Select Coastal Ice-Free Communities
Baseline ISO Container Costs

$3.82; Average price, FY2010-FY2012

red line shows average gas price for time period
Break-Even Natural Gas Prices for Select Coastal Ice-Bound Communities
Baseline ISO Container Costs

$3.82; Average price FY2010-FY2012

Range of breakeven points

2010 Diesel

2012 Diesel
How Is LNG Different From Diesel?

**LNG:**
- Cannot be stored at room temperature
- Needs low-temperature and pressurized storage
  - -260 degrees F and ≤4 psi
- Has a limited storage life
- Has energy density 60% of that of diesel
  - 83,000 versus 138,000 Btu/gallon
- Vaporizes if leaks or spills
- Ignites at 1,004 degrees F
- Weighs 3.5 pounds per gallon

**Diesel:**
- Can be stored at room temperature
- Has an established infrastructure in rural Alaska for production, distribution and storage
- Contaminates soil if leaks or spills
- Ignites at 437 degrees F
- Weighs 7.1 pounds per gallon
How Is LNG Different From Propane?

LNG:
- Cannot be stored at room temperature
- Tank pressure ≤ 4psig
- Classified as a greenhouse gas
- Lighter than air
- Boils at -260 degrees F
- Has an energy density of 83,000 Btu/gallon

Propane:
- Can be stored at room temperature
- Tank pressure 10-200 psig
- Not a greenhouse gas
- Heavier than air and will pool in low spots
- Boils at -44 degrees F
- Has an energy density of 92,000 Btu/gallon
Small-Community Considerations

- If demand can be aggregated there are savings opportunities for rural ice-free communities.
- Amount of savings depends on the price of diesel.
- There is future price uncertainty for both diesel and LNG.
- Specialized infrastructure and high energy input are needed for liquefaction and gasification.
- Does your community have the infrastructure needed to receive and store LNG?
- How will LNG integrate with any existing or planned renewables?
- Does your community have the human/technical capacity to run an LNG powerhouse?
- Are there any industrial users in or near your community that might benefit from natural gas-generated power?
Some Takeaways

- Economies of scale matter.
  - Project will aggregate larger loads to start
  - Economics for smaller loads may work, but larger-project optimization must occur first
  - Challenges face ice-bound communities unless loads are comparatively large

- Reasonable to expect:
  - Unalaska/Dutch – Dillingham – Naknek bulk (non-ISO) project
    - ISOs for proximal communities may follow
  - SE ISO project with PCE utility needs met by ISOs, but anchored by industrial tenant(s)
    - ISOs for proximal communities may follow
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