# Cook Inlet Energy Supply Alternatives Study

By: Dunmire Consulting
For: Alaska Natural Gas Development Authority
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# Agenda

- Why CI Energy Alternatives Study
- Study Results
- Study Conclusions

# Dunmire Consulting Team

- Carolyn Dunmire
  - 20 years energy industry experience
  - Lake and Peninsula Borough Study
- Integral North America
  - Charlie Sassara and Shawn O'Fallon
  - Survey and stakeholder analysis
- Cronshaw Consulting
  - Mark Cronshaw
  - Pipeline alternatives and financial analysis

# Cook Inlet Energy Alternatives Study Objectives

- Identify and quantify major energy sources in Cook Inlet
- Identify energy alternatives
  - Estimate on-line date
  - Quantify future costs
- Compare alternatives

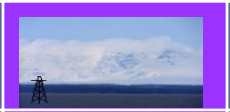
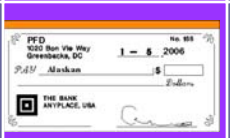
# Supply Alternatives
## Increase gas supply to Cook Inlet

| Alternative | Description |
|---|---|
| Increase Production | Enhance existing gas production and develop new production in Cook Inlet. |
| Spur Line | Deliver North Slope gas to Cook Inlet with Spur Line from a main gas line. |
| Bullet Line | Deliver North Slope gas to Cook Inlet with Bullet Line. |
| Enriched Gas Line | Deliver North Slope gas to Cook Inlet with methane carrier for liquids line. |
| CBM | Develop Coal Bed Methane in Susitna Basin. |
| Import LNG | Import Liquefied Natural Gas from outside to existing Kenai LNG facility. |
| Other Alaska Gas | Develop and deliver gas from Copper River, Bristol Bay or Nenana Basins. |
| Coal Gasification | Implement coal gasification such as Agrium's Blue Sky Project. |

# Demand Alternatives
## Reduce consumption or substitute for natural gas

| | |
|---|---|
| Coal Power | Replace gas-fired electric generation with coal-fired power (Emma Creek) |
| Hydro Power | Replace gas-fired electric generation with small-scale hydro power. |
| Wind Power | Replace gas-fired electric generation with wind power (Fire Island Project). |
| Nuclear Power | Replace gas-fired electric generation with small-scale nuclear power. |
| Tidal Power | Replace gas-fired electric generation with tidal power (Knik Arm Project) |
| Gas Conservation | Implement end-use gas conservation programs (weatherization, efficiency) |
| Electric Conservation | Implement end-use conservation programs (appliance & light bulb upgrade) |
| Distributed Generation | Implement small-scale electric generation at point-of-use to displace central gas-fired electric generation. |
| Geothermal Power | Replace gas-fired electric generation with geothermal generation (Chena HS) |

# Evaluation Process

| Evaluation Criterion | Icon | Characteristics |
|---|---|---|
| Energy Service |  | Amount of energy service provided by the alternative reported in billon cubic feet of natural gas per year. Highest ranked alternatives provide level of energy service equivalent or greater than Cook Inlet's gas demand. |
| Prerequisites for Success |  | What must happen before the alternative can produce energy. Highest ranked alternatives have lowest hurdle to clear. |
| Start-up Date | 5 years | Years from present that the alternative starts to deliver energy service. Highest ranked alternatives start immediately. |
| Investment | $ | Total capital investment needed by an alternative to deliver energy service. Top alternatives need lowest investment. |
| Monthly Bill | % | Effect that the alternative will have on residential monthly gas and electric bills. Highest ranked alternatives can lower bills. |
| Uncertainty |  | Uncertainty associated with level of energy service, start-up date, investment, or operation for the alternative. Highest ranked alternatives have lowest levels of uncertainty. |
| Environmental |  | Unmitigated environmental impacts associated with the alternative. Highest ranked alternatives have fewest impacts. |
| Alaskan Citizens |  | Potential impacts of the alternative on Alaskan citizens such as increased employment, economic activity, and permanent fund. Highest ranked alternatives have potential for positive impacts. |

# Energy Service

| Rank | Alternative | Bcf/year | Energy Service |
|---|---|---|---|
| | Enriched Gas Line | 360 | Additional 16.5 million barrels of liquefied petroleum gas LPG |
| | Bullet Line | 360 | Pipeline capacity 1 Bcf per day. |
| | Spur Line | 145-220 | Depends on pipeline capacity (400-600 million cubic feet/day) |
| | Increase Production | 100-200 | Develop 1.4 trillion cubic feet (Tcf) of gas in Cook Inlet. |
| | CBM | 100-200 | Develop 1 Tcf of CBM. |
| | Other Alaska Gas | 50-100 | Bristol Bay may hold 7 Tcf of gas. Nenana Basin 3-10 Tcf. |
| | Coal Gasification | 40-65 | 40 Bcf as feedstock. 25 Bcf for 350 MW electric generation. |
| | Import LNG | 40-120 | Imported LNG to be used to meet peak winter demand. |
| | Coal Power | 10-15 | 200 mega-watts (MW) of electric generation. |
| | Gas Conservation | 2.5-5 | Reduce expected growth in home and business gas demand. |
| | Wind Power | 2.5-5 | 50-100 MW of wind generation at Fire Island. |
| | Electric Conservation | 0.5-2.5 | Reduce expected growth in electric demand. |
| | Nuclear Power | 0.5-2.5 | 10-50 MW of nuclear generation at Galena. |
| | Hydro Power | 0.5-2.5 | 10-50 MW of small-scale run-of-river hydro projects. |
| | Geothermal Power | 0.25 -5.0 | 200 kW to 100 MW (Chena Hot Springs or Mt. Spurr) |
| | Distributed Generation | 0.25-0.50 | 10 MW of distributed generation (<1 MW per project). |
| | Tidal Power | 0.25-1.0 | 0.5-20 MW tidal power (17 MW potential in Knik Arm) |

# Prerequisites for Success

| Rank | Alternative | Prerequisites |
|---|---|---|
|  | Gas Conservation | Increase residential and commercial gas rates to promote efficiency. |
| | Increase Production | Higher contract prices for Cook Inlet gas to promote exploration. |
| | Electric Conservation | Increase rates. Implement efficiency and education programs. |
| | Distributed Generation | Affordable & reliable fuel cell projects using non-gas hydrogen source. |
|  | Hydro Power | Access to sufficient electric load and infrastructure. |
| | Wind Power | Successful large scale wind power project in Alaska. |
| | Coal Power | Successful demonstration of clean coal technology using Alaskan coal |
| | Geothermal Power | Geothermal resource located near load or grid-intertie. |
| | Bullet Line | Increased industrial gas demand to 0.5 Bcf per day in Cook Inlet to support project. |
| | Coal Gasification | Successful demonstration of gasification technology with Alaskan coals. |
| | Enriched Gas Line | Increased industrial gas demand to 0.5 Bcf per day in Cook Inlet to support project. |
|  | Spur Line | Construction of main line from North Slope to Spur take-off point. |
| | CBM | Discover and implement commercial production in Susitna Basin. |
| | Other Alaska Gas | Discover and implement commercial gas production in other Basins. |
| | Import LNG | Access to imported LNG affordable to Cook Inlet consumers. |
| | Nuclear Power | Successful implementation of small scale nuclear technology and licensing. |
| | Tidal Power | Successful implementation of commercial-scale projects. |

# Start-up Date

| Rank | Alternative | Start-up Date |
|---|---|---|
| 0-1 year | Gas Conservation | 2006 – Presently occurring because of rate increases. |
| | Increase Production | 2006 – Presently occurring because of higher contract prices. |
| 2–5 years | Electric Conservation | 2007 – Implement conservation programs. |
| | CBM | 2008 - Leasing and community standards complete. |
| | Geothermal | 2009 – Chena Hot Springs demonstration operating, Mt. Spurr evaluation. |
| | Distributed Generation | 2010 - Demonstration projects have been successful. |
| | Wind Power | 2011 - Preliminary permitting and feasibility completed for Fire Island. |
| | Import LNG | 2011– Depends on retrofit starting in 2009. |
| | Coal Gasification | 2011 – Reported start-up date for Agrium Blue Sky project. |
| 6–10 years | Enriched Gas Line | 2012 |
| | Bullet Line | 2012-2016 |
| | Spur Line | 2012 – Depends on completion of main line to Spur take-off. |
| | Other Alaska Gas | 2012 – Bristol Bay leases sold in 2005. |
| | Hydro Power | 2012-2020 Long lead time to complete licensing, raise capital. |
| | Coal Power | 2008 - Healy Clean Coal Plant restart possible in 18 months.<br>2014 - Emma Creek project operational. |
| | Nuclear Power | 2012 - Proposed start-up date for Galena project. |
| | Tidal Power | 2015 – Demonstration project under construction. |

# Capital Investment

| Rank | Alternative | Level of Investment |
|---|---|---|
| $ <$100 million | Hydro Power | $10 - $100 million ($1 to $2 million per MW) |
| | Distributed Generation | $25 - $50 million ($5 million per MW) |
| $$ 100 – 500 million | Tidal Power | $10 - $100 million ($2 million per MW) |
| | Gas Conservation | $25 - $100 million |
| | Geothermal Power | $25 - $100 million ($10 million per MW for low temp.) |
| | Import LNG | $70 - $200 million |
| | Electric Conservation | $50 - $100 million |
| | Nuclear Power | $75 - $150 million |
| | Wind Power | $100 - $200 million |
| | Coal Gasification | $100 - $500 million |
| $$$ >500 million | Spur Line | $300 - $500 million<br>$700 - $900 million if main line follows Highway Route. |
| | Coal Power | $400 - $500 million |
| | Increase Production | $500 million |
| | Bullet Line | $3 - $4 billion |
| | Enriched Gas Line | $4 billion with 2 LPG tankers |
| | CBM | $1- $5 billion |
| | Other Alaska Gas | $1- $5 billion |

# Monthly Bill

| Rank | Alternative | Production Costs and Issues |
|---|---|---|
| Savings | Gas Conservation | Can reduce total monthly bill. |
| | Electric Conservation | Can reduce total monthly bill. |
| +0-50% | Coal Power | 5-10 cents per kilo-watt hour (kWh). |
| | Geothermal Power | 5-7 cents per kWh (for low temperature projects). |
| | Tidal Power | 6 - 9 cents per kWh. |
| | Wind Power | 7-12 cents per kWh. |
| | Hydro Power | 7-15 cents per kWh. |
| | Spur Line | Gas rates to Cook Inlet would be bounded by Lower 48 prices. |
| | Distributed Power | 5 -15 cents per kWh for fuel cells. Lower costs if heat can be used. |
| | Coal Gasification | Production costs uncertain with Alaskan coals. Power as by-product. |
| | Enriched Gas Line | Gas transport costs subsidized by income from LPG exports. |
| | Nuclear Power | 10-20 cents per kWh depending on value of by-products (hydrogen) |
| | Bullet Line | Cook Inlet consumers could pay substantial share of pipeline cost. |
| +50 - 100% | Increase Production | Higher gas prices needed to encourage investment in development. |
| | CBM | Higher gas prices needed to encourage investment in development |
| | Other Alaska Gas | Higher gas prices needed to encourage investment in exploration. |
| | Import LNG | Depends on world market prices of LNG, transport, & operating costs. |

# Uncertainty

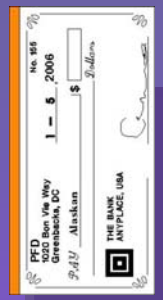
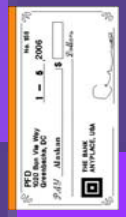
| Rank | Alternative | Types of Uncertainties |
|---|---|---|
|  | Gas Conservation | Persistence, level, and cost-effectiveness of energy savings. |
| | Electric Conservation | Persistence, level, and cost-effectiveness of energy savings. |
|  | Hydro Power | Cost and availability of electric power. |
| | Coal Power | Operation of clean coal technology with Alaska coals. |
| | Wind Power | Availability and level of energy service. |
| | Geothermal Power | Low temp system operation, lifetime of geothermal resource. |
| | Bullet Line | Cost over-runs and delays are possible. |
| | Enriched Gas Line | Cost over-runs and delays are possible. Dense phase technology. |
| | Distributed Power | Operating cost, availability, and efficiency of fuel cells. |
| | Spur Line | Route, completion, cost of main line carrying North Slope gas |
| | Coal Gasification | Efficiency of coal gasification process with Alaskan coals. Transport and cost of coal. Value of gasification products. |
|  | Nuclear Power | Reliability and affordability of small-scale nuclear reactor. |
| | Tidal Power | Availability, cost, and level of energy service in Alaskan waters. |
| | Import LNG | Availability and cost of imported LNG. |
| | Increase Production | Amount of economically recoverable gas in Cook Inlet. |
| | CBM | Amount of economically recoverable gas in Cook Inlet. |
| | Other Alaska Gas | Amount of economically recoverable gas in Bristol Bay, Copper River, and Nenana Basins. |

# Unmitigated Environmental Impacts

| Rank | Alternative | Potential Unmitigated Impacts |
|---|---|---|
|  | **Gas Conservation** | Net positive environmental impacts. More efficient fuel use. |
| | **Electric Conservation** | Net positive environmental impacts. |
| | **Distributed Power** | Net positive. No transmission impacts. |
| | **Spur Line** | Risk of accident. Increased access and travel opportunities provided by right-of-way (ROW) (positive/negative impact) |
| | **Bullet Line** | Risk of accident. Increased access provided by ROW. |
|  | **Enriched Gas Line** | Risk of accident. Increased access provided by ROW. |
| | **Geothermal Power** | Water quality and water consumption (cooling water source). |
| | **Wind Power** | Noise. View shed impacts. |
| | **Import LNG** | Risk of leaks/spills. Facility emissions, noise, odor. |
| | **Nuclear Power** | Risk of accident. Long term land use. Nuclear waste. |
| | **Hydro Power** | Aquatic and surface/site impacts. |
| | **Tidal Power** | Aquatic impacts. Naval traffic constraints. |
| | **Increase Production** | Land use. View shed. Wildlife. Waste water into Cook Inlet. Risk of spills/accidents. Remediation of offshore platforms. |
|  | **Other Alaska Gas** | Loss of undeveloped land. Wildlife. Risk of spills/accidents. |
| | **Coal Gasification** | Ash disposal. Facility emissions. Impacts from coal mining. |
| | **Coal Power** | Ash disposal, cooling water requirements, increased greenhouse gas emissions. Impacts from coal mining. |
| | **CBM** | Produced water disposal. Industrial landscape. Noise. |

# Positive or negative?

# Alaskan Citizens

| Rank | Alternative | Potential Impacts |
|---|---|---|
|  | Spur Line | New jobs, increased State revenues from North Slope gas development. |
| | Enriched Gas Line | New jobs, increased State revenues. |
| | Bullet Line | New jobs, increased State revenues. |
| | Increase Production | New jobs. Increased State revenues. |
| | CBM | New jobs. Increased State revenues. |
| | Other Alaska Gas | New jobs. Increased State revenues. |
| | Coal Gasification | New jobs. Retention of industrial operations and jobs. |
|  | Coal Power | New jobs. Energy security by using indigenous energy resource. |
| | Distributed Power | New job opportunities/industries in remote locations.<br>Imported generation technology (negative impact). |
| | Hydro Power | Energy security with indigenous renewable energy resources. |
| | Gas Conservation | Money saved on energy bills stays in the economy. |
| | Electric Conservation | Money saved on energy bills stays in the economy. Imported technology. |
| | Wind Power | Renewable energy resource/energy security. Imported technology. |
| | Geothermal Power | Renewable energy resource/energy security. Imported technology. |
| | Tidal Power | Renewable energy resource/energy security. Imported technology. |
|  | Nuclear Power | Imported generation technology (negative impact). |
| | Import LNG | Imported fuel. Large negative impact on economy. |

# Top Alternatives

- Near term: Gas Conservation and Increased Production in Cook Inlet would prolong gas supplies and buy time to select long term option and raise funds.
- Intermediate term: Coal Gasification could keep industrial facilities operating and provide electric power. Depends on process feasibility with Alaskan coals.

# Top Alternatives

- Long Term: Enriched Gas Line may be better investment than Bullet Line.
- Coal, Wind, and Hydro deserve equal consideration.
- Geothermal and Tidal merit further research.
- Spur Line tops the list if pipeline carrying North Slope gas is built through Alaska.

# Cook Inlet's Energy Future?

Unisea Inc. used over 1 million gallons of 50:50 fish oil-diesel blends at its Unalaska powerhouse in 2003.

# Contact Information

- Cook Inlet Energy Supply Alternatives Study available at: http://www.angda.state.ak.us/

- Dunmire Consulting

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