KODIAK

REGIONAL ENERGY PLAN

Volume I: Resource Inventory and Priorities

Prepared for the Alaska Energy Authority

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Acronyms

AC	Alternating Current
ACDC	Alaska Community Development Corporation
ACEP	Alaska Center for Energy and Power
ADOLWD	Alaska Deparment of Labor and Workforce Development
AEERLP	Alaska Energy Efficiency Revolving Loan Fund Program
ARIS	Alaska Retrofit Information System (ARIS)
AEA	Alaska Energy Authority
AHFC	Alaska Housing Finance Corporation
AIDEA	Alaska Industrial Development and Export Authority
ALARI	Alaska Local and Regional Information
ANTHC	Alaska Native Tribal Health Consortium
ASHP	Air Source Heat Pump
AVTEC	Alaska's Institute of Technology – ADOLWD Program
B/C	Benefit-cost ratio
BEES	Alaska Building Energy Efficiency Standard
BFU	Bulk Fuel Upgrade
BTU	British Thermal Unit
CBEA	Commercial Building Energy Audit
CCHRC	Cold Climate Housing Research Center
CHP	Combined Heat and Power
COP	Coefficient of Performance
DCCED	Alaska Department of Commerce, Community, and Economic Development
EDA	United States Economic Development Administration
EECBG	Energy Efficiency and Conservation Block Grant Program
EETF	Emerging Energy Technology Fund
EIS	Environmental Impact Statement
ESCO	Energy Savings Company
ESPC	Energy Savings Performance Contracting
FERC	Federal Energy Regulatory Commission
GSHP	Ground Source Heat Pump

ISER	Institute of Social and Economic Research – University of Alaska
HER	AHFC's Home Energy Rebate program
HVDC	High-Voltage Direct Current
KANA	Kodiak Area Native Association
KEA	Kodiak Electric Association
KIB	Kodiak Island Borough
KIBSD	Kodiak Island Borough School District
kW	Kilowatt
kWh	Kilowatt hour
kV	Kilovolt
LED	Light-Emitting Diode
LNG	Liquified Natural Gas
MMBTU	One million BTUs
MW	Megawatt
MWh	Megawatt hour
NA	Not Applicable
NAHASDA	Native American Housing Assistance and Self Determination Act of 1996
O&M	Operations and maintenance
PCE	Power Cost Equalization
PV	Photovoltaic Solar System
RAFS	Rural Alaska Fuel Services
REAL	Retrofit Energy Assessment for Loan Program (AHFC)
REF	Renewable Energy Fund (AEA grant program)
RPSU	Rural Power System Upgrade (AEA program)
SCADA	Supervisory Control and Data Acquisition
SWATP	Southwest Alaska Transportation Plan
UA	University of Alaska
UAA / UAF	University of Alaska Anchorage / University of Alaska Fairbanks
ULSD	Ultra Low Sulfur Diesel
USACE	United States Army Corps of Engineers
USCG	United States Coast Guard
VEEP	Village Energy Efficiency Program
Wx	Weatherization

EXECUTIVE SUMMARY

The Kodiak Regional Energy Plan is part of a statewide effort led by the Alaska Energy Authority to identify energy projects that will reduce the long-term cost of power and dependence on fossil fuels in Alaska. The process looks at the total mix of energy needs in the Kodiak region, including electricity, heating and transportation, and considers all local and regional energy resources, including efficiency and conservation.

Phase I with the resource inventory and community profiles was the first step in the planning process. Phase II involved dialog with community and regional leaders, residents, utilities, industry representatives, and other key stakeholders about their priorities for addressing energy needs in the region. The Phase I Resource Inventory and Community Profiles were used as tools during Phase II to focus conversations on the most technically feasible and economically realistic projects given the region's mix of energy resources and the current state of technology.

The data included in these volumes represent a snapshot in time and some will be out of date. Corrections collected during Phase II have been included. A full list of corrections and updates are in Appendix C. Though factual inaccuracies have been addressed, data has not been updated to reflect information released since August 2014.

ENERGY SUPPLY AND DEMAND

Current Energy Use

The total amount of electricity generated in the Kodiak region was just over 157,000 MWh in FY2013, 94% from renewable energy (77% hydropower, 17% wind energy). Diesel accounted for the remaining 6%, consuming 615,000 gallons of fuel. Looking only at rural communities not on the Kodiak Electric Association (KEA) grid, diesel generation accounted for two-thirds of electricity produced and hydropower one-third. Total installed capacity for electric generation in the region was 63.1 MW in 2010 (1).

It is more difficult to estimate heating and transportation energy use. Residential heating (including space heating and domestic hot water) is estimated at over 460,000 MMBTU region wide, requiring 3.3 million gallons if all homes heated only with fuel oil. Without an inventory of public and commercial buildings, no estimate can be made for non-residential heating.

A conservative estimate of transportation fuel use is 700,000 gallons (350 gallons per household or 120 gallons per person) based on data in the 2010 Alaska Energy Pathway report. Bulk fuel purchase data in Kodiak and other regions suggests that actual energy used for aviation, marine, on-road and off-road transportation is likely to be substantially higher.

Forecast

Energy planners should conservatively assume a modest load growth due to projected population growth at the borough level and a continued trend in increasing household energy use due to changes in consumer habits. This could be offset by energy efficiency and conservation measures if public outreach and regional EE&C coordination are adopted as energy strategies. A survey of industrial energy users about business plans and forecasts was conducted in Phase II of the energy planning process, but a low response rate prevented use of specific company data to predict load changes. This report assumes a modest load growth projection.

GOALS

Setting energy goals is an ongoing and iterative process. Community and regional leaders worked together to define energy goals and strategies as part of the 2009 Kodiak Island Borough Regional Energy Plan. Many of these goals were reaffirmed in April 2014 during a regional energy planning session at the Kodiak Archipelago Rural Regional Leadership Forum. These are summarized in the *Stakeholder Outreach* section in Table 42. Phase II of this project included additional stakeholder outreach, including community meetings, industry survey, and a region wide Energy Summit, with the goal of developing common energy goals and strategies with widespread support. The prioritized strategies identified in Phase II are outlined in *Stakeholder Outreach* section

ISSUES AND OPPORTUNITIES

Regional Energy Issues

For planning purposes the Kodiak region is often divided in two: the more urban communities on the road system in northeast Kodiak Island and the five small rural communities not connected to Kodiak or each other by road. In between is the village of Port Lions, which is connected to the Kodiak grid by intertie but not by road. The challenges faced by the two areas are similar, varying mostly in degree, and they are similar to issues faced elsewhere in rural Alaska and in the state as a whole:

- High and volatile fuel prices, even in regional hub cities like Kodiak
- Dependence on expensive fuel oil for space heating
- Aging and inefficient housing stock contributing to high heating costs
- Rough terrain that increases the cost and technical challenge of building roads and energy infrastructure
- Majority of rural communities served by "islanded micro-grids" making it difficult to create economies of scale or a truly "regional" energy plan
- Declining population trends in many communities
- Technical challenges in integrating variable resources like wind with small diesel loads
- Logistical challenges in delivering supplies and equipment to remote project locations
- The absence of deepwater docks and protected moorage in several communities

- Patchwork of land ownership—federal, state, tribal and Alaska Native Corporation lands—creating permitting challenges and uncertainty for project developers
- Small percentage of land in private ownership which limits economic growth
- Heat recovery systems largely missing from the region's diesel power plants
- Other diesel infrastructure in fair or poor condition
- Uncertainty about the future availability of natural gas

Regional Recommendations

Specific opportunities for the communities on the Kodiak road system and individual rural communities are included in *Community Profiles*. Regional opportunities identified in Phase I have been organized into 12 strategies:

STRATEGY #1: ENDORSE DEVELOPMENT OF COMMUNITY- SUPPORTED RENEWABLE ENERGY PROJECTS

Prioritize development of renewable energy projects that have strong public support and have passed preliminary feasibility screens. Increase the potential for state or federal funding by actively supporting community projects at the regional level, prioritizing energy projects in regional economic development and comprehensive plans and on capital projects priority lists.

STRATEGY #2: DO WHOLE VILLAGE RETROFITS OF 100% DIESEL-DEPENDENT COMMUNITIES

Undertake whole village energy retrofits for the region's smallest communities, especially those that lack near-term renewable energy solutions. Where energy is most expensive, it makes the most sense to maximize efficiency.

STRATEGY #3: BUILD CONSENSUS THROUGH COMMUNITY VISIONING

Conduct community-level strategic planning in communities that have yet to identify an energy project or strategy with widespread community support. Assistance with community planning and visioning is available from AEA program staff, the DOE Office of Indian Energy START Alaska Program (for tribal entities), UAF's Community Partnerships for Self-Reliance and Sustainability, among others.

STRATEGY #4: STUDY FEASIBILITY OF RENEWABLE RESOURCES COMMUNITIES ARE INTERESTED IN

Pursue reconnaissance or feasibility studies of renewable resources that have yet to be assessed but which communities have expressed interest in, such as wind studies in Akhiok and Karluk and biomass feasibility in Kodiak or Afognak.

STRATEGY #5: SUPPORT RURAL COMMUNITIES IN WRITING SUCCESSFUL GRANT AND LOAN APPLICATIONS

Provide technical support at the regional level, including grant writing assistance and assistance with loan applications, for rural communities in order to increase successful applications to the Renewable Energy Fund (REF) and other energy programs. Kodiak is a resource rich area which could be expected to produce a greater yield of successful project applications than regions with fewer renewable energy options. To date, successful REF applications from the region have been submitted by KEA and AVEC, both entities with substantial organizational leadership and capacity. In some regions, such as Lake & Peninsula and Northwest Arctic Boroughs, borough governments help bridge the capacity gap by taking an active role in rural energy project development and financing resulting in a large number of funded projects.

STRATEGY: #6: REPAIR AND MAINTAIN CURRENT INFRASTRUCTURE

Repair and maintain current energy infrastructure to ensure it operates efficiently and with minimal environmental risks. Pursue advanced operator training to improve maintenance planning and performance. Rural utilities can work with the program managers at AEA to design and prioritize system upgrades to diesel powerhouses, hydro power plants and bulk fuel upgrades. Funders want to see that diesel systems are well maintained and operating efficiently before funding new renewable generation projects.

STRATEGY #7: MAXIMIZE DIESEL EFFICIENCY AND HEAT RECOVERY

Maximize diesel efficiency and heat recovery throughout the region. The cheapest kilowatt or gallon of fuel is the one you don't have to buy. By cutting down on the amount of fuel oil needed to meet a community's electrical needs, improvements to diesel efficiency lead directly to lower electrical costs. Increasing diesel efficiency by 10% regionwide would save 60,000 gallons of fuel annually that do not need to be purchased, shipped or stored. Savings to utilities would total $215,000 per year. Heat recovery can lower community heating costs by reducing the fuel used to heat public buildings near the power plant. This is a resource that is essentially untapped in the region and which offers a potential revenue stream to local utilities.

STRATEGY #8: ENCOURAGE EE&C OF HOMES AND BUSINESSES

Encourage energy efficiency and conservation (EE&C) of homes and businesses through a mixture of active public outreach, education and technical assistance, and smart meter technologies. Maximizing residential energy efficiency regionwide would save over $2 million annually at current fuel prices. Businesses use anywhere from 22 to 72 percent of the electricity produced by community utilities. Encourage local business owners to apply for existing audit and revolving loan programs to fund commercial audits and finance recommended building improvements.

STRATEGY #9: MAXIMIZE ENERGY EFFICIENCY OF PUBLIC INFRASTRUCTURE

Maximize energy efficiency of public facilities by taking advantage of AHFC public facility audits and investing in the most cost-effective recommendations. Conduct an inventory of public outdoor lighting throughout the region and apply for a single grant to replace all conventional lights with LED lighting in rural communities. Cost savings should be available in procurement, logistics and installation by doing the retrofits as one project. Work with ANTHC to identify funding options for completing audits of rural sanitation systems.

STRATEGY #10: ADDRESS MARINE INFRASTRUCTURE NEEDS

Study the feasibility of dock and harbor projects to improve barge access for fuel delivery to Akhiok, Karluk and Larsen Bay. Update previous cost estimates if available and prioritize economically and technically feasible projects in regional transportation plans.

STRATEGY #11: ADDRESS RURAL UTILITY ISSUES AND NEEDS THROUGH COLLABORATION

Consider forming a Regional Electric Utility Association or informal regional energy steering committee to address common interests and needs, share information, and engage in ongoing planning. Services could include: Coordinating training needs, providing backup or substitute operators, remote monitoring using SCADA to improve diesel efficiency, collective bulk fuel bidding, quarterly or semi-annual forum for discussion of common issues and solutions.

STRATEGY #12: MONITOR EMERGING ENERGY TECHNOLOGIES

Monitor ongoing demonstration projects and other developments in emerging energy technologies that hold promise for the region, including tidal and wave power, low-power HVDC transmission, flywheel energy storage, and seawater heat pumps, as well as improvements in wind-diesel integration for small loads and wind to heat applications.

Data Gaps

Data gaps are identified throughout the resource inventory and community profiles. The most significant are in areas needed to assess total energy use in the region. While data is abundant on the electricity side, not enough is known to estimate non-residential heating or transportation energy demand on either a community or regional basis.

Energy end use models for different climate zones and regions cannot be applied with good results without a building inventory for the region, including building type and size. An inventory that includes preliminary benchmark data on energy use would provide a strong foundation for developing a regional EE&C strategy or "roadmap" to guide public investment, as well as a baseline for evaluating results.

Fuel price data that includes the date fuel was delivered to the community would materially improve future price forecasts for rural Alaska and result in more accurate project evaluation. This will become more important when priority projects are evaluated for economic and technical feasibility in Phase III. Fuel price and project modeling are explained in detail in the "Economic Modeling & Methodologies" appendix to the *Bristol Bay Regional Energy Plan Phase I* report.

Given the technical challenges of integrating renewable technologies into diesel-powered micro-grids, an analysis of small-scale wind and solar projects already installed in rural Alaska would help utilities and energy planners identify the most successful approaches.

More information on projects currently using excess electrical generation for space and hot water heating in rural Alaska would improve benefit-cost modeling for renewable generation projects with excess capacity. In lieu of performance and cost data on specific technologies, a set of standard assumptions from AEA on modeling for thermal load conversion would be useful.

Factors for Success

Energy planning and project development is a slow and iterative process. It requires clear-eyed vetting in which risks are analyzed as well as benefits. The following lessons learned about developing successful energy projects come from regional energy planners and project developers at the 2013 Alaska Rural Energy Conference:

TO BE SUCCESSFUL...

Energy projects must be

- Economically viable
- Technologically feasible
- Supported by the local community, resource owners, utility operators, and state and local governing entities

Energy projects must have

- A local champion
- Long-term, reliable and sustainable fuel sources

Energy planners must have

- Hope and optimism
- Many conversations with stakeholders

REGIONAL ENERGY PRIORITIES

The goal of Phase II is the prioritization of regional energy strategies and the identification of a mechanism to implement community and regional energy priorities. The steps taken to identify regional energy priorities are laid out in this report. The establishment of a mechanism to implement regional and community energy priorities is still a work in progress. However, the program goals for this body, which are based on the prioritized regional energy strategies, are below.

PROGRAM GOAL #1 ENCOURAGE ENERGY EFFICIENCY AND CONSERVATION OF HOMES, BUSINESSES AND PRIVATE CAPITAL

PROGRAM GOAL #2 MAXIMIZE ENERGY EFFICIENCY OF COMMUNITY BUILDINGS AND INFRASTRUCTURE

PROGRAM GOAL #3 STRENGTHEN UTILITIES TO ENSURE MAINTENANCE OF CURRENT INFRASTRUCTURE, WITH A FOCUS ON MAXIMIZING DIESEL EFFICIENCY, HEAT AND ELECTRIC SUPPLY AND INCORPORATING NEW POWER

PROGRAM GOAL #4 INVESTIGATE AND DEVELOP LOCAL ENERGY GENERATION AND MONITORING EMERGING TECHNOLOGIES FOR BOTH SUPPLY AND EFFICIENCY

Introduction

The goal of the Kodiak Regional Energy Plan is to identify local, subregional and regional energy projects that reduce the long-term cost of power and dependence on fossil fuels. The final report will feature a prioritized list of projects the State can support and an action plan designed to capitalize on the programs and funding sources available. The process will look at the total mix of energy needs in the Kodiak region, including electricity, heating and transportation, and consider all local and regional energy resources, including efficiency and conservation.

The project is part of a statewide effort led by the Alaska Energy Authority that builds off work begun with the Alaska Energy Pathway series. The regional planning process for Kodiak has been organized in three phases: Phase I includes preliminary planning, resource inventory and data collection. Phase II will include drafting the plan based on community input and stakeholder engagement. Phase III involves the economic and technical analysis of projects identified in the first two phases for which there is significant local support.

While the report itself represents a snapshot in time of projects, resources and technologies with the potential to meet the region's energy needs, the plan that develops through community and regional engagement will continue to evolve.

> *Ultimately, this data collection effort is to determine what energy programs will be viable in the different communities, and what solutions communities would like for solving their energy needs. The most efficient, sustainable program will be the program most likely to gain support for funding.*
>
> *- Deborah Vo, AEA Regional Planners Meeting, June 2012*

Table 1: What Other Regions Are Planning

This partial list of recommendations from Phase I and II regional energy planning documents shows the diversity of approaches being considered in different regions to the energy opportunities and challenges that exist in Rural Alaska.

Aleutian & Pribilof Islands	▪ Diesel Efficiency & Heat Recovery ▪ Weatherization and Energy Efficiency ▪ Wind-diesel Integration ▪ Stakeholder Forum ▪ Maximize Economic Impact and Jobs
Copper River	▪ Transmission Study ▪ Develop In-region EE&C Approach ▪ Biomass & Natural Gas ▪ Wind & Solar Reconnaissance Studies
Interior	▪ Efficiency First! EE Standards for New Construction ▪ 100% Power Plant Operator Training Goal ▪ Biomass Assessments & Projects ▪ Greenhouse Pilot Project
Northwest Arctic	▪ Vision: 75% Decrease of Imported Fossil Fuels by 2030 ▪ Wind Projects ▪ Solar PV on all Water & Sewer Facilities ▪ Smart Meters in Every Home
Southeast	▪ Regional EE&C Program ▪ Reconnaissance Study and Standards for New Hydro Development ▪ Consider Heat Pumps and Biomass for Heating

Sources: (2) (3) (4) (5) (6). Note: In some cases these are preliminary recommendations by regional energy planners that have not yet been discussed, adopted or revised by stakeholders in the region.

1| Regional Overview

The Kodiak Island Archipelago lies 30 miles off the coast of Alaska on the western side of the Gulf of Alaska. The string of islands of which Kodiak Island is the largest stretches about 180 miles and covers 5,000 square miles.

Located at the northeast tip of Kodiak Island, the City of Kodiak is about 250 air miles south of Anchorage. The city is connected to surrounding communities (Chiniak, Womens Bay, Kodiak Station and the U.S. Coast Guard Kodiak Base) on the east side of Kodiak Island by 140 miles of state roads. Five other communities (Akhiok, Karluk, Larsen Bay, Old Harbor and Port Lions) are located on the island, while Ouzinkie is on the west coast of Spruce Island, just across Ouzinkie Narrows from Kodiak. Air and marine taxi are the only forms of transportation to these six villages.

For planning purposes the Kodiak region is often divided in two: the more urban communities on the road system, powered by the KEA grid and the five rural communities not connected to Kodiak or each other by road. These are powered by “micro-grids” each serving a single community. In the middle is the City of Port Lions, which is connected to the Kodiak grid by intertie but not by road. Unincorporated settlements not currently served by an electric utility are not addressed in this study.

Energy Issues

The challenges faced by the communities on the road system and by rural villages are similar, varying mostly in degree. They are similar to issues faced elsewhere in rural Alaska and in the state as a whole.

- Fuel oil prices have risen sharply in the past decade and continue to be volatile, challenging planning efforts and creating economic hardship in all communities, but especially those most dependent on fossil fuels for electric generation.
- Without access to natural gas or other inexpensive heating fuels, the region is largely dependent on fuel oil for space heating resulting in high heating costs for homes and businesses even in regional hub communities like Kodiak. Alaska’s cold climate and the region’s aging housing stock (built mostly in the 1970s and '80s) contribute to high costs.
- Logistical challenges in the delivery of supplies, personnel and equipment to remote project locations drive up construction and maintenance costs for energy projects, especially in communities without good barge access.
- The absence of deepwater docks and protected moorage in several communities increases freight costs, limiting competition for bulk fuel delivery and driving up energy costs.
- The region is characterized by steep mountainous terrain increasing the cost and technical challenge of building roads, transmission lines and other energy projects. The rough terrain

and large distances between communities has resulted in few interconnections and preponderance of "island systems" making it difficult to create a truly "regional" energy plan.

- Declining population trends in many communities of the region create uncertainty and make it challenging to project future energy demand.
- Small populations with no ability to share capacity among communities make it difficult to achieve economies of scale in energy systems. The small electrical loads of many communities create technical challenges for integrating variable resources like wind without complex control and energy storage systems. These costs challenge the economics of often already marginal projects.
- The patchwork of land ownership—including federal, state, tribal and Alaska Native Corporation lands—creates permitting challenges and uncertainty for would-be energy project developers. Only a small percentage of land in the region is in private ownership. This limits economic growth and potential commercial energy loads making it more difficult to achieve economies of scale in electrical generation and distribution.
- Heat recovery systems are largely missing from the region's diesel power plants. Some other diesel infrastructure is in fair or poor condition.
- Popular state and federally funded energy programs like the Renewable Energy Fund, Home Energy Rebate program, Village Energy Efficiency Program, and DOE START, have been little used by rural communities in the Kodiak region. Though the Kodiak region is small compared with other regions, the area is rich in resources so the small number of successful REF applications is somewhat surprising. To date, only three separate projects have received funding from the region.
- Uncertainty about the future availability of natural gas complicates long-term energy planning scenarios in the region as in the rest of the state.

Table 2: Renewable Energy Fund Projects in the Kodiak Region

REF Round	Project Title	Stage	Applicant
1	Old Harbor Hydroelectric	Feasibility	AVEC
0, 1	Pillar Mountain Wind Project	Construction	KEA
2	Terror Lake Unit 3 Hydroelectric Project	Feasibility	KEA
3	Terror Lake Unit 3 Hydroelectric Project	Final Design	KEA
4	Terror Lake Unit 3 Hydroelectric Project	Construction	KEA
4	Old Harbor Hydroelectric	Feasibility	AVEC
5	Pillar Mountain Wind Project	Construction	KEA

Source: **(7)** Notes: A number of projects in recent rounds have been recommended for funding by AEA but not funded by the state legislature due to funding limits and projects receiving a lower relative rank in AEA recommendations. These includes feasibility studies for wind in Karluk, a biomass project in Kodiak, and an intertie between Ouzinkie and Kodiak in Round 6, and final design for Old Harbor Hydro and a flywheel for the Kodiak Pier Crane in Round 7.

Economy

The City of Kodiak serves as the major supply and transportation hub for the archipelago's villages and communities and is the economic hub for the region's fishing and tourism industries. The Port of Kodiak, which is the largest in Alaska, has two boat harbors and three deep draft piers that accommodate ferries, cruise ships, container ships, military vessels and a variety of large commercial fishing vessels.

Employment in the Kodiak region is dominated by the fishing industry. In 2012, 36 percent of the jobs in the region were in seafood-related activities (8). All communities in the region practice subsistence fishing and with, the exception of Karluk, have a relatively high number of commercial fishing permit holders. The other major employer in the region is the U.S. Coast Guard with Kodiak Base having 1,000 active duty personnel and an additional 130 support jobs. Similar to other regions in Alaska, a large portion of total jobs are in local government (14 percent) and service industries, which include health care (9 percent) and retail sales (8 percent). A closer look at the communities off the Kodiak road system, shows most business licenses are in the service industry (food, gear, and fuel) and hospitality/tourism (lodges and charters) (9).

The 2013 unemployment rate in the Borough was 5.6 percent compared with 6.5 percent for the state as a whole. From 2008 to the present the annual unemployment rate in the borough has been below the state's unemployment rate (10).

Climate

The Kodiak region has a maritime climate with mild winters and cool summers. The normal temperature range in Kodiak is narrow: 25°F to 60°F. Precipitation is moderate. Strong storms are common from December to February.

Outdoor temperature has a strong effect on energy demands in a region. Heating degree days are a measure developed to relate daily temperatures to the fuel needed to heat buildings. A higher number of heating degree days means a larger difference between the outside temperature and a comfortable inside temperature (65°F), resulting in a higher demand for energy. Heating degree days are used to determine the climate zone of a region and to compare different locations.

Mean annual temperature and heating degree days for the Kodiak region are shown in Table 3. These are based on a 30-year period from 1981 to 2010. The cut off between climate zone 7 and 8 is 9,000 heating degree days, placing the Kodiak region on the margin. AHFC's Building Energy Efficiency Standard places Kodiak in climate zone 7. The sites listed in the table are on the northern and eastern edges of the Kodiak region. Given the strong maritime influence throughout the region, only minor variations in mean annual temperatures and heating degree days are found.

In Kodiak the heating degree days are just at or under 9,000. By comparison, the heating degree days in Anchorage are above 10,000 and in Barrow are over 19,000.

Table 3: Climate and Heating Degree Days for Kodiak Region

	Mean Annual Temp	Heating Degree Days (Base 65°F)	Climate Zone
Kodiak	41°F	8794	7
Kitoi Bay	41°F	8923	7
Ouzinkie	40°F	9068	7

Source: (11). Note: The Alaska Energy End Use study includes the Kodiak region in Climate Zone 6 (the same zone as Southeast Alaska) for the purposes of estimated building energy use because of the region's maritime climate.

DEMOGRAPHICS

An overview of demographics in the Kodiak Island Borough (KIB) is presented in Table 4. Demographics for individual communities are included in their community profile in Volume II of this report.

Table 4: Kodiak Island Borough Demographics

Population	13,592			
Gender	Female	47%	Male	53%
Race	White	55.3%	Alaska Native	13.2%
	Asian	19.6%	Two or more races	7.6%
Age	Under 18 years	28.6%	18 to 64 years	64.6%
	Over 65 years	6.7%	Median Age	32.5

Sources: (12) (13)

Population Trends

The borough's population has hovered between 13,000 and 14,000 for the past 10 years with an overall growth of 3 percent (10). By contrast, the school population in the Kodiak Island Borough School District (KIBSD) shows a 7 percent decline over roughly the same period. This decline, though not evident every year, is indicative of a trend seen throughout rural Alaska of families moving out of rural Alaska to the state's urban centers.

In 2013, the City of Kodiak accounted for 46 percent of the KIB population. Adding in other communities along the road system – Chiniak, Kodiak Station, Mill Bay, Monashka Bay, Womens Bay, and Woodland Acres – brings that figure closer to 95 percent of the region's population.

The trends for both general and school populations mask variations among individual communities. Looking at Table 5, which shows population change by community since the 2000 census, the most significant declines have been in villages of 100 to 250, while a few of the smallest communities—Akhiok and Karluk—have seen their populations increase significantly in recent years as families that had moved away earlier in the decade moved back (14). Many villages have taken active steps since the early 2000s to encourage economic development in order to stem or reverse population losses.

Figure 1: KIB Population, 2004-2013

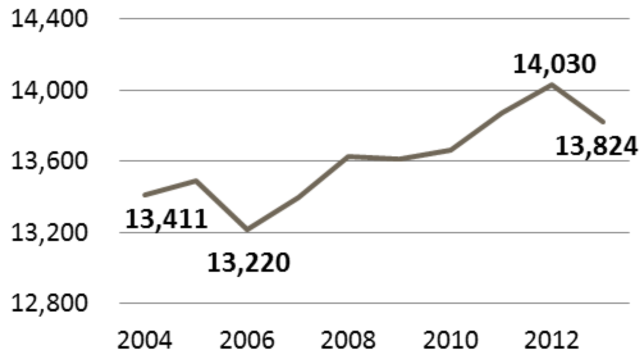


Figure 2: KIBSD Students (Pre-K to 12th), FY2005-2014

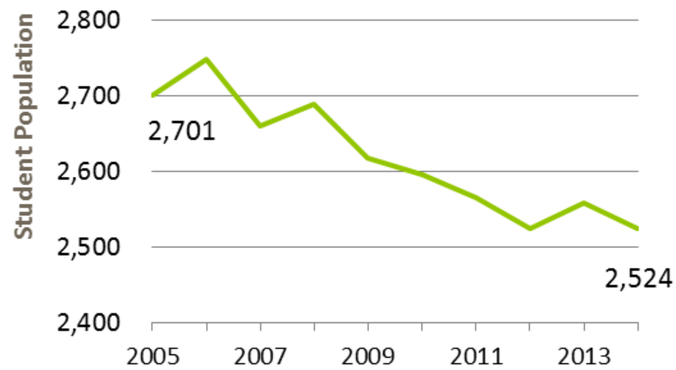


Table 5: Population Trends by Community, 2000-2013

Population		2000 Census	2013 Est.	Change Since 2000	Avg. Annual Growth
	Borough	**13,913**	**13,824**	-0.64%	-0.05%
	Roadbelt[1]	8,914	8,363	-6.18%	-0.44%
201 to 500					
	Old Harbor	237	225	-5.06%	-0.36%
100 to 200					
	Port Lions	256	188	-25.56%	-1.90%
	Ouzinkie	225	185	-17.78%	-1.27%
Under 100					
	Larsen Bay	115	88	-23.48%	-1.68%
	Akhiok	80	85	6.25%	0.45%
Under 50					
	Karluk CDP	27	43	59.26%	4.23%

Source: (15). **Notes**: 1/ Includes City of Kodiak, Kodiak Station, Womens Bay and Chiniak.

Capacity Building Opportunities for Small Communities

Small communities in rural Alaska face multiple challenges. For communities that wish to build local capacity to develop their renewable resources or develop a community vision of a sustainable future, there are several programs designed to help.

COMMUNITY PARTNERSHIPS FOR SELF-RELIANCE & SUSTAINABILITY

Community Partnerships for Self-Reliance and Sustainability (CPSS) is collaboration between the Alaska Native Science Commission (ANSC) and the University of Alaska to partner with selected rural communities to refine and implement their visions of self-reliance in the face of major challenges from rising fuel costs, climate warming, declining state and federal budgets and many social and cultural changes. CPSS creates liaison teams that match the needs of communities with the research expertise at the University of Alaska. Communities that participated in the first round of partnerships include Igiugig in the Bristol Bay region, Koyukuk and Nikolai in the Interior, and Newtok in Western Alaska. Contact Dr. Todd Brinkman at UAF for more information.

DOE OFFICE OF INDIAN ENERGY

The Department of Energy's Office of Indian Energy (DOE-OIE) offers several programs to assist tribes and Alaska Native organizations in building capacity to develop energy resources on their lands.

The START Alaska program provides community-based strategic planning and technical assistance for the purposes of developing clean energy projects, including energy storage and energy efficiency projects. The START program offers hands-on technical support with clean energy project development and financing. It pairs tribal leaders with experts at DOE, NREL, and others who have experience relevant to the tribe's project development stage and technology. There is a competitive application process with successful applicants chosen yearly.

A total of 10 communities have received START Alaska grants in 2012 and 2013, including four communities in the Interior (Minto, Koyukuk, Arctic Village and Venetie), two in Western Alaska (Shishmaref, Teller) two in Southeast (Kake, Yakutat) and two in the Yukon-Kuskokwim Delta (Quinhagak, Kongiganak). To date, no Kodiak area tribes or Native corporations have participated. More information: http://energy.gov/indianenergy/resources/start-program

In addition to the START program, DOE-OIE offers other grant programs:

- **EERE Tribal Energy Program: P**romotes tribal energy sufficiency and spurs increased deployment of clean energy and energy efficiency on Indian lands by soliciting applications from Indian Tribes, Tribal Energy Resource Development Organizations, and Tribal Consortia to: (1) install clean energy and energy efficiency retrofit projects for tribal buildings; and (2) deploy clean energy systems on a community scale.

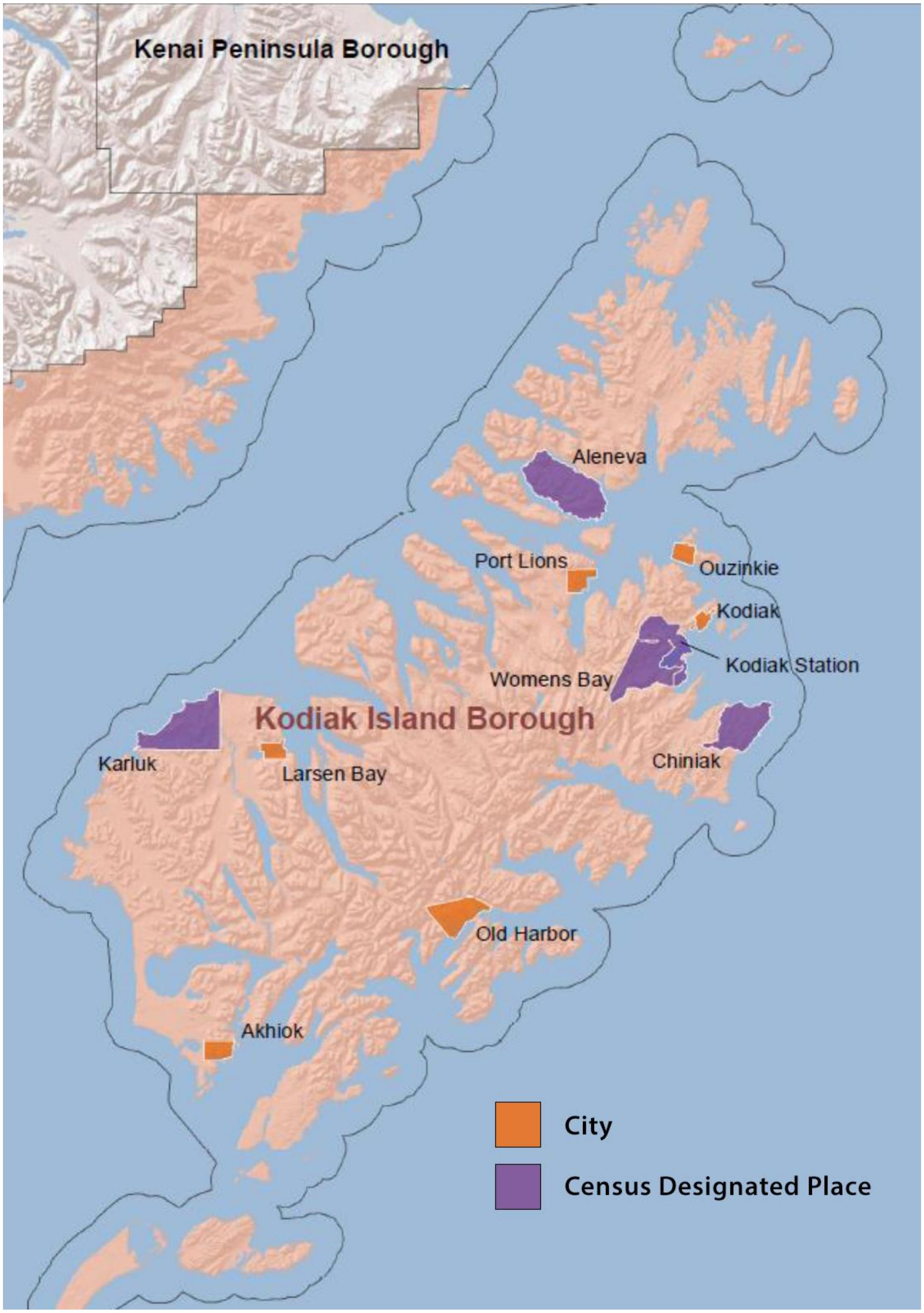
For more information on these programs and others offered through the Tribal Energy Program, visit: http://apps1.eere.energy.gov/tribalenergy/financial_opportunities.cfm

DOI OFFICE OF INDIAN ENERGY AND ECONOMIC DEVELOPMENT

The Department of Interior's (DOI) Office of Indian Energy and Economic Development also offers grant programs aimed at promoting economic self-sufficiency of Indian communities through the development of energy resources.

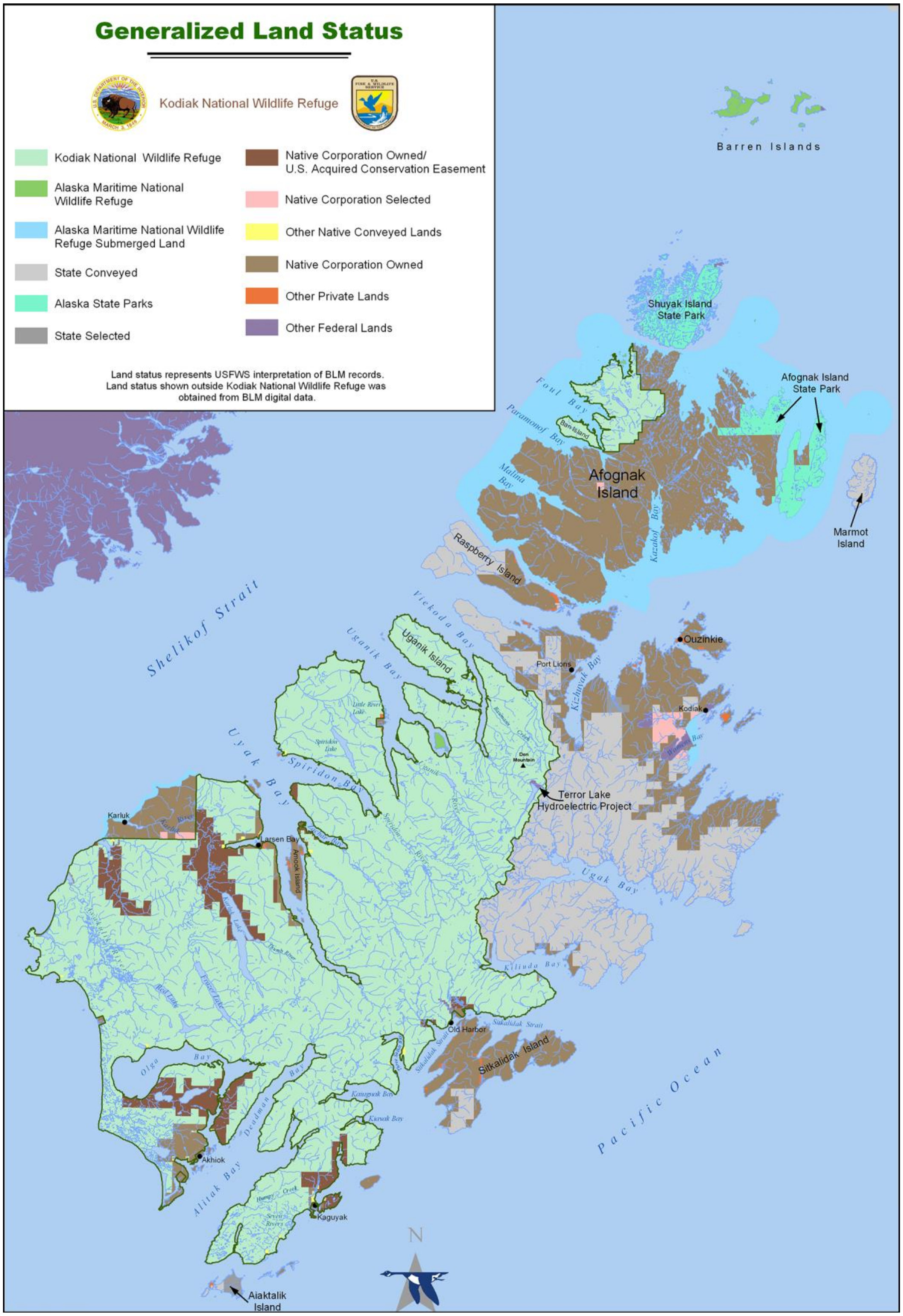
- **Tribal Energy Development and Capacity-Building (TEDC)**: Provides grants for Tribes needing assistance in assessing, developing, or obtaining the managerial and technical capacity needed to develop energy resources on Indian land. Examples of previously funded activities include evaluating the environmental effects of energy resource development projects, establishing or managing energy development-related departments and negotiating and reviewing leases, business agreements, or rights-of-way.
- **IEED Grant Program to Assess, Evaluate, and Promote Development of Tribal Energy and Mineral Resources:** Solicits grant proposals for projects that explore for energy and mineral resources, inventory or assess known resources, or perform feasibility or market studies about the use and development of known energy and mineral resources on Indian lands.

Figure 3: Communities in the Kodiak Region



Source: (16)

Figure 4: Land Status in the Kodiak Region



Source: (17)

2 | Energy Supply & Demand

Current Loads

The ability to estimate total energy use and to project future demand is a necessary step in energy planning. While electrical generation and use data is readily available for electricity thanks to state utility regulation and the PCE program, not enough data exists on heating and transportation energy to quantify it with confidence for planning purposes on a community or regional scale.

Electric Energy Supply

Total installed capacity for electric generation in the Kodiak region was 63.1 MW in 2010 (1). In 2013, the total amount of electricity generated in the region was 157,003 MWh. Renewable generation accounted for 94% of all power produced in the region, including 77% from hydropower and 17% from wind energy. Diesel accounted for the remaining 6% of generation, consuming 615,000 gallons of diesel fuel.

The diesel vs. renewable picture is a little different when looking at communities not on KEA's grid. In FY2013, diesel accounted for two-thirds of electrical generation and hydropower for one-third. There are no utility-scale wind projects in these communities.

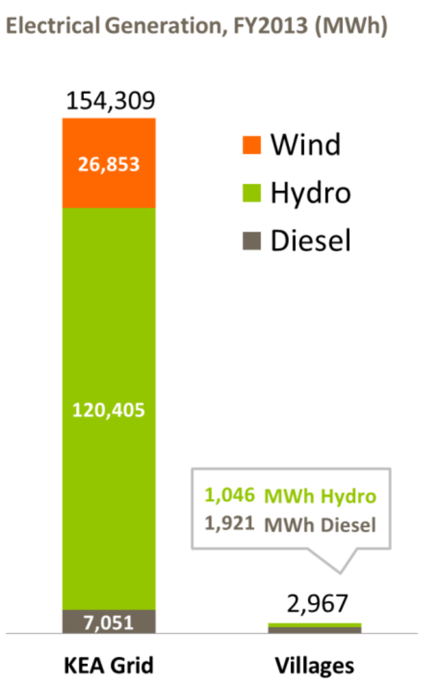


Figure 5: Kodiak region generation

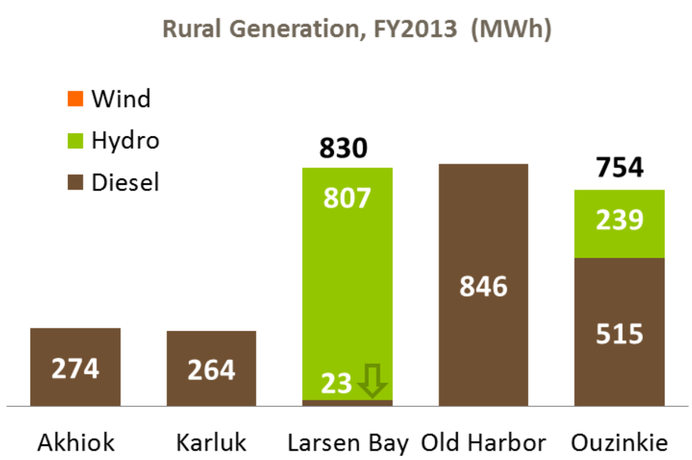


Figure 6: Rural only generation

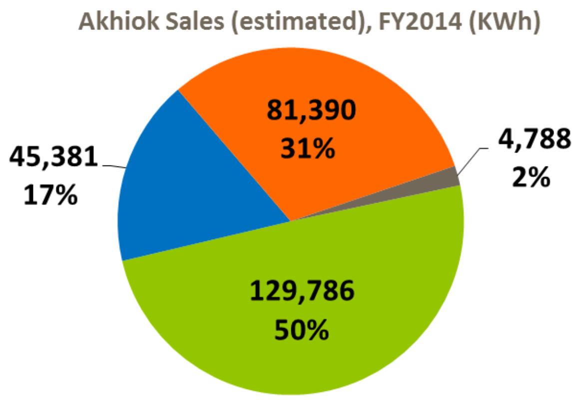
Table 6: Current Electricity Generation and Sales in the Kodiak Region, 2013

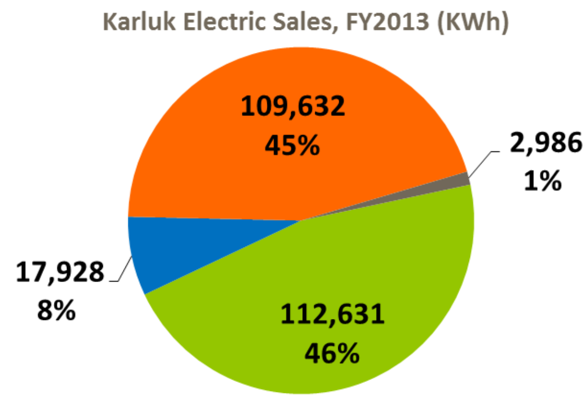
	Generated (kWh)[1]			Sold (kWh)[1]					Fuel Used (Gallons)
Utilities	**Diesel**	**Renewable**	**Total**	**Residential**	**Public Facility**[4]	**Commercial**[4]	**Utility Use**	**Total**	
Kodiak Grid[1,2]	7,051,089	147,258,210	154,309,299	14,214,052	11,782,347	63,282,898	-	**89,279,297**	490,000
Akhiok[3]	273,600	-	273,600	129,786	45,381	81,390	4,788	**261,345**	26,505
Karluk	263,781	-	263,781	112,631	17,928	109,632	2,986	**243,177**	23,759
Larsen Bay	22,672	807,425	830,097	169,763	125,930	452,156	20,791	**768,640**	2,245
Old Harbor	845,627	-	845,627	386,479	199,407	189,299	29,104	**804,289**	58,192
Ouzinkie	515,092	238,736	753,828	308,609	141,409	240,135	36,020	**726,173**	40,800
Port Lions[2]	-	-	-	689,545	171,444	248,829	-	**1,109,818**	-
Total Rural (MWh)	**1,921**	**1,046**	**2,967**	**1,797**	**701**	**1,321**	**94**	**3,913**	**151,501**
Total (MWh)	**8,698**	**148,304**	**157,003**	**16,011**	**12,484**	**64,604**	**94**	**16,011**	**641,501**

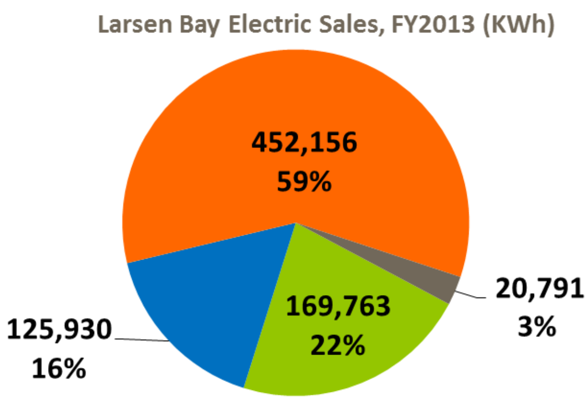
Source: (18) (19) (20). Notes: 1/ Generation and fuel use data reported for entire Kodiak grid. Sales data reported for City of Kodiak and Port Lions only. 3/ Annualized based on 4 months of data (Oct. 2013 – Jan. 2014). 4/ Government buildings are included under Commercial for PCE communities and under Public Facilities for Kodiak and Port Lions.

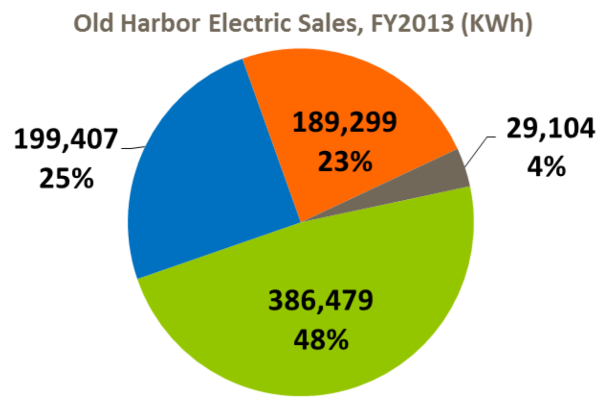
Electric Energy Demand

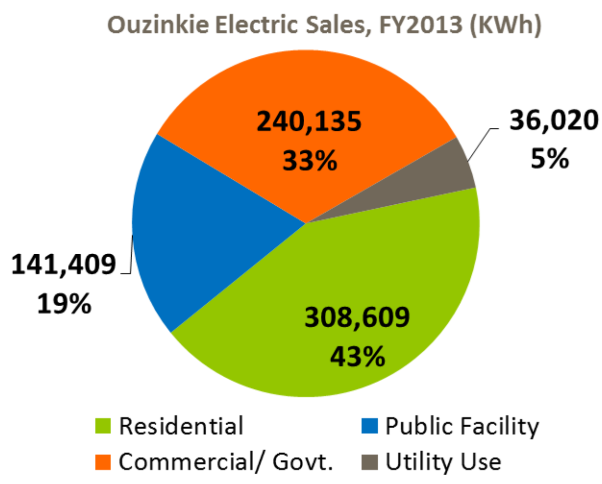
Among rural communities including Port Lions, residential sales accounted for 46% of kWh sold, commercial sales 33%, and public facilities 18%, while 2% was used for power generation. There are some significant differences among communities in how electricity is being used, which may suggest where to focus energy efficiency and conservation efforts:

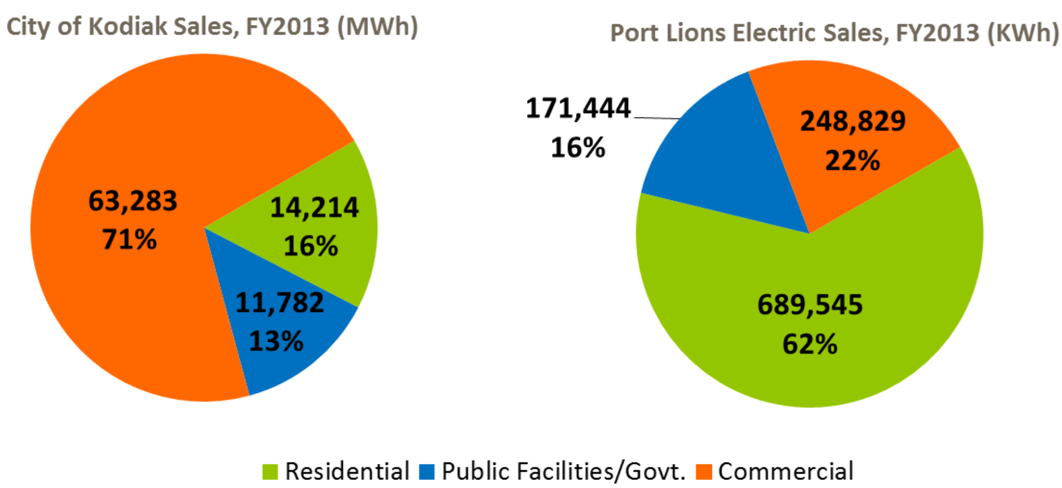




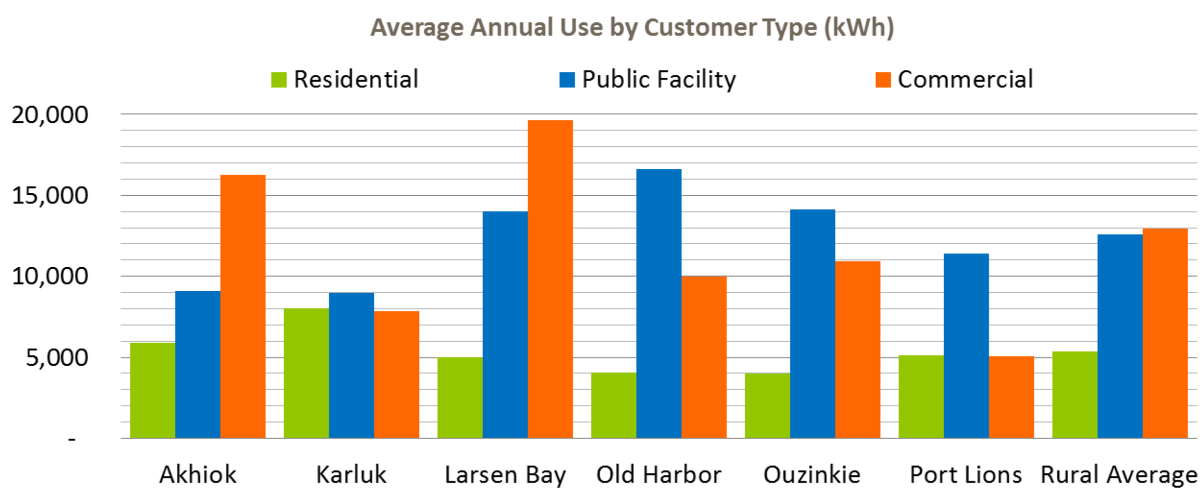


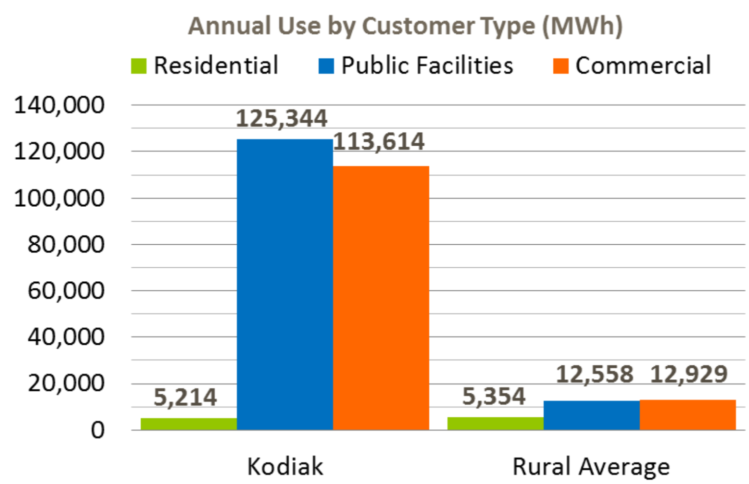






Average annual use by customer type and community also reveals differences in end use demand within the region. Potential strategies for maximizing energy efficiency efforts, based on annual use data, are described in detail in Volume II.





Sources: (18) (19) (20). Notes: In Kodiak and Port Lions, government facilities are grouped under Public Facilities. In PCE communities, government facilities are grouped under commercial accounts.

Heating Energy Use

Energy demand for space and hot water heating is less well documented and requires some modeling. Using housing stock and energy efficiency data from the 2013 Alaska Housing Assessment and data from AHFC's home energy rebate and weatherization projects in the region, we modeled residential heating energy use. This model does a better job estimating electrical use in the Kodiak region when compared with PCE data than applying data from the sampled rural communities (e.g. New Stuyahok) in the 2012 AEA Energy End Use Study (21).

Table 7: Residential Energy Use per Home

	City of Kodiak[1]		Kodiak Region - Rural[2]		End Use Study - Rural[3]	
By Use	Average Annual MMBTU	% of Total Residential Energy Use	Average Annual MMBTU	% of Total Residential Energy Use	Average Annual MMBTU	% of Total Residential Energy Use
Space Heating	124	67%	101	80%	88	85%
Hot Water	32	17%	8	6%	3	3%
Electrical	29	16%	18	14%	13	12%
Total	**185**	**100%**	**126**	**100%**	**103**	**100%**

Source: (22) (16) Notes: 1/ Actual energy use data compiled by AHFC energy efficiency programs for the region. 2/ Modeled based on housing stock and energy efficiency data from 2013 Statewide Housing Assessment, adjusted to fit actual usage data. 3/ Based on data for New Stuyahok in the Energy End Use Study.

Applying this model to the number of occupied homes, we can estimate the total heating energy demand for space and hot water heating for each community, as shown in Table 8.

Table 8: Estimated Annual Residential Energy Use by Community

	Heating Energy (Space + DHW) (MMBTU)	Electric Energy (MMBTU)	Total Energy Use (MMBTU)	Heating Fuel Use[1] (Gallons)
Akhiok	2,044	333	2,377	14,677
Karluk	1,775	289	2,064	12,747
Kodiak	424,788	78,967	503,755	3,049,978
Larsen Bay	3,431	559	3,989	24,633
Old Harbor	7,770	1,265	9,035	55,788
Ouzinkie	10,774	1,754	12,528	77,357
Port Lions	11,398	1,856	13,254	81,841
Total	**461,981**	**85,022**	**547,002**	**3,317,021**

Notes: 1/ Assuming all houses heat entirely with fuel oil. Actual fuel use will be lower where wood stoves and electric heaters are used. Does not include diesel fuel used for electrical generation.

The fuel use numbers are quite a bit smaller than those in the 2013 Alaska Housing Assessment, which estimated space heating fuel use for the City of Kodiak and the borough as a whole based on data in the Alaska Retrofit Information System (ARIS). ARIS data is mostly from the City of Kodiak and, to a lesser extent, Port Lions—the communities where almost all of the region's state-funded energy audits have been done. Outside of Kodiak, Port Lions, Larsen Bay and Ouzinkie, Housing Assessment data quality is low.

Table 9: Estimated Annual Community Space Heating Fuel Use

	Fuel Oil (Gallons)	Electricity (kWh)	Wood (Cords)	Propane (Gallons)
Total Region	3,754,910	2,597,149	4,244	2,384
City of Kodiak	1,732,901	1,246,112	1,914	982

Source: (16). Notes: Does not include diesel fuel used for electrical generation.

Unfortunately, looking at residential heating gives us only half the picture, since we lack a good inventory of non-residential buildings (including building use and square footage) for the region[1]. Energy use in commercial buildings and public facilities can vary widely depending on building type and use, with warehouses using much less energy per square foot than schools or offices. For this reason, we have not estimated non-residential heating demand. See Appendix B in *Volume II: Community Profiles* for a list of community buildings and other public infrastructure in the region.

Transportation Energy Use

Little data is available to estimate energy used for transportation in the Kodiak region, including aviation, on-road, off-road and marine uses. The AEA 2010 Alaska Energy Pathway report estimated transportation fuel use in the Kodiak region at close to 350 gallons per household, or 120 gallons per person, totaling 683,000 gallons for the region (23). Adjusted for population gains since 2000, transportation fuel use is estimated at just over 700,000 gallons for the region.

However, when compared with bulk fuel survey and data from other regions, it looks like the Alaska Energy Pathway model may significantly underestimate transportation fuel use for rural Alaska (24).

Gasoline (Gals.)	Akhiok	Karluk	Kodiak	Larsen Bay	Old Harbor	Ouzinkie	Port Lions	Region Total	Region Average
2013 est.[1]	8,760	4,422	604,017	11,842	29,906	24,214	25,243	708,404	
Per HH	103	103	95	135	133	131	134		119
Per person	385	317	287	344	345	376	338		342
2014 Fuel Purchase				30,000					

Source: (23) **Notes**: 1/ Based on Transportation fuel use in Alaska Energy Pathway, 2010, adjusted for population change.

[1] Limited inventories of public and commercial buildings in the region were completed in the 2012 End Use Study and in AHFC's statewide benchmarking effort.

Load Forecasts

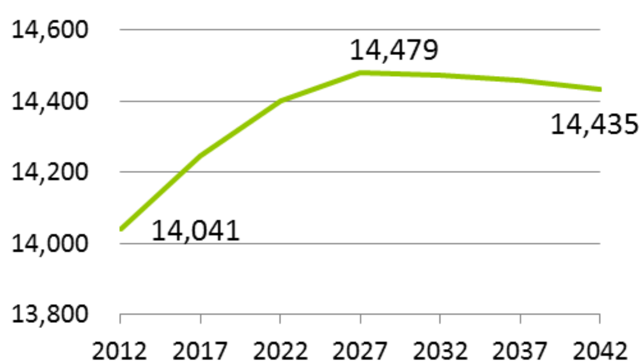
Energy planners should conservatively assume a modest load growth due to projected population growth at the borough level and a continued trend in increasing household energy use due to changes in consumer habits. If energy prices fall due to market fluctuations or in the wake of new energy projects, we can also expect to see an increase in demand.

Population Change

Population size directly impacts the demand for energy and thus the economics of any energy project being considered. Calculating the return on investment or benefit-cost ratio of a 20- to 50-year energy project requires assumptions about future energy consumption including the number of energy customers. Planners at KEA expect a continuation of historic trends in electrical consumption (25).

The 30-year population projections by state demographers at ADOLWD predict a population increase for the borough through 2027. After this time, the population is expected to level off and decrease slightly to a total population of 14,435 in 2042, a growth of 2.7 percent over 30 years.

Figure 7: Population Projection, 2012 to 2042



Source: (26)

Without infrastructure to connect rural communities, new energy projects not on the KEA grid will likely continue to serve small, discrete markets or "islanded systems." As a result, understanding where future populations will live is important to energy planning. Unfortunately, the small sample sizes and large margins of error in much of rural Alaska for both the decennial Census and American Community Survey makes sex by age data unreliable for projecting population growth at the community level (27). For this reason, the state only projects population growth at the borough or census area level.

This makes it difficult to estimate future energy needs for very small communities, particularly those where populations have been declining. In some cases, rural community leaders and utility managers were asked in interviews conducted for this study for their predictions on local population change. Where available, their answers are included in individual *Community Profiles*.

Other Factors

Other reasons to plan for growth in energy demand are new commercial and industrial developments—especially in energy-intensive industries like mining, oil and gas exploration, and seafood processing—and changes in consumer habits (e.g. trends toward bigger televisions and more electronic gadgets per household). These are offset by the adoption of energy conservation habits and the manufacture of more energy efficient appliances and electronics.

There are no mines known to be under exploration or development in the Kodiak region, and no planned lease sales for oil and gas exploration. Change in activity by seafood processors will be impacted by changes in many factors that are hard to predict: the abundance and distribution of fishery resources, variability in climate conditions, adaptations of fishery managers in response to climate change, industry consolidation (trend toward fewer shoreside seafood processors), outsourcing of production activities (moving secondary production to low-cost countries in Asia), and changes in fishery resource marketing (28).

For transportation planning purposes, the Southwest Alaska Transportation Plan Update Phase I Report assumes no change or a very modest change in seafood tons shipped from SW Alaska ports over the next decade (28).

A survey of seafood processors in the Kodiak region about future energy loads and plans to expand operations (or leave the market) has not been done, but should be part of Phase II activities.

Data Gaps

The most useful data for compiling a comprehensive picture of energy use and costs in the region and identifying energy saving opportunities include:

- Public and commercial building inventory (building type/use, owner, size, age, heating fuel, energy use, EE&C audit status, retrofits completed)
- Electric rates for commercial customers and utility demand charges
- Residential housing inventory (size, type, age, audit status, retrofits completed, owner or renter occupied, Low-Moderate Income status, heating fuel)
- Street light inventory (number, type, lumens, owner)
- Bulk fuel infrastructure and use data (tank numbers, size, use, condition, owner, purchase and sales practices and quantities)
- Transportation energy: vehicles (number, type, fuel, annual fuel use)

Additional data that would be useful for forecasting changes in energy demand include:

- **Accurate population and occupied housing counts**, especially for communities with populations under 100. Much of the data available from the U.S. Census Bureau's American Community Surveys is not dependable for small communities in rural Alaska due to very large margins of error.
- **Load modeling data for communities**. AEA does extensive community load modeling when designing power plant upgrades and bulk fuel projects, including space heating loads at larger community buildings. It would be helpful if more raw data were available to regional energy planners. Conceptual design reports include only brief summary tables.

3 | Energy Efficiency & Conservation

Energy efficiency and conservation (EE&C) is a resource every community can take advantage of—one that offers significant savings on heating as well as electricity costs. Since space and hot water heating typically account for over 80% of home energy budgets (and around 50% of energy used in public and commercial buildings), EE&C improvements provide one of the best ways to address total energy costs—not just the cost of electricity which is already subsidized for most rural Alaska residents and community facilities through the state PCE program.

Reducing energy demand through EE&C should be communities' first strategy in energy planning, since it provides both current savings through avoided fuel purchase, transportation and storage costs, and offers potential future savings by reducing or postponing the need for new capital investments in energy production.

Energy efficiency measures also act as an economic driver in Alaskan communities, while providing a quick payback on investment for building owners. Energy efficiency projects create more jobs in the economy than investments in some other energy projects do. There are approximately 7.8 jobs created for every $1 million spent on EE&C compared with only 2.6 jobs from the same investment in electrical power and 1.3 jobs from natural gas projects (22). Payback periods for EE&C investments can be as short as 4 months, while typical paybacks on new renewable energy generation are rarely shorter than 5 years (29).

Resource Inventory

KODIAK REGION HOUSING STOCK

The 2013 Alaska Housing Assessment estimated that there are roughly 5,323 housing units in the region. Of these, 4,445 are occupied. The remainder is either for sale, rent or is seasonal or otherwise vacant.

Unfortunately, the data quality for some of the region is considered to be low. Only data quality for the City of Kodiak is high, while Larsen Bay, Ouzinkie and Port Lions have medium quality data. Much of the data was collected through the AHFC Home Energy Rebate (HER) and Weatherization (Wx) programs. However, within the Kodiak region, only homes in Kodiak and Port Lions and one home in Ouzinkie have taken advantage of these state-funded energy efficiency audit and renovation programs. For that reason, information on housing size, condition and efficiency cannot be freely applied to housing stock in other communities. With that caveat, the housing assessment's energy-related findings for the region include:

- The average home in the region is 1,714 square feet and uses 117,000 BTUs of energy per square foot annually, 15% less than the statewide average of 137,000 BTUs per square foot per year.

- The average annual energy cost for homes in the Kodiak Island Borough is $6,260, which is approximately 2.2 times more than the cost in Anchorage, and 2.9 times more than the national average.
- Approximately 16% of occupied housing in the Kodiak Island Borough has completed either the Home Energy Rebate program, the Weatherization program, or BEES-compliant construction since 2008, compared to 21% statewide.

NON-RESIDENTIAL BUILDINGS AND PUBLIC FACILITIES

Inventories of non-residential buildings and other public facilities in rural Alaska tend to be nonexistent or frustratingly incomplete. Filling in the following data gaps would allow a regional EE&C strategy to be designed that targets public investment and educational messaging to maximize energy savings.

- **Non-residential building inventory**. While there is not good data on non-residential building stock in rural Alaska, there is data on how different types of non-residential buildings behave in different climate zones that could be used to model non-residential energy consumption in the Kodiak region. A small inventory project to collect information on the number, type and size of public and commercial buildings in each community could be used to identify and prioritize public and commercial EE&C opportunities and strategies.
- **Street lighting inventory.** It would be useful for regional planning to know the type and approximate number of street lighting and other public outdoor lighting in each community.
- **Water and sewer energy use and heat recovery status.** In order to identify on a regional basis the highest priorities for efficiency upgrades to community sanitation systems, it is necessary to understand current energy use and know which communities already have heat recovery systems that serve sanitation facilities or have the potential to do so.
- **Saturation rates for specific EE&C measures.** Knowing which consumer investments (programmable thermostats, efficient water heaters, other appliances and lighting) and behaviors (setting back thermostats, turning off lights, powering off computer equipment), etc. have already been widely adopted and which still provide significant opportunity

EE&C Opportunities

Alaska has multiple programs to help individual homeowners, businesses, and local governments fund energy efficiency improvements. Total state funding for energy efficiency has grown from about $2 million in 2008 to over $300 million (22). Information on state and federal programs and eligibility requirements is included in the *Project Financing* section.

Residential Energy Efficiency Savings

Common home energy efficiency and weatherization measures typically save Kodiak households 18% to 35% on energy consumption, which translates into 250 to 550 gallons of fuel oil per home per year. Most of the energy savings is in home heating, although lighting efficiency upgrades result in some electrical savings.

Table 10: Average Residential EE&C Savings per Household in the Kodiak Region

	Pre "As-Is" Energy Audit (MMBTU)	Post Improvement Audit (MMBTU)	Annual Energy Savings (MMBTU)	Estimated Annual Fuel Oil Savings (Gals.)	Annual Savings at $4.50/gal.
Home Energy Rebates	220	144	76	546	$2,456
Weatherization	196	160	36	258	$1,163

Source: (22). Note: This data is based on AHFC energy efficiency program results.

Statewide the average investment per home in the two programs is about $17,000. That cost is to the state. There is no cost to the resident or the community for participation in the Weatherization program, making this a good program for communities that wish to reduce local energy bills, especially heating costs and fuel use.

AHFC Wx projects in road-connected communities are funded up to $11,000 per home. This applies to the City of Kodiak, because it is on the Alaska Marine Highway. "Enhanced weatherization" services up to $30,000 per home are available to rural off- road communities. That includes logistics, transportation, overhead, and health and safety measures.

In the Kodiak region, AHFC's weatherization work is provided by the Alaska Community Development Corporation (ACDC). The Kodiak Island Housing Authority (KIHA) has also been weatherizing many homes in the region, especially in rural areas, through its NAHASDA Indian Housing Block Grant funds. The scope of both agencies' weatherization work is similar, with KIHA project spending ranging from $2,000 to $15,000 per home, with village projects at the upper end of the range due to freight and lodging expenses. Investment by ACDC in 22 Wx projects in the City of Kodiak last year ranged from $3,300 to $15,125—with an average per home of $10,664 (30).

Home Energy Rebate reimbursable costs are limited to direct labor and materials. The HER program requires homeowners to pay for an audit and recommended upgrades up front and the homeowner is then reimbursed up to a certain amount once work is done and a "post" audit is completed. The average rebate to homeowners is around $4,800 statewide. Individual homeowners may spend more than the reimbursed amount on energy efficiency retrofits, but that information is not available since participants are not required to turn in receipts for work done over the rebate amount. With annual cost savings averaging $1,464 statewide, the payback period for homeowners is 3.3 years (31).

Participation by Kodiak communities in residential EE&C programs is shown in Table 11.

Table 11: Participation in Residential Energy Efficiency Programs, 2003-2014

	Home Energy Rebates			Weatherization			Efficient Housing Stock	
	HER Audits (# Homes)	HER Rebates (# Homes)	HER Completion Rate	AHFC 2003-2007 (# Bldgs)	AHFC 2008-2014 (# Bldgs)	KIHA NAHASDA (# Bldgs)	New or BEES certified	Total Efficient Housing
Akhiok						8		**8**
Karluk				1		7		**8**
Kodiak	433	267	62%		129	34	411	**841**
Larsen Bay						9	3	**12**
Old Harbor						23		**23**
Ouzinkie				17	1	5	6	**29**
Port Lions					31	7	6	**44**
Total	**433**	**267**	**62%**	**18**	**161**	**93**	**426**	**965**

Sources: (22) (16) (30)

ESTIMATING REMAINING RESIDENTIAL EE&C SAVINGS OPPORTUNITY

Estimates for regional energy savings from residential EE&C measures are shown in Table 12. HER and Weatherization measures already completed or planned for 2014 will account for over 26,400 MMBTU annually in energy savings, 189,500 gallons of heating fuel, and nearly $850,000 in avoided fuel costs (see Table 10). Additional potential for residential EE&C could save another 65,150 MMBTU per year, assuming all older, eligible homes participate in an EE&C program. This would save an additional 468,000 gallons of heating oil and over $2 million annually in avoided fuel costs.

Table 12: Estimated Energy Savings and Potential from Residential EE&C

		EE&C Savings Achieved			EE&C Remaining Opportunity			
	Occupied Housing Units (2010)	Annual Energy Savings (MMBTU)	Annual Diesel Savings (Gals.)	Annual Avoided Fuel Cost Savings	Remaining Residential EE&C Opportunity	Annual Energy Savings (MMBTU)	Annual Diesel Savings (Gals.)	Annual Avoided Fuel Cost Savings
Akhiok	19	184	1,322	$9,255	58%	272	1,955	$13,683
Karluk	16	190	1,364	$6,709	50%	200	1,438	$7,076
Kodiak[1]	2,723	23,411	168,093	$731,206	69%	58,371	419,107	$1,823,117
Larsen Bay	34	194	1,395	$8,105	65%	516	3,703	$21,517
Old Harbor	73	524	3,761	$22,075	68%	1,997	14,338	$84,165
Ouzinkie	103	515	3,696	$17,370	72%	1,288	9,250	$43,474
Port Lions	94	1,370	9,840	$48,707	53%	2,503	17,972	$88,962
Total	**3,062**	**26,389**	**189,470**	**$843,428**	**63%**	**65,148**	**467,764**	**$2,081,994**

Sources: (21) (13) (16). **Notes**: 1/ Includes City of Kodiak only. **Model Assumptions**: All older income-eligible homes are weatherized. Remaining owner-occupied homes participate in Home Energy Rebate program. Average energy savings for region based on 2008-13 ARIS data (35% HER, 18% AHFC weatherization projects). Assumes retail fuel costs for communities as of January 2014.

REGIONAL EE&C OUTREACH AND COORDINATION

The Home Energy Rebates program has been aggressively funded by the state and has been very popular in urban areas, but less utilized in rural Alaska. This pattern is the same in the Kodiak region, where 433 audits have been done in Kodiak, but none in villages. There are several barriers to rural participation in the program.

- Home owners must be aware of the program and take initiative to sign up
- Home owners must pay for audits and retrofits up front and are reimbursed, up to a set amount, after a post-audit is complete.
- Some home owners report that it is hard to find auditors in rural Alaska
- It is expensive to ship building materials to remote communities

The Kodiak Area Native Association (KANA) hopes to address these barriers by hiring a regional EE&C coordinator to help rural residents access existing grant programs. KANA has applied for an EDA grant to fund the position.

AHFC ROVING ENERGY RATER PROGRAM

AHFC will now send a rater to a community if there are 3 to 5 customers signed up, depending on the size of the community (generally 3 for small communities or 5 for rural hub communities). Customers can always choose their own rater, but their costs will be lower if they use the AHFC sponsored rater.

SMART METERS

Smart Meters like The Energy Detective (TED) teach energy efficiency and awareness by giving utility customers the ability to monitor their own electrical use more closely. Studies have shown that 10 to 20% can be saved on electric bills by providing consumers more frequent, detailed information on their electrical energy usage than what they currently receive on monthly bills. KEA is considering the use of smart meters as tool to help with demand side management (25).

In 2009 AEA and the Chugach Electric Association conducted a small pilot program, distributing smart meters to 90 residential and commercial participants. Specific cost recovery data was not obtained (32). Nationwide millions of smart meters have been distributed. Florida Power & Light Company installed 4.5 million smart meters (33).

The Northwest Arctic Borough (NWAB) used a 2009 grant from the Coastal Impact Assistance Program (CIAP) to allocate a smart meter to every household so that residents could monitor their energy use in real time and see when the power cost equalization (PCE) limit of 500 kWh has been reached, after which electricity costs increase dramatically. NWAB trained youth in each community to provide technical assistance to local residents. The borough planned to install a prototype commercial grade meter is in school buildings in 2013 (5).

ENERGY WISE

The Rural Alaska Community Action Program (RurAL CAP) offers another program to help raise awareness of energy efficiency in rural Alaska. The program uses a multi-step educational approach involving residents in changing home energy consumption behaviors. Locally hired crews are trained to educate community residents and conduct basic energy efficiency upgrades during full-day home visits. The cost of implementing Energy Wise varies by location due to labor and logistic costs as well as the efficiency of serving communities of different sizes. The average cost per home is estimated to be under $2,000. Approximately half of this amount provides for local hire; the other half covers training, supplies and coordination (34).

In order to implement Energy Wise in a community or region, RurAL CAP requires a private sector partner. The NWAB partnered with NANA, the region's regional native corporation, to bring Energy Wise to all Northwest Arctic communities. One year after the program was implemented, the region's villages reported a 20% to 30% reduction in residential energy consumption (5).

Non-residential Energy Efficiency

Savings for efficiency improvements to non-residential buildings average 33% statewide, although there is some variation based on building type, and now total more than $750,000 per year in statewide savings.

Table 13: Participation in Public and Commercial Energy Audit Programs

	Public Facilities					Commercial
	VEEP[2] (# Bldgs)	EECBG[2] (# Bldgs)	Street Lighting Upgrades	AHFC Public Facility Audits (# Bldgs)	ANTHC Water & Sewer (# Bldgs)	AEA Commercial Energy Audits (# Bldgs)
Akhiok			5			
Karluk				8		
Kodiak[3]			In progress			3
Larsen Bay				1		
Old Harbor	7					
Ouzinkie				1		
Port Lions		1	30			
Total	**7**	**1**	**35**	**10**	**0**	**3**

Sources: (35) (36) (37). Notes: 1/ AHFC public facility audits include fire station in Womens Bay and school in Chiniak. 2/ The Small Cities EECBG Program was an American Recovery and Reinvestment Act (ARRA) project that provided grants to 97 Alaska small cities and boroughs to make energy efficiency improvements in public buildings and facilities. EECBG and VEEP programs were conducted simultaneously using ARRA grants, and based on their success, AEA continued to fund VEEP through FY2014.

VILLAGE ENERGY EFFICIENCY PROGRAM (VEEP)

Like the Energy Efficiency and Conservation Block Grant Program (EECBG), the Village Energy Efficiency Program (VEEP) offered a great resource to small communities that wished to make significant progress on energy efficiency with real, recurring annual savings. Port Lions received EECBG funding to upgrade its City Office Building lighting and LED street lighting, and Old Harbor upgraded seven public buildings in the very first (pre-ARRA) round of VEEP,[2] but overall participation has not been as high in the Kodiak region as in some other regions of the state, as shown in Table 14.

[2] The first iteration of the current VEEP model was VEUEUM, which is now referred to as VEEP round 1.

VEEP will not continue in FY2015 due to a lack of state funds, but the model established through VEEP and EECBG projects continues to offer a proven approach to achieving substantial whole village energy savings.

Under VEEP, energy efficiency audit and upgrade services were provided to Alaska communities with populations of 8,000 or less. In 2013, the average funding amount was $200,000 per community, with specific funding levels based on population. Grants covered efficiency improvements in public and community buildings, including upgrades to the building envelope, domestic hot water, HVAC controls, heating, lighting, motors and pumps, and ventilation. The energy auditor would assess the best use of funding to achieve the highest energy savings. Recipient communities were given three years to complete work. They could choose to administer and report on grants themselves or choose to have AEA do so on their behalf.

Savings from VEEP have been impressive. The program resulted in a $3 return for every $1 invested statewide, with a 3.8 year simple payback. In King Cove, improvements to three community buildings and street lighting retrofit resulted in a 72% reduction in energy use and a $25,000 annual savings (31).

Table 14: VEEP Participation by Region, 2005-2013

	VEEP	Whole Village Retrofit
Aleutians	1	
Bristol Bay	12	
Interior	9	1
Kodiak	1	
North Slope		
Northwest	4	
Southeast	1	
Western	17	2
Total	**45**	**3**

WHOLE VILLAGE ENERGY RETROFITS

AEA has also done three "whole village retrofits" in other regions completing additional energy efficiency work in each community. The most successful whole village project was begun in Nightmute in 2007 as part of VEEP round 1. Whole Village Energy Retrofit program took VEEP a couple steps further by upgrading the powerhouse, installing smart meters in residential and non-residential buildings, switching to LED streetlights, retrofitting or recommissioning most non-residential buildings, and weatherizing all homes. Only three whole village retrofits have been done. Like VEEP, the program is not currently funded.

One lesson learned in these efforts is that to be successful there must be sufficient time in the project to manage logistics and engage stakeholders, including partners from outside the community. In Nightmute, AEA partnered with AHFC, AVEC, the housing authority, local and tribal governments, the Denali Commission, RurAL CAP, and the Alaska Building Science Network (ABSN). AEA grant funds of $165,000 were combined with over $600,000 in RurAL CAP weatherization funds, plus cash and in-kind matches from the city, tribe, church, and village corporation totaling $75,700. The community funding contributions allowed the scope of the program to be expanded by over 40 percent. The program resulted in weatherization of 34 homes (65 percent of total housing), energy efficiency and lighting upgrades to 10 community buildings (all public buildings except the school), lighting upgrades to the school gym and four teacher housing units, and smart meters installed in every building (residential and non-residential). Powerhouse upgrades had already been planned and were conducted simultaneously.

AEA is now in the process of going back to assess the success of the project five years later and compare actual with estimated savings. At the time the project was completed in 2008, fuel savings from the weatherization of public buildings was estimated at 56 percent, with average per building fuel use dropping from $5,096 to $2,205 per year. The simple payback on community building weatherization was calculated at 5.2 years for ABSN's investment and 2 years for the community's investment. Savings from lighting upgrades alone were calculated at 4.7 percent of village electrical consumption, with a payback of less than five years.

FINANCING A WHOLE VILLAGE APPROACH

Though neither the VEEP nor Whole Village Energy Retrofits programs is currently funded, they provide powerful models for achieving long-term, village-wide energy savings. Since typical payback periods are short for these programs and savings can be significant, it makes more sense to pursue them now using loans or other available financing mechanisms than waiting for the possibility of future state grant funding. Creating financing options could include the Alaska Energy Efficiency Revolving Loan Fund Program (see page 41) for financing public-building energy retrofits, the Power Project Fund for efficiency upgrades to the powerhouse, existing weatherization programs for funding a coordinated residential energy efficiency initiative, and other grant and loan opportunities listed in the *Project Financing* section that include energy efficiency among their program guidelines for financing street lights, smart meters or other EE&C upgrades (see page 79).

Since these financing options take more work and organizational capacity to coordinate than state grant funding, there is an important role for a regional organization to take in helping implement an aggressive whole village—or whole region—approach to energy efficiency. A regional entity or other third-party with capital to invest may also be interested in financing a whole village EE&C initiative using an ESCO-type model in which the loan is paid back by savings from the efficiency measures being installed (see page 89).[3]

AHFC PUBLIC FACILITY AUDITS AND IMPLEMENTATION

AHFC funded 327 audits statewide in 2011 and 2012 through the Retrofit Energy Assessment for Loan Program (REAL), including audits of 10 public buildings in the Kodiak region. Since the public funds cover the cost of the audits only— not the cost of retrofits—it is not known how many recommended measures have been implemented by building owners, but since many EE&C retrofits pay for themselves within a few months to a few years through energy savings, it makes economic sense to complete the most cost effective building upgrades as soon as possible,

[3] Unlike conventional ESCOs which finance efficiency upgrades to individual public buildings with large square footage, there is the potential to use the same model to fund upgrades to a many smaller public buildings in the same community to realize comparable savings. While this model has not been tried yet in Alaska, it has been talked about.

even if grant funding is not available. The state has several revolving loan funds that can also help finance the upfront costs of energy improvements.

Statewide, AHFC estimates that few retrofits have been implemented to date (38). KIBSD has primarily been implementing energy saving recommendations in the seven schools it had audited in four communities (Kodiak, Womens Bay, Chiniak, Larsen Bay and Ouzinkie) as repairs and replacement opportunities arise (39). Public building audits for the region can be downloaded at: http://www.akenergyefficiency.org/koniag_audits/

COMMERCIAL ENERGY AUDITS

AEA's Commercial Building Energy Audit program funds audits for commercial buildings, and over half of the audits funded in 2013 were in non-railbelt communities (40). However, only three businesses in Kodiak received Alaska Commercial Energy Audits.[4] As with other non-residential EE&C programs, because the program only covers the cost of the audit (it does not reimburse owners for building improvements), it is not known how many of the recommended improvements are made. However, since many upgrades pay back in just a few years, it makes sense to do them as long as the up-front investment can be made. Loan programs for commercial building energy efficiency improvements are currently being developed by DCCED and AIDEA.

Estimating Remaining Non-residential EE&C Savings Opportunity

The lack of data on public and commercial buildings (including number, type and square footage) in the region makes it difficult to estimate non-residential energy savings potential. In addition, most local governments operate multiple facilities and purchase fuel for a variety of buildings and vehicles. They do not usually account for individual building energy use, and fuel metering is rare. This makes it difficult to understand current energy use in public buildings and limits the accuracy of the community-reported data used in many audits. Though data are often unavailable on public and commercial buildings, an estimate for the savings potential is shown in the table below. This is based on behavioral changes (like setting back thermostats) by building managers and occupants as well as efficiency and conservation retrofits identified in building energy audits.

Table 15: Savings Potential for Public and Commercial Facilities

Make All Behavioral Changes	Male All the Most Cost-Effective Changes	All EE&C Recommendations
10-15% Savings	15-25% Savings	25-35% Savings

Source: (38)

NON-RESIDENTIAL BUILDING INVENTORY AND BENCHMARKING

At the community or regional level, a public building inventory can be used to identify and prioritze public facilitly EE&C opportunities and develop an "EE&C Roadmap" for the community or region. Data can be collected using local labor and a standard input form. It should include, at a minimum, building type, age, square footage, fuel type, owner, occupancy, hours of operation and EE&C audit/renovation status. Additional data fields may include bulk fuel tank capacity and annual community fuel order by type, and the number and type of street lights or other public outdoor lighting. Data can be used to help ground truth statewide energy end use

[4] Alaska Hydraulics, ISA Plant 2, and Kodiak Island Brewing

models and be used to develop a grant proposal for community or regional public facility EE&C upgrade project.

"Benchmarking" public and commercial buildings also benefits individual facility owners and managers by giving them the ability to see trends in a building's energy use and compare use and operating costs to other buildings. Owners can benchmark their facility by completing the REAL Benchmark Form at: http://www.ahfc.us/efficiency/research-information-center/energy-efficiency-public-facilities/ (41).

REVOLVING LOAN FUNDS

State loan programs exist to fund the deployment of energy efficiency and conservation measures in commercial and public buildings.

- **Commercial Alternative Energy Conservation Loan Fund:** DCCED provides loans up to $50,000 to finance alternative energy systems or conservation in commercial buildings. For more information, visit http://commerce.alaska.gov/dnn/ded/FIN/LoanPrograms/AlternativeEnergyLoanProgram.aspx.
- **Alaska Energy Efficiency Revolving Loan Fund (AEERLP) for Public Facilities:** AEERLP provides financing for permanent energy-efficient improvements to government-owned facilities. Financed improvements must be from the list of measures identified in an Investment Grade Audit. For more information, contact Eric A. Havelock at AHFC (907) 330-8245 or visit www.ahfc.us/efficiency/energy-programs/energy-efficiency-revolving-loan-fund-aeerlp

Energy Efficient Lighting

INDOOR LIGHTING RETROFITS

Electrical efficiency measures such as lighting retrofits generally have shorter payback periods than other building efficiency measures. After one whole village retrofit, AEA saw a total energy savings of 1% to 4% in the community just by looking at lighting improvements. The median savings from lighting retrofits identified for 13 public and commercial buildings in the Kodiak region is $4,997 per building per year.

Table 16: Savings from Energy Efficient Lighting Upgrades in Small Communities

	Investment per Building	Savings per Building	Electric Savings per Building	Simple Payback Period
Mean	$2,754	$839/year	1,703 kWh/year	3.3 years
Average	$5,642	$1,565/year	3,685 kWh/year	3.6 years

Source. (36) Based on 156 lighting upgrades completed in 32 villages with VEEP and EECGB grants through 2013.

STREET LIGHTING

LED lighting is highly efficient compared to conventional street lights. Though somewhat capital intensive (about $1,000 per light), communities can save up to 75% on annual energy used for outdoor public lighting (including security lighting at tank farms or harbors). KEA has a 7- to 10-year vision to replace all street lights in Kodiak with LEDs. Akhiok and Port Lions have completed street lighting retrofits as part of their VEEP or EECBG grants, but there is potential for additional savings in the region by switching out street lighting in other communities.

Table 17: Average Savings from Implemented LED Street Lighting Retrofits by Community Size

Community Population	Investment	Annual Savings: Dollars	Annual Savings: MMBTU	Annual Savings: kWh	Simple payback (Yrs)
50-100	**$ 12,835**	**$ 2,202**	**21**	**6,158**	**6.9**
per capita	*166*	*30.91*	*0.28*	*83.0*	
100-250	**$ 22,395**	**$ 2,602**	**23**	**6,733**	**10.1**
per capita	*95*	*13.09*	*0.12*	*34.8*	
250-500	**$ 25,933**	**$ 4,616**	**38**	**11,135**	**6.5**
per capita	*69*	*12.31*	*0.10*	*29.1*	
500-1000	**$ 54,250**	**$ 11,195**	**106**	**31,103**	**7.4**
per capita	*86*	*17.52*	*0.16*	*46.7*	
1000-2500	**$ 68,942**	**$ 16,873**	**315**	**92,318**	**5.5**
per capita	*40*	*8.30*	*0.15*	*43.9*	
2500-5000	**$ 153,500**	**$ 113,956**	**1,339**	**392,312**	**2.3**
per capita	*35*	*27.16*	*0.32*	*94.1*	
Statewide	**$ 39,216**	**$ 10,899**	**130**	**38,195**	**7.1**
per capita	*82*	*15.36*	*0.15*	*43.4*	

Source: (36)

Water and Sewer Energy Efficiency

Sanitation systems are one of the single largest energy users in rural communities, accounting for 10% to 35% of a community's energy use. Alaska Native Tribal Health Consortium (ANTHC) estimates that for every $1 spent on energy retrofits of rural sanitation facilities (including the cost of audits), there will be a 50 cent return each year to communities plus a 50 cent annual return to the State's operating budget through lower PCE payments.

ANTHC performed energy audits of public facilities in small communities as part of its study of energy use in rural Alaska sanitation systems. Average savings based on audits in 40 rural communities are shown in Table 18. ANTHC estimates another 40 communities could benefit (42). Note that most of the audits were done in colder climate zones where energy use for sanitation systems is higher. None were done in the Kodiak region, where savings may be somewhat lower due to the milder climate.

Table 18: Savings per Community from Water and Sewer Efficiency Measures

Cost of Audit	Estimated Investment	Annual Savings to Community	Annual Savings in PCE Costs to State	Simple Payback
$17,500	$31,896	$9,847/year	$8,067/year	1.8 years

Source: (42). Notes: Does not include heat recovery.

Table 18 does not include potential savings from heat recovery, which will not be practical to install in every community. Because sanitation facilities can use low-quality recovered heat to warm large volumes of stored and circulation water, heat recovery systems offer even more efficiency for sanitation facilities than they do for other public facilities. While heat recovery projects require a substantial initial investment in material and labor, they result in significant savings to communities where they are appropriate.

Unfortunately, the state does not currently have a good mechanism for funding energy efficiency projects in sanitation facilities, according to ANTHC. Many rural utilities have poor credit and lack the administrative capacity to acquire loans through AHFC Energy Efficiency Revolving Loan Fund. Communities that have completed retrofits have largely done so with nontraditional funding sources (42).

Successful EE&C Messaging in Rural Alaska

Rural Alaskans are already highly engaged in energy efficiency and conservation. The high cost of energy and low household income in most rural communities means that rural Alaskans have been practicing efficiency and conservation out of necessity for some time. The following findings on what EE&C messaging is most effective with rural Alaska audiences is from Recommendations for Alaska Energy Efficiency and Conservation Public Education and Outreach conducted by Information Insights and Milepost Consulting for the Alaska Energy Authority (43).

- Rural communities must trust the messenger. In many places this means getting buy-in from community elders and leaders. Rural outreach programs often require more time to build trust than is needed in urban places. Close coordination with regional entities, such as Native organizations, in program design and implementation is a preferred model.
- To the extent that funding allows, education and outreach campaigns should incorporate regional modification, such as using local language, local personalities and entities, and appropriate delivery mechanisms.
- Engaging the whole community from youth to elders is important in very small communities. Creating events with activities for all ages is recommended.
- Messages with "future-conservation" and "monetary-social norming" frames play well in rural Alaska. Future-conservation frames are less effective in urban Alaska. The least effective messages with rural audiences are those with a "combination-gain" frame.
    - Future-conservation messages (*"Conserve now for the next generation!"*) are more effective in rural Alaska than messages with simply an environment-gain (describing an improving impact on the environment) or a straight-up gain frame (describing generic money or energy "savings").
    - Social norming messages promote the idea that others within a given peer group or community are already participating in the desired behavior and, in monetary-social norming messaging, already seeing monetary benefits from that behavior. For example, *"Your neighbors have already saved around $50 per bulb on their energy bills by installing efficient lighting, you can too!"*

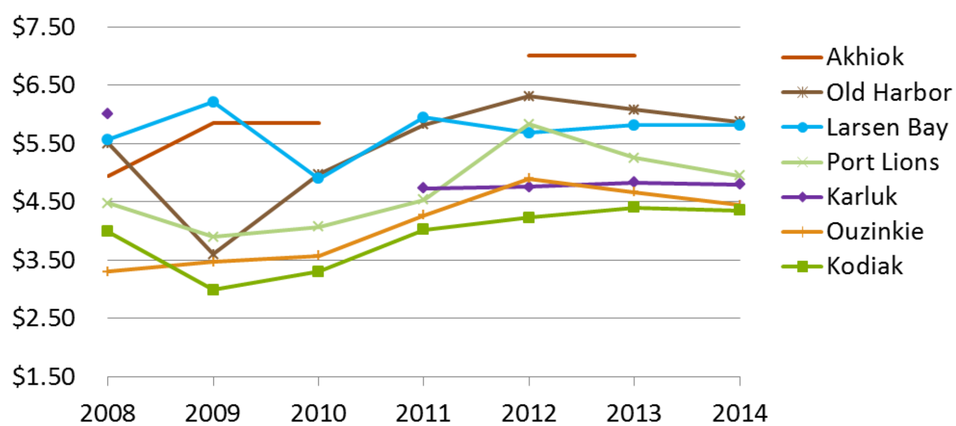
4 | Fossil Fuels

Bulk Fuel

Heating oil and gasoline prices have been a point of considerable attention in rural Alaska for many years. The challenges of delivering and storing fuel in remote locations are significant and substantially increase energy costs in the region. Fuel costs are tied closely to crude oil prices, which are set on a global market. While the market price (the price paid at the refinery) cannot be influenced by local, regional or state actions, two options exist to lower the cost of fuel oil and gasoline and thereby lower the cost of energy in rural communities: lower storage and transportation costs.

Wholesale price data is not available, but it is apparent from retail fuel survey data for #1 heating oil that significant price differences exist across the region.

Figure 8: Retail Prices for #1 Heating Oil Fuel, January 2014



Sources: (44) (45). Notes: Reported price of No. 1 fuel oil from AHFC Fuel Survey. Sales tax is included since 2011, but may or may not be included for prior years.

Bulk Fuel Storage

BULK FUEL UPGRADE PROGRAM

Upgrading bulk fuel facilities reduces the cost of storing fuel by replacing leaking tanks and reducing the risk of future tank and equipment failure. Bringing these facilities into compliance with federal and state regulations also makes them safer and more reliable. With the help of federal funding from the Denali Commission, AEA has invested over $200 million statewide to upgrade bulk fuel infrastructure in over 70 rural communities. All rural communities in the Kodiak region, including Port Lions, have received bulk fuel upgrades.

BULK FUEL STORAGE CAPACITY

Information on bulk fuel storage capacity and needs was not uniformly collected for this study. See individual *Community Profiles* for information. The Denali Commission has funded a statewide bulk fuel inventory assessment, which is scheduled to be completed by AEA by the end of FY2015 (46). The assessment will be used to prioritize state bulk fuel upgrade (BFU) projects based on infrastructure needs and potential for refurbishment.

ULTRA LOW SULFUR DIESEL

As the region replaces diesel gen-sets, heavy equipment, and on-road diesel vehicles, it will increasingly have to use Ultra Low Sulfur Diesel (ULSD) instead of Low Sulfur Diesel. It is possible that fuel providers will switch entirely to ULSD, even though it is not required for heating purposes. Communities will need to address the issue of dedicated ULSD storage (47). More information from regional fuel providers would help assess the need for dedicated ULSD storage. (47)

Bulk Fuel Purchasing Group

Based on the experience of bulk fuel purchasing groups in other regions and statements by fuel vendors, modest savings are available from consolidating bulk fuel orders in order to increase the incentive of fuel vendors to lower their bids for delivered fuel. Additional savings may come from reduced administration costs for buyers and vendors.

However, the challenges of setting up a purchasing cooperative are not trivial and due to the many factors that go into fuel prices, it is difficult to estimate how much savings might be realized by a purchasing group in the Kodiak region. Fuel vendors generally calculate the delivered price of fuel on a case-by-case basis and do not publish price breaks. However, there are increased efficiencies at several volume thresholds from as low as 3,000 to over one million gallons, according to Delta Western (24).

Fuel is already being purchased cooperatively on an informal basis in the City of Kodiak by the Kodiak Island Borough, the School District, and the Providence Kodiak Island Medical Center. The total volume combined for bid this year was over 500,000 gallons. Now that KEA's annual fuel purchase is down to 70,000 gallons, the utility may be able to lower its fuel cost by joining the combined order.

Analyzing the feasibility of a rural Kodiak region purchasing group is beyond the scope of this study. However, the opportunity for significant savings by combining fuel orders into a single bid process is limited for several reasons:

- The total volumes purchased in the remainder of the region are not known but presumed to be small based on available data. (See Table 19.)
- Several communities said in interviews conducted for this study that they are unlikely to be interested in a fuel purchase group.
- Competition among fuel vendors can only be leveraged when it exists. In three of six rural communities (Akhiok, Karluk and Larsen Bay) little to no competition exists due to the absence of docks and marine headers that would allow fuel barges to off-load fuel safely and efficiently. In Larsen Bay, for example, only one vendor (Crowley Maritime) has

typically been willing to anchor out and use a floating line to off-load fuel. Other vendors will not come in without a dock (48).

Table 19: Bulk Fuel Used or Purchased by Community

	Heating and Electricity			Transportation		
	#1 Oil (gals.)	#2 (gals.)	Propane (gals.)	Avgas (gals.)	Gasoline (gals.)	ULSD (gals.)
Akhiok[1,2]	?	26,505	?	?	?	?
Karluk[3]	22,500	22,500	0	0	0	0
Larsen Bay[3]	15,000	10,000	0	0	30,000	0
Old Harbor[2]	?	58,192	?	?	?	?
Ouzinkie[2]	?	40,800	?	?	?	?

Source: (18) (49) (19). Notes: 1/ Does not include fuel purchased from cannery. 2/ Shows FY2013 utility use only. Does not include #2 diesel used for heating. 3/ From 2014 bulk fuel order. Includes total order for #2 diesel for both electrical and heating use.

The volumes in the table above do not include fuel purchased by (or from) seafood processors or by school districts or businesses with their own fuel tanks. Unless they are independently owned, seafood processors likely pool their own fuel orders for Alaska operations at the corporate level. Alaska DOT&PF purchases all its vehicle and aviation fuel as part of a statewide bid and procurement process (24).

Resources for Communities

RURAL ALASKA FUEL SERVICES (RAFS)

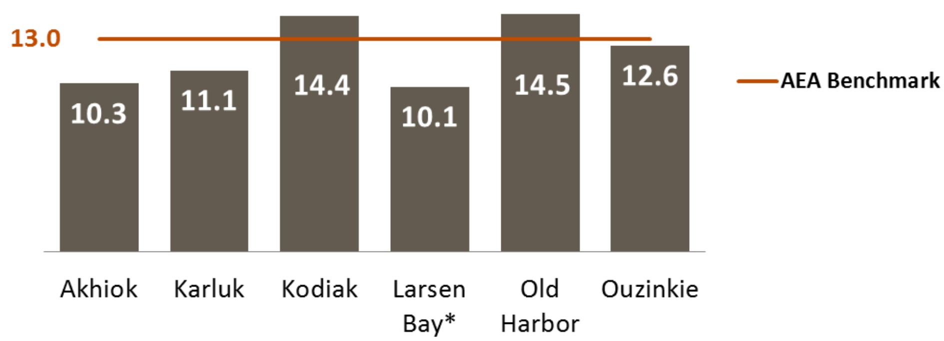
Rural Alaska Fuel Services is a nonprofit organized to contract for the operation and maintenance of rural Alaska bulk fuel storage facilities constructed by the Denali Commission. A condition of Denali Commission grants is that the newly constructed tank farms be maintained and operated in accordance with applicable state and federal regulations. RAFS offers a variety of financial services to its customers, including records retention, billing and collections, budgets and planning and pricing analysis. RAFS' Power Cost Equalization Training and Assistance services include regular courses for utility clerks and managers and assistance with reporting compliance.

DIESEL EFFICIENCY & HEAT RECOVERY

Diesel generation accounts for only 6% of the electricity in the region as a whole, but 65% of the electricity generated by the region's small utilities. Inherently inefficient as a power source, diesel loses 60% of its energy to heat even in the most efficient generators. The inefficiency is greater in poorly sized or maintained gen-sets, therefore considerable savings are available to a community by improving maintenance and system efficiency and by adding or expanding waste heat recovery.

Diesel efficiency is measured by the amount of electricity produced in diesel generators from one gallon of fuel (kWh/gallon). Diesel efficiency at Kodiak region utilities ranges from 10.1 to 14.5 kWh/gal., as shown in Figure 9.

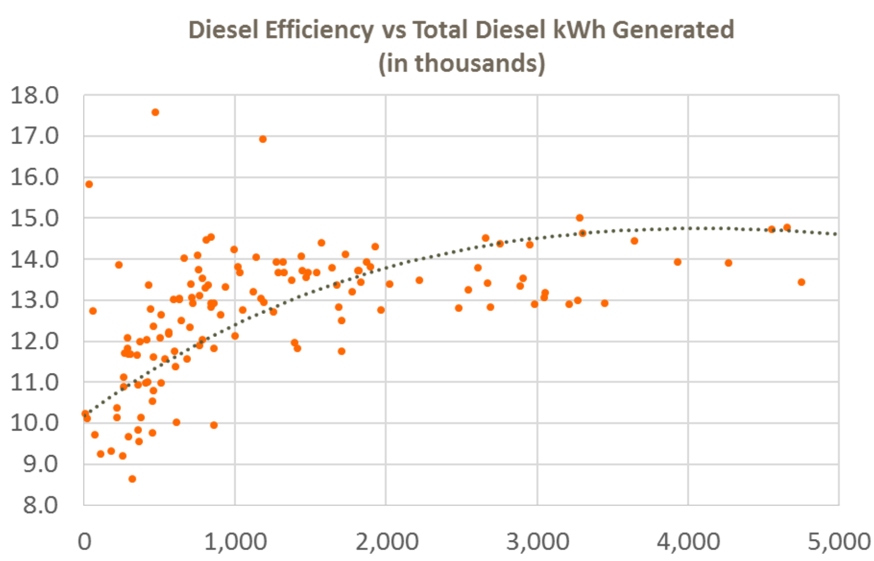
Figure 9: Diesel Efficiency in the Kodiak Region (kWh/gallon)



Sources (18) (19): Notes: Diesel efficiency based on generators in place in FY2013. *Larsen Bay's diesel efficiency is expected to improve with the recent upgrades to its diesel generators and switchgear.

In the past, AEA has used 13.0 kWh/gal as a very general efficiency benchmark in evaluating Renewable Energy Fund project applications. They are considering changing that in the future to a lower number for smaller utilities and a higher number for larger ones, since there is a correlation between load size and efficiency, as shown in Figure 10. However, even small utilities are able to achieve diesel efficiencies of 14.0 and above. Every utility should be able to achieve the efficiency on the trend line in the chart. A goal might be to be 5% above the line for small utilities (50).

Figure 10: Diesel Efficiency at Different Load Sizes, FY2013 PCE Data



Source: (50)

Even if a community produces most of its electricity with renewable energy—or hopes to in the future—optimizing diesel efficiency is important since almost any renewable resource needs to integrate with existing generators to ensure that power is available in the community when variable energy sources like wind or run-of-river hydro are off line.

The primary powerhouse infrastructure must be in good working order and well maintained and adequate switchgear and controls installed so the integration of wind or hydro does not damage diesel equipment or lead to a marked decrease in generator efficiency that can result from operating at low capacity when the renewable resource is online (2).

Another reason for getting the diesel powerhouse in order before pursuing renewable energy opportunities is that potential funders typically look at a community's capacity for maintaining its current infrastructure (and for record keeping and business administration) before awarding funds for new projects.

Resource Inventory

DIESEL POWERHOUSES

In 2012, AEA conducted an assessment of the condition and needs in rural powerhouses statewide to help prioritize system upgrades. Selected results for Kodiak communities are included in Table 20: Village Power System Assessment, 2012. Recommendations from AEA staff based on the assessments are included in individual *Community Profiles*.

Table 20: Village Power System Assessment, 2012

	Generator Condition	Load Sizing	Load Imbalance	Operator Proficiency	Control Switchgear
Akhiok[1]	C/C/C	Good	10-25%	D/D/D/D/D	Semi-automatic
Karluk	C/C	Good	10-25%	C/C/C/C/D	Semi-automatic
Larsen Bay[1]	D/C	Oversized	>25%	C/B/D/D/D	Manual transfer
Old Harbor	C/C/C	Good	10-25%	A/A/A/B/B	Manual synchronizing
Ouzinkie	A/A/C	Good	10-25%	B/B/C/C/C	Fully automatic

Sources: (51) (19) (18). **Notes**: 1/ Does not reflect recent administrative improvements in Akhiok before rejoining PCE or powerhouse upgrades in progress in Larsen Bay. **Generator Condition**: A=Good (like new), C=Fair, D=Poor. **Operator Proficiency**: A=Excellent, B=Good, C=Acceptable, D=Unacceptable for: Meter Reading / Daily Logs / Routine Maintenance / Scheduled Maintenance / Maintenance Planning

The Rural Power Systems Upgrade (RPSU) program replaces outdated, inefficient village powerhouse and electrical distribution systems, adds or upgrades heat recovery where possible and remote monitoring systems, and improves overall diesel efficiency through other upgrades including electronic fuel injectors, switchgears and controls.

RPSU projects have been completed in Karluk and Ouzinkie. Upgrades in Larsen Bay are in progress. The new diesel powerhouse will be substantially complete by fall 2014, followed by hydro refurbishment, and electrical distribution construction is expected to be completed in fall 2015. As part of its upgrade, the community will receive three new gen-sets (1 x 210 kW, 2 x 65 kW), replacement of most of the existing underground distribution system, and replacement of the existing hydro Pelton wheel.

Akhiok and Old Harbor are on the list of 87 potential RPSU projects remaining. Now that Akhiok is active again in the PCE program, there is an opportunity to talk with AEA program staff about prioritizing an RPSU project.

HEAT RECOVERY

Heat recovery lowers community energy costs by reducing the cost of heating public buildings near the powerhouse. This is a resource that is essentially untapped by the region's rural utilities, offering significant opportunity.

Table 21: Heat Recovery by Community

	Heat Recovery Operational	BTU/hr Meter	Current Buildings Heated	Additional Waste Heat Available	Potential New Users
Akhiok	Not Known				
Karluk	No			Pumphouse?	
Larsen Bay	No				
Old Harbor	No				
Ouzinkie	Not Known				

Source: (51) (52)

Even when gen-sets operate at maximum efficiency, 60% of all energy in the diesel fuel will be released as heat. The waste jacket heat can be run through a heat exchanger that transfers the heat to a heat loop that can warm nearby buildings. This process can recover 10 to 20% of the energy in the fuel. The heat can be measured and, if a heat sales contract is developed, sold to consumers, providing another revenue source for the utility. Potential users are often schools.

The heat expelled in the exhaust is more difficult to capture—cooling the exhaust causes sulfuric acid to develop and can cause other operational issues with the engine. Low sulfur diesel and other technologies may help limit these issues (2).

While excess or waste heat is primarily a byproduct of diesel generation, heat can be harnessed from hydro plants in situations where there is excess hydro (e.g. water going over the spillway) that can be used as a dump load to power an electric heater.

Technology Notes

Diesel efficiency is improved through:

- **Proper maintenance of gen-sets**. The efficiency of a new generator or diesel power plant declines quickly if not maintained.
- **Type and proper sizing of gen-sets**. Diesel generators are significantly less efficient when run at low capacity. This is particularly an issue when trying to integrate wind in small communities where the system is already oversized. Ideally, gen-sets can be sized so that one generator can go offline completely when the wind is blowing, leaving a smaller generator operating at close to optimal capacity.
- **Effective switchgear**
- **Properly balanced distribution system**

Opportunities

By cutting down on the amount of fuel oil needed to meet a community's electrical needs, improvements to diesel efficiency lead directly to lower energy costs by reducing the cost of buying, shipping and storing fuel. Increasing diesel efficiency by 10% in every community—or alternatively to the level of 13.0 kWh/gallon regionwide—would result in savings of 10,000 to 60,000 gallons of diesel annually. The savings to utilities, which would be $40,000 to $215,000, are shown in Table 22. This amounts to a savings of $0.02 to $0.10 per kWh.

Table 22: Diesel Efficiency Savings Potential by Community

	Current		Increase by 10%			Increase to 13.0 kWh/gallon		
	FY2013 Diesel Efficiency	FY2013 Fuel Price to Utility	New Diesel Efficiency	Fuel Savings	Annual Savings	New Diesel Efficiency	Fuel Savings	Annual Savings
Akhiok[1]	10.3	$ 3.75	11.4	2,404	$9,019	13.0	5,459	$20,484
Karluk	11.1	$ 4.37	12.2	2,155	$9,419	13.0	3,468	$15,156
Kodiak[2,4]	14.4	$ 3.50	15.8	44,545	$155,909	*NA*		
Larsen Bay[3]	10.1	$ 4.45	11.1	204	$909	13.0	501	$2,229
Old Harbor[4]	14.5	$ 4.13	16.0	5,284	$21,823	*NA*		
Ouzinkie	12.6	$ 4.76	13.9	3,695	$17,588	13.0	1,178	$5,605
Total	**Avg. 12.2**		**Avg 13.4**	**58,288**	**$214,688**		**10,606**	**$43,475**

Sources: (18) (19) (25). Notes: 1/ Based on 4 months of FY2014 PCE data 2/ Reported by KEA, April 2014. 3/ Based on old generators. Powerhouse upgrades installed in 2014. 4/ There are upper limits to the amount of fuel efficiency that can be achieved with current technology. It may be difficult to raise efficiency above 15.0.

AEA program managers offered the following additional observations and recommendations to increase system efficiency (53) (54):

- SCADA software systems are included on all power plants installed since 2004 allowing remote monitoring to identify maintenance and performance issues. Remote site monitoring on a regional or subregional basis can save energy. The Bering Strait school district has one employee who watches all school systems and contacts schools when there is an issue.
- Education and training are very important, so operator turnover is a big issue. AEA educates local operators on the systems they have, but knowledge can be lost through turnover. AEA operates a circuit rider program to assist local operators and keep education and training current. The state also pays for rural power personnel to attend AVTEC's operator training courses in Seward.
- Energy and cost savings are available by taking a more holistic approach to a community's needs and combining projects, such as powerhouse and tank farm upgrades, when possible. Heat recovery systems are included in every power plant upgrade project. AEA works with renewable resource managers when designing power and bulk fuel upgrade projects.
- There are a lot of fuel additives available but it is not clear whether they help with engine efficiency. It is up to a community if they want to try them. ACEP is looking into the efficiency of fuel additives.

Resources for Communities

AEA HEAT RECOVERY PROGRAM

AEA provides feasibility studies for heat recovery systems. Utilities should contact the AEA Heat Recovery Program Manager if they would like to assess the potential for installing or expanding a heat recovery system.

AVTEC TRAINIING FOR POWER PLANT OPERATORS

AVTEC, with funding from AEA, offers training courses for bulk fuel and power plant operators at its facility in Seward. Bulk fuel courses are two weeks long and power plant courses are eight weeks long but can be broken into two four-week courses that can be taken at different times. Advanced power plant courses are three weeks long and require the basic power plant course as a prerequisite. This is an excellent way to improve diesel efficiency by improving operator proficiency and system maintenance. There is no cost for instruction, lodging and per diem. The community is only responsible for travel to and from Anchorage. A bigger barrier may be the need to have an alternate power plant operator in the interim. Training is available for bulk fuel operators, power plant operators, advanced power plant operators, and hydroelectric plant operators. More information: Contact Chris Gobah at (907) 771-3989 or www.akenergyauthority.org/programtraining.html

AEA CIRCUIT RIDER / EMERGENCY RESPONSE SERVICES

AEA's Circuit Rider/Emergency Response program provides on-site assistance and training to local operators in the daily operation and maintenance of their powerhouse, as well as on-call, as-needed emergency action response to mitigate extended power outages and electrical hazards that present imminent threat to life or property. It provides funding for procurement of manpower, materials and equipment for emergency response to electrical generation and distribution system emergencies and disasters in Alaska. Emergency response is provided on an as-needed basis only. Well-managed utilities with adequate technical and financial resources are not candidates for these services. More information: Contact: Kris Noonan at (907) 771-3061 or go to www.akenergyauthority.org/programsenergysystemupgrade.html (55)

FOSSIL FUEL EXPLORATION & DEVELOPMENT

Resource Inventory

The report on Fossil Fuel and Geothermal Energy Sources for Local Use in Alaska shows coal, oil and gas are not known to occur in large quantities in the Kodiak region. The coal beds on Kodiak Island are believed to be thin and likely not an economic resource. Current data indicate accessible, recoverable conventional oil and gas resources are unlikely to be found.

There may be technically recoverable gas resources offshore on the Kodiak shelf or in Shelikof Strait. However, these areas have seen limited drilling, and there has been no petroleum industry interest in the region in 25 years. The geology of the region also makes it unlikely that commercial quantities of unconventional oil and gas resources, such as coalbed methane, tight gas sands, shale gas or gas hydrates, will be discovered. As a result, the report does not recommend future exploration (56).

5 | Renewable Energy

Biomass

As an energy source, biomass offers a range of options from a simple wood stove to a complicated system for gasification of solid waste. In Alaska the primary biomass fuels are wood, sawmill waste, fish byproducts and solid waste. In FY2015 six community-level biomass heat projects received funding for design and construction through AEA's Renewable Energy Fund. Large biomass projects are found primarily in Southeast and Interior Alaska. In Tok, a chip-fired boiler was installed at the school in 2010 and offsets an estimated 65,000 gallons of fuel oil annually. The project is successfully providing electricity and heat for the school building and has expanded to heating a commercial greenhouse with the aim of growing vegetables for school meals (57). Also in 2010, the Sealaska Corporation's headquarters in Juneau converted to a wood pellet boiler with an estimated offset of 30,000 gallons of fuel oil annually (58).

Resource Inventory

In the Kodiak region, utility level biomass is limited by the lack of commercially accessible timber and the absence of Class I landfills other than one in the City of Kodiak. This may prevent development of utility-scale combined heat and power (CHP) or complex gasification systems using large landfills. However, opportunities exist for smaller scale biomass projects.

FISH OIL

Seafood processors in Alaska produce approximately 8 million gallons of fish oil annually (59). The oil is usable as a boiler fuel or may be converted into biodiesel for use as diesel or heating fuel. Many seafood processors in the state use raw fish oil for heating and power generation onsite (59). An estimated 13 million gallons of fish oil is unrecovered, primarily from smaller fish processors. The technology for converting fish oil into biodiesel is available and would likely take the form of a portable fish oil rendering facility (59) (60).

Fish oil is a potential biofuel resource for communities that have at least one fish processing plant. With eleven land-based seafood processors, the City of Kodiak has the greatest resource potential. A demonstration project on community use of fish oil has not taken place in Alaska so this is an opportunity for exploration (60).

Table 23: Fish Oil Resource Potential by Community

Fish Processors (2013 permits)	Communities
1 to 3	Alitak (near Akhiok), Larsen Bay & Old Harbor
4 or more	City of Kodiak

Source: (61) (48) (14)

WOOD BIOMASS

The potential for utility-scale heat and electricity from woody biomass is minimal in large communities on Kodiak Island, particularly the City of Kodiak and the USCG base. A recent investigation by the National Renewable Energy Laboratory (NREL) found woody biomass on the island was not sufficient for sustainable or affordable use by the USCG Kodiak Base (62). A 2013 forest inventory report on state timber lands on Kodiak Island determined that state timberlands were not suitable for biomass harvest due to barriers to access, grazing lease conflicts, large diameter trees requiring expensive logging equipment, reforestation establishment problems, and likelihood of public opposition to harvesting the limited forest cover on the island (63). Other locations in the region, notably Afognak Island, have significant timber resources but are not easily accessible (60).

No community- scale wood biomass projects are currently operational in the region; however, there are many homeowners and businesses who heat with wood. The Alaska Energy Pathway report identified wood as a resource that could be deployed in the short-term for reducing diesel dependence in Akhiok, Larsen Bay, Old Harbor, Ouzinkie and Port Lions. Long-term sustainability could be an issue even for smaller-scale projects if wood biomass projects are pursued simultaneously in multiple communities or by multiple users within the same community without adequate communication and planning.

Successful deployment of biomass energy systems requires secure and sustainable wood supplies. It is important that wood harvest operations be planned in the context of overall land use objectives to minimize conflicts with other users (59).

Technology Notes

Technology to generate electricity from biomass is generally considered pre-commercial in the U.S. Most biomass to electrical generation systems are complex and have significant technical and economic challenges (59). This is especially true for small scale systems (less than 10 MW). Some companies are trying Organic Rankine Cycle and other new technologies around the 2 MW and less scale, but they are not yet proven to be commercially viable. Biomass to Steam Turbine electrical generation technology less than 2 MW is proven technology, but requires a very large heat load and certified mechanics and operators. Large hospital complexes are good applications for steam to electrical generation because they have large steam/heat needs (47).

By comparison, high-efficiency, low-emissions (HELE) wood boilers used for space and hot water heating rely on simpler technology widely used in rural Alaska. Woody biomass can be used directly as cordwood, processed into woodchips, or densified into pellets or bricks to increase their BTU content. Buildings that can be heated with less fuel can be equipped with high efficiency cordwood boilers. Larger buildings with higher fuel consumption need an automated boiler system that uses woodchips or pellets. The following information on the relative benefits of each for community-scale projects is from the Wood Heat Boiler Design & Permitting report prepared by RBA Engineers, Inc. (64).

CORDWOOD BOILERS

High-efficiency cordwood boilers are fairly simple systems. The GARN boiler, used in many Alaska communities, burns cordwood in a large combustion chamber to heat a large tank of water. When a thermostat calls for heat, a pump turns on and draws the hot water out of the tank into the heated space for distribution. The boiler can provide heat for domestic hot water by adding a water-to-water heat exchanger. Most cordwood boilers are manually operated.

Cordwood needs to be "seasoned" or "dry" in order to burn cleanly and efficiently. Depending on the unit size and outside temperature, boilers need to be loaded one to three times per day. The ash needs to be removed after every complete burn. Solid residues are mostly non-toxic and can be used as a soil amendment.

WOODCHIPS

Woodchips are a step up from using raw wood logs. A wood chipper ($30,000 to $100,000) needs to be purchased to process the trees. Compared with a cordwood system, wood harvesting is faster and more automated, and no cordwood stacking is necessary. More usable wood is available, because all parts of a tree can be chipped, including small limbs and branches.

PELLETS

The advantage of manufactured wood pellets is higher heating output and virtually no dust. Pellet-fed systems also require less complex fuel handling since pellets can "flow" into the combustion chamber. However, pellets would have to be made or imported since there is no pellet mill in the region.

Project Economics

As a fuel, biomass is cost stable compared with fossil fuels and should be for the foreseeable future. However, the economics of specific projects will depend on the abundance and location of the biomass fuel source and the complexity and readiness of the chosen technology.

COMBINED HEAT AND POWER

Biopower projects such as CHP and gasification systems are characterized by high capital and high projected O&M costs. They will likely be feasible only in larger communities with high power demand and high diesel prices. A 2007 study suggested that at then-current fuel oil and technology costs, only larger rural hub communities (e.g. Aniak, Dillingham, Fort Yukon, Galena, Hoonah, Tok, and Yakutat) were likely candidates for CHP systems. The economics could improve in the future for smaller communities as CHP technology evolves, especially if fossil fuel prices increase (59).

WOOD BIOMASS BOILERS

With low capital and operating expenses, wood biomass heating projects have generally strong economics, while providing local jobs benefits. Potential savings are greatest for buildings that currently require a lot of fuel oil to heat. Schools and other buildings that already use waste heat from a power plant to reduce fuel consumption will not benefit as much from switching to wood-fired boilers for heating. Cost savings will also be highest when wood is available as a byproduct of commercial processing (lumber mill, wood product manufacturing). The cost of wood increases and savings decrease where wood fuel is from round wood and forest residue, which is likely to be the case in the Kodiak region (59).

At a price of $250 to $300 per cord, wood provides the same amount of heat as fuel oil at $3.50 per gallon, assuming the wood being burned is locally harvested spruce, including 10% dead trees, air dried to 20% moisture (64). Efficient wood stoves and boilers required by EPA regulations are more expensive than some people can afford. The increased use of older, less efficient wood stoves and boilers in response to rising fuel oil costs can increase health risks related to air quality as has happened in the Fairbanks North Star Borough. Community- and industrial-scale systems are easier to regulate and present less of a health risk compared with domestic systems (59).

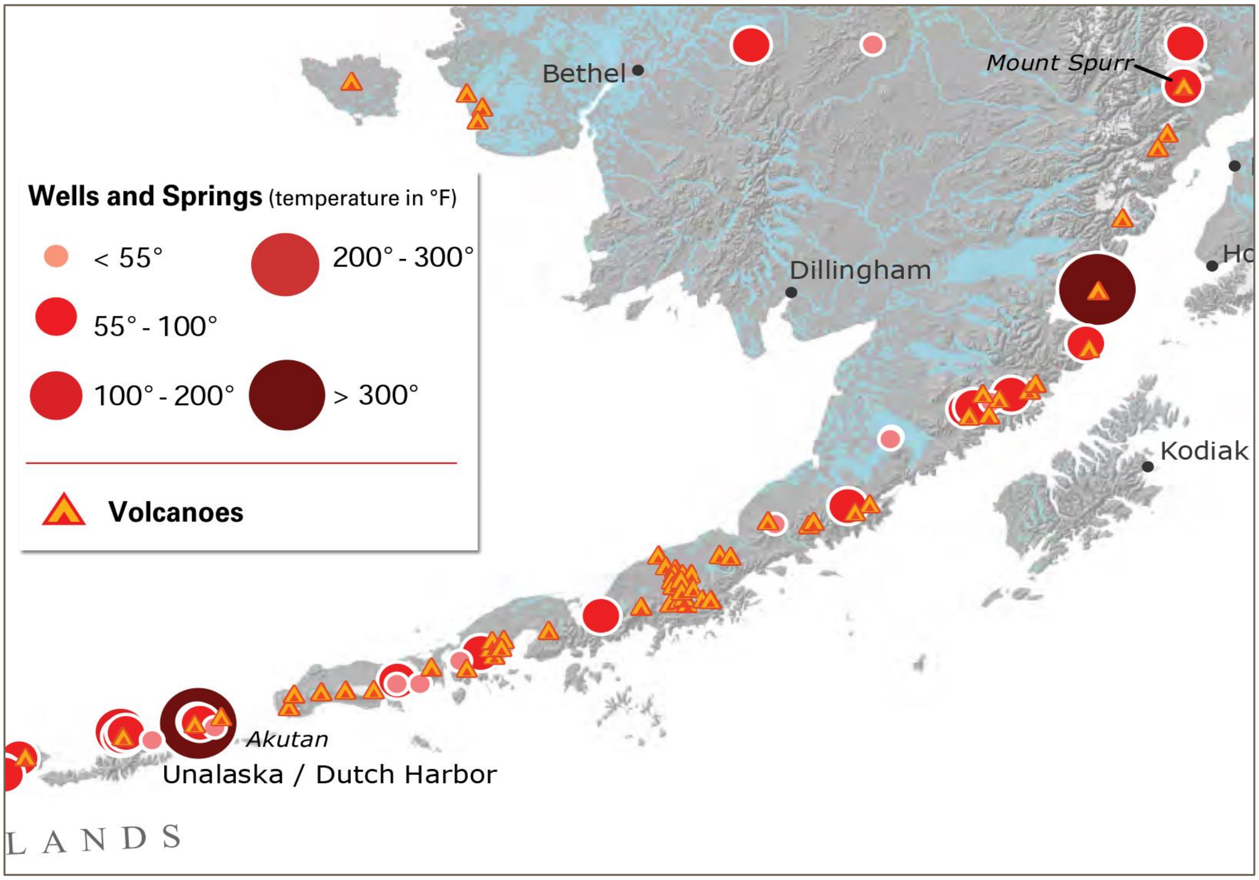
Pellet makers are available for small (residential) and large (industrial-size mills) application, but there is very little equipment and technology available for community scale systems. A micro-mill would likely cost $250,000 while a large mill can cost up to $16 million (64).

OPPORTUNITIES

ALASKA WOOD ENERGY DEVELOPMENT TASK GROUP

The Alaska Wood Energy Development Task Group (AWEDTG) puts out a request for applications each year for communities interested in a wood energy pre-feasibility study. The application is short, and although it is a competitive process, the group has been able to fund all applicants in recent years. More information: Karen Peterson UAF Cooperative Extension Service, phone (907) 821-2681, khpetersen@alaska.edu.

GEOTHERMAL



Geothermal Energy

RESOURCE INVENTORY

The Kodiak region has no known geothermal resources. The discovery of a developable geothermal system is unlikely given the absence of geologic phenomena such as thermal springs, fumaroles, warm lakes or mud pots, outside of the westernmost part of the region which borders the Katmai area but is far from population centers. The authors of the report on *Fossil Fuel and Geothermal Energy Sources for Local Use in Alaska* conclude that developable geothermal potential in the region is low and recommend no exploration (56).

PROJECT ECONOMICS

In evaluating feasibility and reconnaissance studies for potential geothermal projects statewide, AEA resource managers have found it is hard to make the numbers work given the expense of exploration and the relatively small populations served by remote projects. For this reason, AEA recommends a conservative approach when looking at potential geothermal resources (65).

Heat Pumps

Though the Kodiak region does not have developable geothermal resources, the climate and energy rates in the region are well-suited for use of heat pumps. Heat pumps, both ground source and air source, are technologies widely used in the lower 48 and increasingly in Alaska. Heat pumps transfer heat from a lower temperature reservoir (the ground or air) to a higher temperature sink (a building). The ability to extract heat from the environment is nearly unlimited but there is a cost: the electricity required to pump the heat to the high temperature sink (59). At present, the opportunities for ground source heat pumps are focused in areas with easy access to pump installation and with low electricity rates. Air source heat pumps are lower cost and simpler to install and show potential for use across the Kodiak region (66).

TECHNOLOGY NOTES

The Coefficient of Performance (COP) is the ratio of *heat output to work input*, which is a measure of the effectiveness of a heat pump. The COP is dependent on the temperature difference between the heat sources and heat sink—the greater the difference the lower the COP (59).

Heat pumps are classified as either air source heat pumps or ground source heat pumps. Air source heat pumps extract heat from the air and are easier and less expensive to install. The COP for air source heat pumps is highly variable and a major disadvantage of its use in cold climates, namely peak heat demand hits when the pump's COP is lowest. Recent developments have made air source heat pumps suitable for use down to 0°F. Ground source heat pumps use the relatively constant temperature of the earth as their heat source making their COP higher even in colder weather. Though ground source heat pumps have higher efficiency, the pumps are more complicated to install and more expensive (59).

Heat pumps are easily scalable so would work on a single residence or for a larger public building or set of buildings (66).

PROJECT ECONOMICS

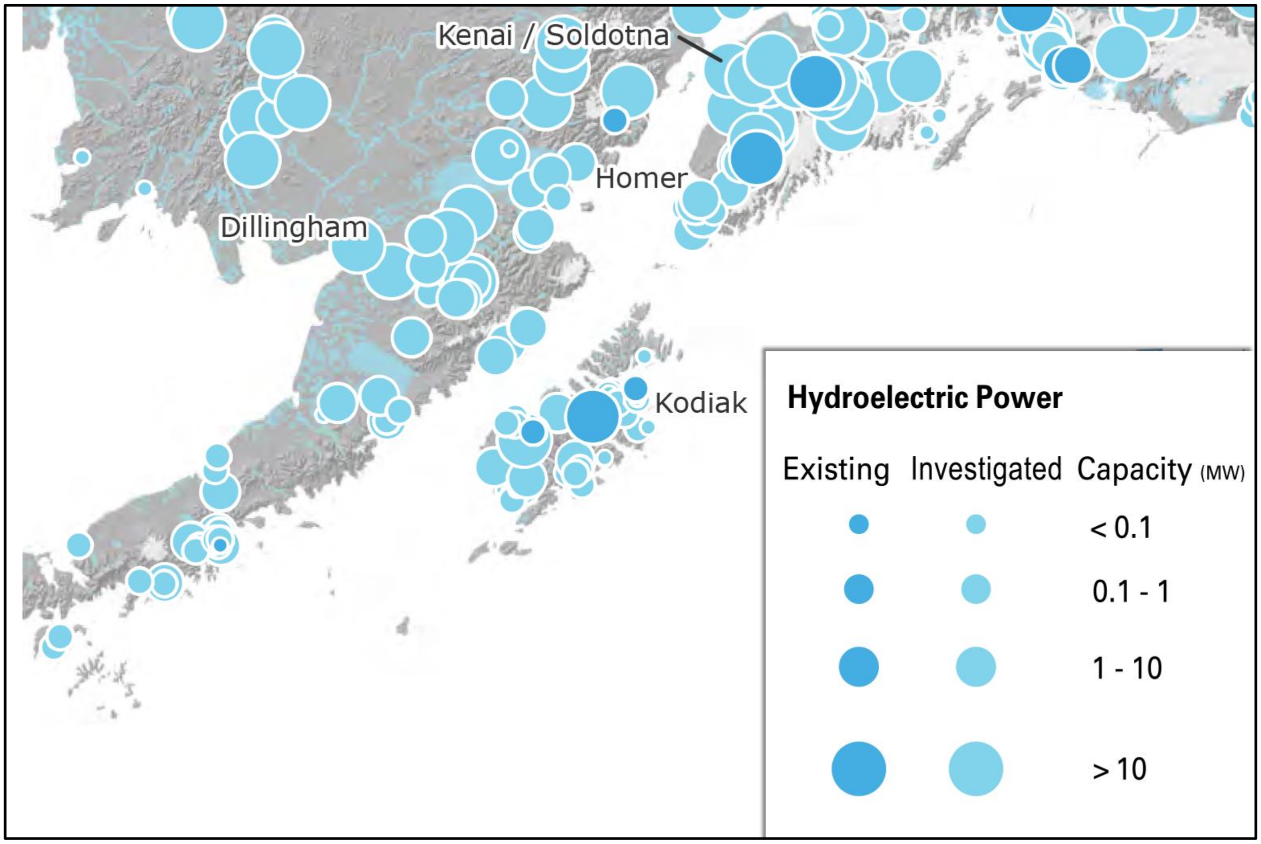
Heat pumps, whether ground or air source, are suitable for areas with high heating and low electricity costs. The upfront capital cost for equipment and installation of a ground source heat pump ranges from roughly $24,000 to $42,000. The wide cost range reflects different retrofits and company quotes from large communities across Alaska (67).The upfront cost for an air source heat pump in a small home is on average $3,000 (68).

Opportunities

ALASKA CENTER FOR ENERGY AND POWER & COLD CLIMATE HOUSING RESEARCH CENTER

ACEP and CCHRC are conducting research on the design, use and costs of heat pumps in Alaska. A recent report assessing ground source heat pumps is available online and a similar assessment of air source heat pumps is underway. CCHRC has a demonstration project with a ground source heat pump heating a building in Fairbanks with a high heating demand. The aim of this and other ACEP and CCHRC research on ground source heat pumps is to provide information on performance and economic viability of the technology in Alaska. For more information on ACEP go to: http://acep.uaf.edu/projects/ground-source-heat-pumps-a-statewide-assessment.aspx and for more information on CCHRC go to: http://www.cchrc.org/

Hydroelectric Power



Hydroelectric power is the largest source of renewable energy in Alaska, providing more energy than all other renewable sources combined. By the end of 2013, 40 hydroelectric projects with an installed capacity of 445 MW provided power to over 100 Alaska communities. Four additional sites or expansions were under construction at the time (69).

Though hydro projects have high up-front costs and significant licensing requirements, they have low operation and maintenance costs and long lifespans (50 to 100 years) that lead to stable, relatively inexpensive electric rates. Hydropower is able to generate large amounts of dispatchable electricity, offsetting diesel use and providing inexpensive electricity. Medium- to large-capacity systems integrate well with wind power, as KEA is doing. Factors that complicate project cost estimates and implementation are the need to mitigate environmental risks, identify site-specific costs, and upgrade powerhouses with automatic switchgears and controls.

Resource Inventory

The Kodiak region is home to three of the state's operational hydro projects and one of the expansion projects. The largest in the region is Terror Lake operated by KEA with an installed capacity of 31 MW. In 2014, it has generated 84 percent of the electrical energy produced for the KEA grid. Two smaller scale projects—Larsen Bay at 475 kW and Mahoona Lake in Ouzinkie at 125 kW—have been generating electricity for these communities for a long time. Needed upgrades and other hydro projects in progress in the region are listed in Table 24.

As with other renewable energy projects, there is a large difference in scale between projects in the KEA service area and the rest of the communities in the Kodiak region. With a hydro capacity of 31 MW, the Terror Lake facility is a large-scale hydroelectric project. The rest of the hydro projects in the region—both operational and proposed—are significantly smaller and serve multiple purposes. For example, the Mahoona Lake reservoir in Ouzinkie also serves as the municipal water supply. The decision on how often to operate the hydro facility is determined by the water level in the reservoir and its effect on providing water to city residents.

Table 24: Existing and Proposed Hydroelectric Projects by Community

Community	Existing Capacity	Proposed Project	Hydroelectric Resource	Next Step
Akhiok	-	-	1 site with 200 kW potential (70)	Hydro reconnaissance study, if interest exists
Karluk	-	-	3 sites with 180 kW to 420 kW (70)	Hydro reconnaissance study, if interest exists
City of Kodiak, Chiniak, Kodiak Coast Guard Base, Kodiak Station, Pasagshak, Port Lions & Womens Bay	31 MW (Expanded in 2013) (69)	Investigating additional hydro resources, will submit FERC app. by 2015 and will be online 5 yrs later.	Large reservoir – Terror Lake	KEA continuing feasibility studies on expansion sites
Larsen Bay	475 kW (Upgraded in 2009)	Complete upgrades to powerhouse and install new Pelton turbine (48)	Run of River – Humpy Creek	Secure funding for upgrades/replacement of equipment and funding and technical support to remove beaver dams without damaging facility
Old Harbor	-	262 kW to 296kW (71)	Run of River - East Fork of Mountain Creek 760 ft gross head	Secure funding for final design and construction
Ouzinkie	125 kW	Dam replacement in progress (replace wooden dam with concrete dam & raise 2 feet) (45)	Small reservoir - Mahoona Lake	Secure funding for study of dam upgrade to increase capacity
Port Lions	-	-	3 sites with 48 kW to 334 kW (70)	Hydro reconnaissance study, if interest exists

Technology Notes

DAM & RESERVOIRS

The dams and reservoirs of large hydroelectric projects provide for energy storage by holding water to be used to generate electricity when flows are lower. A strong attribute of these projects is the dispatchability that results from the ability to control the rate of power production through storage and release of water contained behind the dam. For small reservoirs, such as Mahoona Lake in Ouzinkie, the energy storage capacity is far smaller and would only last a few days (69).

RUN OF RIVER

A run-of-the-river project has little or no capacity for energy storage and cannot generate electricity on a schedule that matches consumer demand. Compared with other renewable energy alternatives like wind and solar, run-of-river hydro projects deliver a relatively consistent supply of electricity throughout the day. However, in Alaska these projects do not typically provide the same seasonal consistency in electricity supply that larger hydro projects can, because river flow rates are diminished in winter when Alaska electric loads are highest. Pairing a run-of-the-river hydro facility with other energy options is one method to avoid the seasonal mismatch.

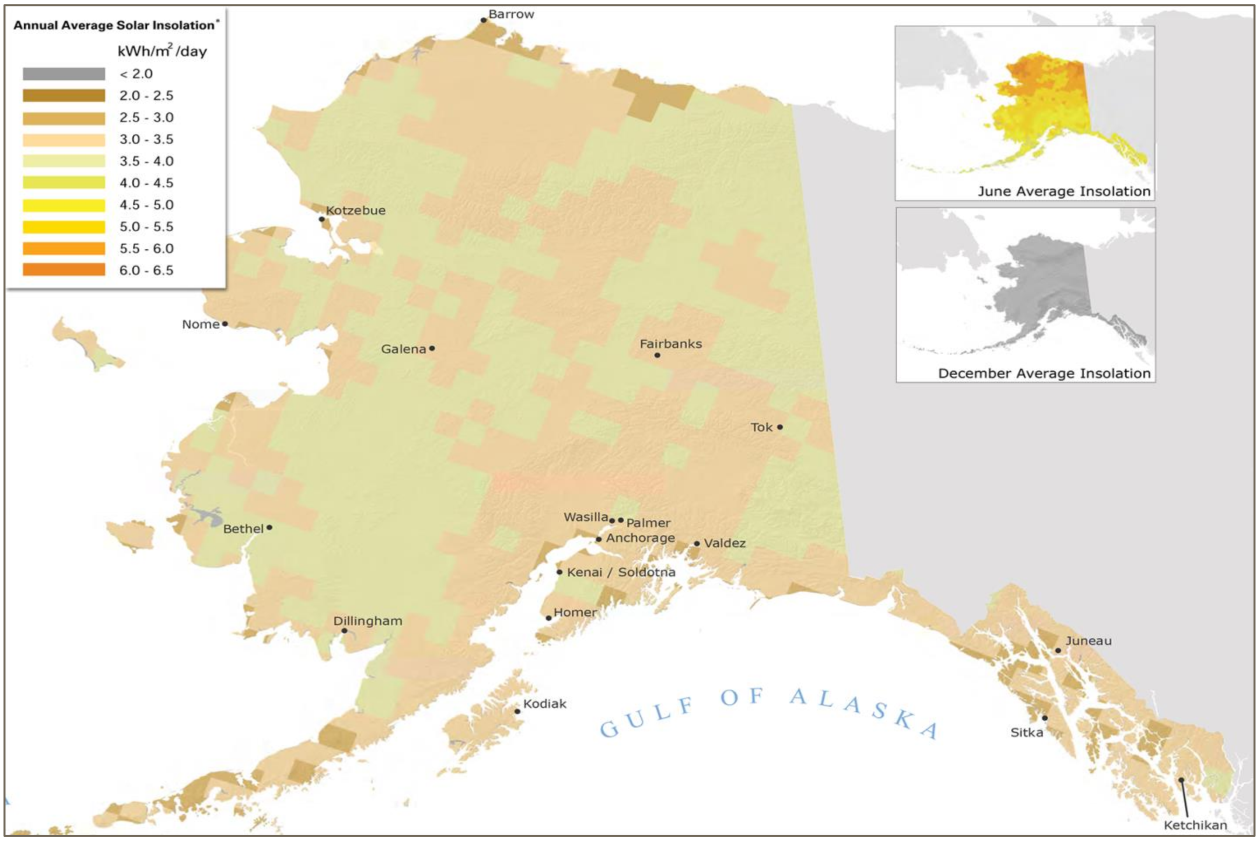
Project Economics

Estimating the cost of a hydro project based on unit cost factors is difficult because unit costs are variable and site specific. Site-specific details are particularly important when it comes to two large elements in the cost of a hydro project: turbine selection and transmission systems (59) (72). The high capital cost of hydro (especially on a per kW basis for smaller projects) is the chief impediment to economic feasibility. This cost tends to decrease over time as original capital costs are paid down through electricity sales and the influence of low O&M costs is felt (72).

Opportunities

The Kodiak region is in a good position to expand hydroelectric generation capacity in existing and proposed project locations. There is significant experience in the region. Despite cutbacks in state spending, the state has a strong record of funding hydroelectric projects that are community supported and economically feasible.

SOLAR



Active solar systems include both solar PV, where solar energy generates electricity directly in a semiconductor solar cell, and solar thermal hot water systems, where water is heated and the heat stored in a reservoir. Solar thermal energy (STE) systems use solar-heated fluid to supply in-floor heating systems normally fueled by conventional boilers. The low level solar resource in Alaska precludes high temperature solar technologies, such as systems that generate steam to produce electricity (59).

In all regions of Alaska, solar energy is most abundant in the spring and summer when it is least needed and minimally available in the fall and winter when it is most needed. For this reason, solar is not a resource likely to meet a major portion of an Alaska community's energy needs.

Since the cost of space heating accounts for close to 90% of household energy use in small rural communities, solar hot water systems may hold greater potential than electricity-producing PV systems for reducing energy costs in the region (21) (59).

Where it can be used economically, solar energy has the advantage of low maintenance and minimal environmental impact, with small project footprints and no CO_2 emissions. It is also an attractive option for sites where the noise and emissions from diesel generators may not be acceptable on a continual basis (73).

Resource Inventory

Solar resource is measured by solar insolation—the amount of solar radiation that strikes a square meter of the earth's surface in a single day ($kWh/m^2/day$). According to NREL data, no place in Alaska has a solar resource greater than 4.0 $kWh/m^2/day$. The average annual solar insolation in the Kodiak region is 3 $kWh/m^2/day$ (74). Given the state of solar technology and the solar insolation rate in the Kodiak region, the opportunity for community-level solar projects is low.

The Kodiak Island Housing Authority (KIHA) installed solar hot water systems in 46 homes in six communities. The projects were grant funded, and no data has been collected yet on energy savings. Solar hot water demonstration projects have been completed in Nome, Kotzebue and McKinley Village that are providing performance and economic data (74).

Table 25: KIHA Solar Hot Water Installation in Kodiak Region

Community	Solar Hot Water Systems Installed
Akhiok	2
Karluk	0
Kodiak	7
Larsen Bay	8
Old Harbor	18
Ouzinkie	7
Port Lions	4
Total	**46**

Source: (75)

Technology Notes

The typical solar energy system consists of multiple arrays of photovoltaic panels situated on top of buildings, towers or other relatively high structures. The fact that sunlight intensity varies from minute to minute due to changes in cloud cover, smoke from fires, blowing dust etc., requires that most solar-based systems have substantial battery storage (76).

Though the longest day is in June, the greatest amount of solar energy can be harnessed in Alaska from March through May when panels receive snow-reflected light in addition to direct sunlight. Coupled with cool temperatures that reduce electrical resistance, PV systems may exceed their rated output at this time of year (74).

Project Economics

While project economics is dependent on fuel oil prices and local resource, generally speaking prices for solar electric and solar hot water systems make them more expensive than diesel systems. This is true in part because of the extreme seasonality of the resource in Alaska where technologies other than solar must carry the load for five of the most energy intensive months of the year. For this reason, the addition of a solar auxiliary system does not reduce the capital cost of a primary heating or electrical system, which must be designed to operate without benefit of significant solar input.

For these reasons, solar PV energy may provide the best solution for systems off the power grid with relatively low power demand that operate primarily in summer, such as remote lodges (59) (74).

A rough look at the amount and costs of electricity generation from a 4 kW capacity residential PV system are shown in Table 26.

Table 26: Solar PV Energy Output in City of Kodiak

Month	Solar Radiation ($kWh/m^2/day$)	AC Energy (kWh)
January	1.18	106
February	2.28	194
March	3.49	331
April	4	352
May	3.97	359
June	4.35	371
July	3.67	315
August	4.27	369
September	3.23	279
October	2.59	236
November	1.71	156
December	1.08	98
Annual	**2.99**	**3,167**

Source: (77). Notes: DC Rating: 4.0 kW, DC to AC Derate Factor: 0.77; AC Rating: 3.08 kW; Fixed tilt: 70 degrees.

The installed cost of a 4 kW system in Fairbanks is currently about $16,000 (78). The payback period in Kodiak communities off the road system will depend on transportation and local installation costs, but could be faster than in Fairbanks or the City of Kodiak because of higher fuel and electricity costs; this is especially true for commercial utility customers in rural communities who pay the full, non-PCE subsidized cost of electricity.

Using solar PV or solar thermal energy technology to reduce space and hot water heating costs may be more economical than using solar energy to generate electricity.

The economics of solar projects will improve if the price of system components continues to drop. The U.S. DOE's SunShot Initiative has set a goal of making PV cells cost competitive without government incentives by reducing the cost of PV-generated electricity by about 75% between 2010 and 2020. Installed prices of U.S. residential and commercial PV systems declined 5% to 7% per year, on average, from 1998–2011 depending on system size, and by 11% to 14% from 2010–2011. Market analysts expect continuing reductions in system costs (79).

OPPORTUNITIES

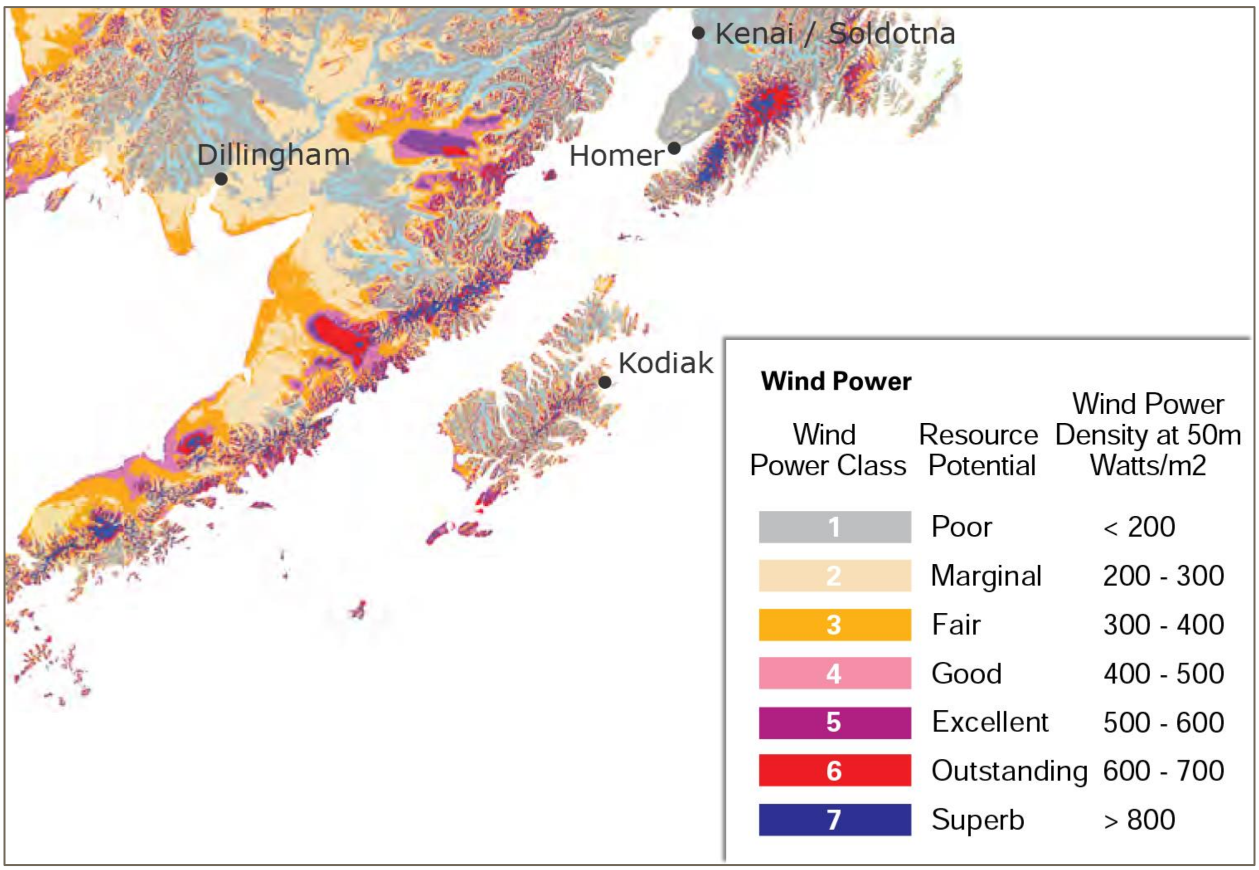
PVWATTS VIEWER

PVWatts uses weather data from stations across the country to provide data on solar insolation. The PVWatts Viewer is a free, Web-based application that lets the user click on a map or input a U.S. zip code to assess the energy production and potential cost savings of grid-connected solar PV systems at that location. The resulting data can then be plugged into a solar calculator on the same site to calculate the potential for solar energy production and cost savings by month based on local electrical rates. The user can either see the results based on a default PV system or input a different type and size of array. Access the PVWatts Viewer at: http://gisatnrel.nrel.gov/PVWatts_Viewer

ALASKANSUN.ORG

The alaskasun.org website has excellent information, including a number of publications related to solar installations in Alaska, and a list of contractors and suppliers.

WIND ENERGY



With commercially available technology and good wind resources, wind energy may be the best renewable resource for power generation in some communities in the region, especially those without a strong hydro option.

Much of the best winds in Alaska are located in the western and coastal portions of the state. In many parts of Southwest Alaska, turbines may actually need to be sited away from some of the best winds to avoid extreme gusts and turbulence (80). Areas with Class 3 winds or greater are considered to have a suitable wind resource for a wind project (81). This means good exposure to prevailing winds and annual average wind speeds around 4 meters per second (8.9 mph) or greater at a height of 30 meters if not obstructed by terrain features, vegetation, buildings, and atmospheric effects (82).

If technical challenges with integrating wind power into diesel systems and using excess generation for hot water and space heating can be resolved, wind could become a large part of energy generation for communities with good wind resources, though it will still not be an economical option for every community in the region. Wind energy economics depends on community size, the price of displaced fuel, as well as the quality and location of the wind resource.

Resource Inventory

The Kodiak region has one active utility-level wind project, producing 17 percent of the electricity generated on the KEA grid in 2013.

Table 27: Current Wind Energy Projects in Region

Communities Served	Utility	Existing Capacity	Next Step
City of Kodiak, Chiniak, Kodiak Coast Guard Base, Kodiak Station Pasagshak, Port Lions & Womens Bay	Kodiak Electric Association	Mt. Pillar Wind Farm – 9 MW with 3 MW Battery Energy Storage System	Wind penetration rate can reach 80%. Electric load must grow before any expansion of wind capacity (62).
Kodiak Island Borough School District	Kodiak Electric Association	2400 Watts	Wind for Schools educational project (83)

Outside the road system, wind resources have only been assessed in Old Harbor (see Table 28). Though the wind potential in the region is promising, additional assessments are needed before moving forward on wind projects.

Table 28: Wind Resource Assessment Data

Community	Met Data Class	Wind Model Class	Mean Annual Wind Speed (at 30m)	Wind Quality	Wind Study	Study Findings
Akhiok		4		Variable – Class 2 at airport, Class 4 at airstrip, Class 6 on hill west of town.	-	-
Karluk		7		All ridges have class 7 winds	-	-
Larsen Bay		6		Steep terrain to access ridges with Class 4 to 6 winds	-	-
Old Harbor	2		4.47 m/s	Low wind shear, moderately high turbulence	2009	Marginal
Ouzinkie		5		Class 5, 3 miles east of town	-	-
Port Lions		7		Class 7 on Mount Elison – very steep	-	-

Source: (23) (84)

Technology Notes

There is a Catch 22 for rural Alaska communities wishing to develop their wind resources. While larger turbines appropriate for the Railbelt or KEA grid are fully commercial, wind projects likely to be economically feasible in small, rural communities must rely on integrated wind-diesel systems that range from commercial to early-commercial depending on the level of wind penetration (59).

Turbines in the 100 to 300 kW range provide lower cost power per kWh, displace more diesel, and generate excess energy when the wind is blowing that can be used for space and hot water heating. However, the operational complexity of the system increases as the amount of wind energy increases compared with the load. Outside of the KEA grid, Kodiak region communities do not have peak loads in excess of 200 kW with most well below 100 kW on average.

Higher penetration systems require more sophisticated and expensive control systems to monitor and control power quality (85). In islanded systems there is also no readily available market for excess power. Excess electrical energy can be stored (in batteries or high temperature bricks) or dispatched as a secondary load to an electric boiler or heat recovery loop, but these increase the cost and complexity of the system. In high wind locations it is a challenge to find cost effective ways to store or dispatch extra wind energy so that it can be put to use reducing diesel consumption rather than being dumped.

The difficulty in integrating wind into a diesel system lies in the fact that diesel generators have a narrow operating range for peak efficiency, and at least one generator must be kept operating at all times to keep the grid up. Operating generators at other than peak efficiency results in higher operation and maintenance costs and generator wear. Unless a turbine generates enough power to allow the utility to shut down one diesel generator completely, savings from diesel displacement will generally be low (86).

Table 29: Wind Penetration Levels

Penetration Level[1]	Operating Characteristics	Instantaneous	Average
LOW	Diesel runs full-time Wind power reduces net load on diesel All wind energy goes to primary load No supervisory control system	< 50%	<20%
MEDIUM	Diesel runs full-time At high wind power levels, secondary loads are dispatched to ensure sufficient diesel loading or wind generation is curtailed Requires relatively simple control system	50% - 100%	20% - 50%
HIGH	Diesel may be shut down during high wind availability Auxiliary components are required to regulate voltage and frequency Requires sophisticated control system	100% - 400%	50% - 150%

Notes: 1/ The average annual penetration level is the amount of energy that will be produced by the wind turbine in a year.

Project Economics

The economics of wind is driven by the wind resource, community size and the cost of avoided fuel usage. A large community with a high cost of delivered fuel and a Class 4 or greater wind site appears to be the best candidate for wind energy under a range of future fuel price and capacity factor scenarios, according to a 2007 study by Crimp, Colt, and Foster. Urban and regional hub communities, like Kodiak, can take advantage of larger more efficient wind turbines, resulting in projects with a lower cost per kWh and shorter payback. The study found wind projects to be feasible in smaller communities if they have wind regimes of Class 5 or above and a high cost of delivered fuel, but as the size of the community drops below 350 people even the relatively small turbines (65 kW) may become difficult to efficiently integrate with an existing diesel system (72).

Because of the remoteness of many rural Alaska villages, most of the capital costs come from having to transport personnel, materials, components and special construction equipment to the site. These factors and construction of transmission lines in remote areas result in a relatively high cost per installed kW for wind energy. There is an opportunity for cost savings if multiple wind turbines are to be installed in the region by combining shipment, mobilization and construction activities (87).

Opportunities

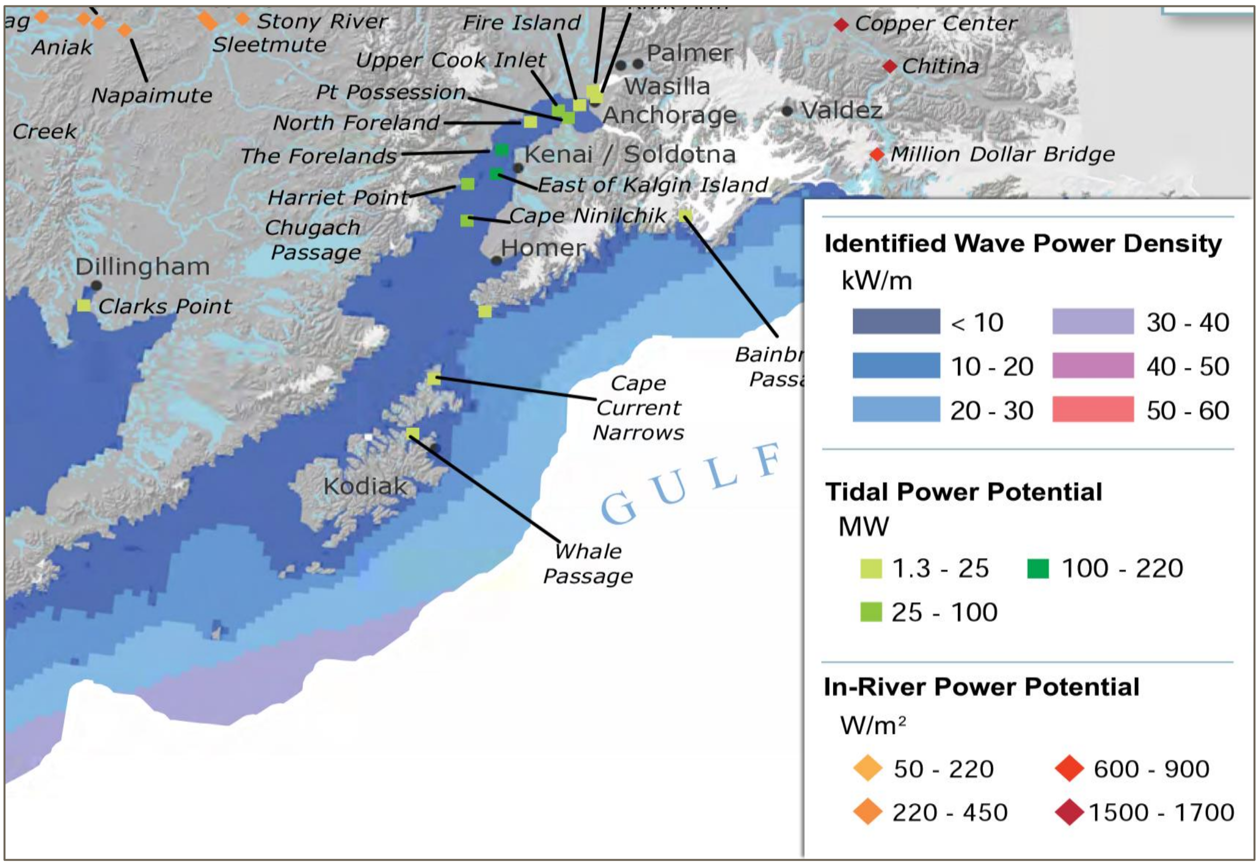
As noted earlier, the wind potential for the Kodiak region is largely unknown. There is a good opportunity for communities interested in wind to pursue or resume reconnaissance studies, which require the installation of a met tower and collection of a year's worth of site-specific wind data.

ANEMOMETER LOAN PROGRAM

AEA's Anemometer Loan Program supplies met towers, data logging equipment and technical support to utilities and communities interested in wind power that have the potential for utility-scale wind energy projects. After at least one year of data is collected the towers are relocated to other communities. Onsite met data allows for precise modeling and feasibility studies and is often required by potential project funding sources (88). More information: www.akenergyauthority.org/programwindanemometerloan.html.

6 | Emerging Technologies

Hydrokinetic



Ocean and tidal energy encompass three types of emerging energy technologies: ocean thermal conversion, tidal energy and wave energy. Requiring warm water, ocean thermal conversion is not suitable for any region in Alaska. However, tidal and wave energy may offer potential for expanding renewable energy resources in the state (89).

- **Tidal energy** is a concentrated form of the gravitational energy exerted by the moon and, to a lesser extent, the sun. This energy is converted into electricity by dams that force water through turbines at high and low tidal stages and by underwater turbines activated by tidal flows. These tidal flows may be captured in the ocean or in rivers using in-stream tidal generators.
- **Wave energy** harnesses the rise and fall of waves using generators that flex and bend as the waves push hydraulic fluids through turbines, which produces electricity (74).

The technology to harness hydrokinetic power from rivers, tides and waves is largely pre-commercial, especially in arctic and cold climate conditions, but it is developing rapidly. A tidal power pilot project is underway in Cook Inlet near Nikiski with the expectation of providing 5 MW of electricity to the Homer Electric grid (74) (90). Another demonstration project is underway in False Pass on the Aleutian chain. In-river systems have been tested in the Yukon River near Ruby and Eagle and the Tanana River near Nenana (66) (74). Ocean Renewable Power Company deployed a 25 kW in-river turbine in the Kvichak River at the village of Igiugig in 2014 (91).

Resource Inventory

Two locations in the Kodiak region, Whale Passage and Cape Current Narrows, are identified in the 2013 Renewable Energy Atlas of Alaska as sites with 1.3 to 25 MW of tidal power potential (74). Preliminary assessments on in-stream tidal potential in the Kodiak region have not been conducted. Since hydrokinetic turbines are emerging technologies, a significant amount of work remains to determine the feasibility of using tidal power in these sites or yet-to-be identified sites in the region, and to determine which devices perform the best.

Technology Notes

Tidal and river in-stream energy devices are placed directly in the river or tidal current and powered by the kinetic energy of the moving water. In-stream hydrokinetic devices typically use vertical or horizontal axis turbines similar to wind turbines. Because water is approximately 850 times denser than air, the amount of energy generated by a hydrokinetic device is much greater than that produced by the same-sized wind turbine. In addition, river and tidal flow do not fluctuate as dramatically as wind does. This is particularly true for tidal energy, which is not affected by weather and can be predicted years in advance (59).

Project Economics

There is minimal, if any, third party testing and verification of devices yet. Cost information is based largely on claims from manufacturers who typically underestimate project expenses in the early stages of development. In addition to capital costs, the economics of a project are also tied to other project costs (operation and maintenance, insurance, permitting, design and environmental monitoring costs) which could be substantial especially for early generation installations. These will likely vary from site to site and could dramatically impact the payback period (59).

Early estimates of the cost of energy for the first commercial-scale wave power facilities in the United States vary primarily with resource potential and O&M costs at different sites. While they do not compare favorably with some other forms of renewable energy such as hydropower, they are somewhat less than the costs for early commercial wind energy devices. Like those devices, the cost of wave energy facilities is expected to decrease with device improvement and operating experience (59).

HIGH VOLTAGE DIRECT CURRENT (HVDC) TRANSMISSION

The Kodiak region currently has only one intertie that connects a community off the road system with an existing grid: KEA and Port Lions. Preliminary studies of an intertie extending and connecting KEA's existing Monashka Feeder to Ouzinkie, which would include both over land and submarine sections, have been conducted but future action is not certain (92). All other electric generation and distribution systems function as islanded systems serving only a single community. This is due to economics, technology and historic interests of local communities.

An emerging, alternative technology to the traditional AC transmission lines is low-power high voltage direct current (HVDC), which is widely used around the world for transmission of large amounts of power (thousands of MWs) over hundreds of miles of land or for long-distance submarine cable interties. HVDC transmission technology for intertie applications below 20 MW is not commercially available at present (93).

The potential of HVDC for low-power applications is currently being studied. According to Joel Groves, an engineer with Polarconsult Alaska, Inc. work is underway to commercialize a compact, modular 500 kW HVDC converter suitable for interconnecting Alaska villages. The purpose of developing this technology is to help reduce the high cost of electricity in interconnected villages by lowering the cost of building and operating rural interties. The Denali Commission-funded project successfully constructed and tested a prototype converter in 2012. Future efforts will focus on refining the hardware design and completing testing and demonstration efforts so the converter technology is available for commercial applications in the next three to five years.

Resource Inventory

Low-power HVDC transmission lines are not currently installed anywhere in Alaska.

Project Economics

Where both systems are technically feasible, the decision is largely economic. An HVDC intertie will have higher terminal costs and lower per-mile costs. Accordingly, an AC intertie is likely to be more cost effective for short interties and HVDC more cost effective for long interties. The distance at which HVDC becomes more economic will be project specific, but is estimated at between 6 and 31 miles for low-power overhead interties in rural Alaska. The longer the intertie, the greater the cost savings of an HVDC versus AC system (93).

Conceptual cost estimates for a 25-mile 1 MW intertie in rural Alaska indicate the capital cost of an HVDC intertie will be approximately 30% less than for a comparable AC intertie (93). Since the HVDC converters under development for rural Alaska applications are new technology, substantial savings may need to exist to encourage utilities to adopt the technology in lieu of proven intertie solutions.

Opportunities

Since AC lines are not feasible for long-distance transmission, HVDC offers a potential solution to any Kodiak communities interested in interconnection. This is especially true when an intertie must employ long-distance submarine or buried cables, an area where HVDC is technically superior and as well as potentially less costly.

An additional potential benefit of HVDC transmission in the Kodiak region is its smaller visual footprint. Most AC interties are overhead and may not be environmentally acceptable in parts of Alaska. HVDC interties are either buried or have fewer wires and structures and may be more acceptable within refuges and other environmentally sensitive or protected areas.

Resources for Communities

ALASKA HYDROKINETIC ENERGY RESEARCH CENTER

The Alaska Hydrokinetic Energy Research Center housed within ACEP is actively testing and researching hydrokinetic technologies and sites with potential in Alaska. Reviewing the website or contacting researchers is an option for interested communities: http://acep.uaf.edu/programs/alaska-hydrokinetic-energy-research-center.aspx

AEA OCEAN AND RIVER ENERGY RESOURCES

Additional information on hydrokinetic devices and projects is posted on AEA's Ocean and River webpage: www.akenergyauthority.org/oreassessmentprojperm.html#Projects

7 | Energy Infrastructure

Transportation Infrastructure

Transportation is one of the primary uses of energy. Targeted improvements to transportation infrastructure will lower the amount of energy required to move passengers and freight. They can also directly lower the cost of energy in the region by reducing the transportation component of bulk fuel costs and the freight and logistical costs associated with energy project development.

Intermodal Access

While the Phase I Report for the Southwest Alaska Transportation Plan (SWATP) does not recommend specific projects, it suggests the following approaches (28):

- Prioritize roads that provide access to hub communities.
- Given the importance of air and sea transportation in Southwest Alaska, roads to aviation and marine facilities are of primary importance. Among the roads proposed by residents of the Kodiak region:
    - Road between Kodiak and Anton Larsen Bay, 12 miles
    - Road between Kodiak and Old Harbor, 45 miles
    - Road between Akhiok and cannery at Alitak, 7 miles
- Examine the potential of port and harbor improvements at selected regional and sub-regional hubs to reduce regional costs of living (e.g., improving roads to ports, improving barge delivery facilities).

Harbors and Docks

Currently, the condition of port and harbor facilities in Southwest Alaska is not tracked in any database, nor has a statewide port and harbor plan been developed. Communities are responsible for evaluation and maintenance of their facilities, and vie with one another for limited state funding. Few marine facilities in the state charge rates sufficient to cover long-term costs, such as depreciation or replacement.

During 2009 and 2010, the US Army Corps of Engineers (USACE) in cooperation with DOT&PF surveyed 855 facility managers, port and harbor administrators, and other community stakeholders about the condition of marine infrastructure. Responses from the Kodiak region were received from Akhiok, Kodiak, Port Lions, Larsen Bay and Old Harbor. The following tables list port and harbor projects and needs in the Kodiak region based on the survey data. Some improvements have been completed.

Table 30: USACE Marine Facility Data, Kodiak Region

	Dock Name	Control Depth (feet)	Max. Berthing (feet)	Condition[1]
Akhiok				
Karluk				
Kodiak	*Various*	30	40-1200	Fair/adequate to excellent
Larsen Bay				Port facilities: Poor
Old Harbor	City Dock	28	280	Port facilities: Good Boat harbor: Good to excellent
Ouzinkie				
Port Lions	City Dock	8	250	Port Facilities: Poor

Source: (28) (94). Notes: 1/ Based on 23 reponses to a USACE survey of residents 2/Revised based on feedback.

Table 31: Current Port and Harbor Projects, Kodiak Region

	Funding Agency	Project	Stage	Total Cost ($ Millions)
Port Lions	DCRA	City Dock and Ferry Terminal	Design	$11.7

Source: (28)

Recently completed projects include Port Lions: Harbor consturction ($5.0 million) and small boat harbor ($1.5 million). Kodiak: St. Herman Harbor ($5.0 million). Old Harbor: city dock replacement ($8.1 million).

Table 32: Barge Landing Improvement Needs, Kodiak Region

	Dolphins/ Fenders	Dock	Ramp	Dredging/ Rock Removal	Fuel System Improvements	Priority
Akhiok						
Karluk	✓	✓			✓	
Kodiak					✓	
Larsen Bay	✓					✓
Old Harbor					✓	✓
Ouzinkie		✓			✓	
Port Lions		✓			✓	✓
Womens Bay	✓					

Source: (28) (94). Priority means that the community was identified as a priority site in the USACE surveys in 2009-10.

Opportunities

The cost of barge-delivered fuel will be higher if a community has deficient moorings or marine headings due to the increased risk and extra time required for offloading fuel. If a community is missing a marine fuel header, extensive fuel hose runs from the beach up to the tank farms are needed or the fuel must be trucked off the barge resulting in higher costs.

The Denali Commission partnered with the USACE, Alaska District in 2007 to develop a Statewide Barge Landing Assessment, after three previous studies identified barge landing improvements as a critical need in rural Alaska (94). The study focused its first phase on the Alaska Peninsula, the Yukon, Kuskokwim and Kobuk Rivers, and the Bering, Chukchi and Beaufort Sea coasts. The report had the following general recommendations for improving the safety and efficiency of fuel transfers in waterfront communities:

- Consolidate marine fuel headers to a single landing site location at communities where multiple landings are currently required (e.g., electric utility, school, village corporation and stores all have separate tanks and headers). The header location is ideal if installed no more than 300 feet from the landing site, though 100 feet from the landing is preferred.
- Improve environmental concerns associated with floating fuel hose to shore by providing barge access to the shore. This effort could include removing navigation hazards and/or relocating the barge landing to a site where shore side receiving is practical.
- In some communities, a gravel causeway into the water may be a feasible approach to reaching sufficient water depth. In other cases, especially in areas of very shallow water, installing a new landing facility or dredging may not be practical. In these communities, relocating tanks and/or fuel headers may be the most feasible approach to improved delivery.

Ferry Service

Currently the City of Kodiak, Old Harbor, Ouzinkie and Port Lions are served by the Alaska Marine Highway System (AMHS). The concept of island-wide ferry service received support from the Kodiak Island Borough, Kodiak Chamber of Commerce, and the Ouzinkie Tribal Council in comments to the SWATP Phase I Update (28).

The following ferry service options are to be addressed in Phase 2 of the current SWATP Update:

- Evaluate potential use of the refurbished Tustumena as a summer shuttle ferry between Kodiak and Homer and use of the Tustumena replacement ferry for service to the Aleutians.
- Identify options and a strategy for improved ferry service to Kodiak Island and the Aleutians to be considered for further evaluation by AMHS.

Airport Improvements

Examining runway length needs in the region based on recent and potential changes to the aircraft fleet, to support economic development, and for economical fuel/cargo access for communities without barge service is one of the primary regional issues to be addressed in Phase 2 of the SWATP, expected to be released in early 2015. Current airport infrastructure is summarized in Table 33.

Currently, Karluk is the only community that receives bulk fuel by air, at significantly greater expense than barge delivery. Because only small planes can land on the current runway, fuel has had to be flown in daily by the barrel at times. If the necessity of flying fuel in is expected to continue, an expansion of Karluk's runway would lower fuel costs in the community. Runways over 4,000 feet in length can accommodate a Douglas DC-6 fuel cargo plane (73). However, a benefit-cost analysis of runway expansion should consider alternatives to the DC-6, since Everts Air Cargo's small fleet is aging and expensive to maintain.

Table 33: Airport Capacity: Current and Planned Design Aircraft

			Airport Layout Plan (ALP)		
	Runway	Navaids	Update	Current	Planned
Akhiok	3,120 ft. Gravel		1988		
Karluk	2,000 ft. Gravel			A-I Small Aircraft	No Change
Kodiak	7,542 ft. Asphalt	VASI	2004	Boeing 737-400 / Lockheed Martin C-130 Hercules	No Change
Larsen Bay	2,690 ft. Gravel		2008	Brit Norman Islander	No Change
Old Harbor	2,750 ft. Gravel		2008	Brit Norman Islander Piper Navajo Chieftan	
Ouzinkie	3,300 ft. Gravel		2006		Brit Norman Islander Piper Navajo Chieftan
Port Lions	2,200 ft. Gravel		1983		

Sources: (28)

Transmission Lines

The Kodiak Electric Association grid supplies power to the communities on the road system in northern Kodiak Island and the village of Port Lions across Kizhuyak Bay. The feasibility of expanding the grid to Ouzinkie by an undersea cable is currently being studied. More information on the status of the project is included in the community profile for Ouzinkie.

The only other community linkage recommended in recent regional planning documents is a road from Larsen Bay to Karluk. It is not known if residents of the two communities are interested in a road connection or if one would prove feasible given the rough terrain and the permitting challenges of crossing protected federal lands in view of a National Wild and Scenic River. However, if a Karluk–Larsen Bay road is pursued in the future, co-development of an electrical intertie in the same right-of-way should be considered. A road would improve the economics of an intertie by sharing construction costs and equipment and greatly reducing the maintenance costs. An intertie would add value to a road connection by creating economies of scale in electrical generation and allowing new renewable resources like wind to be tied in along the route.

The benefits of interties include (95):

- Greater energy efficiency by sharing available capacity
- Increased reliability of electrical power

- Potential to reduce the cost of electricity through the use of more efficient fuels or renewable resources
- New economic development from reducing the cost of power to business and industry

One downside of connecting villages is the loss of a heat recovery system, if one exists, in the community at the receiving end of the transmission line. The recipient community may also lose all or most of an FTE (full-time equivalent) job in powerhouse operations. A back-up diesel power plant will still be maintained in the community, but it will be operated on a standby basis requiring significantly less labor for operations and maintenance. This may be more than offset by new job creation that results from access to cheaper, more reliable power, especially for businesses and other non-PCE utility customers.

Resource Inventory

Table 34: Current and Proposed Transmission Lines to Non-Road Connected Villages

Community	Status	Capital Cost	Energy Sources
Kodiak – Port Lions	Complete	*NA*	Hydro, Wind, Diesel
Kodiak – Ouzinkie	Seeking funding for ongoing feasibility work	$7-9 Million	Hydro, Wind, Diesel
Karluk – Larsen Bay	Feasibility and community interest not determined	Not Known	Hydro, Diesel, Increased opportunities for wind

Project Economics

The cost of building transmission lines in roadless areas of Alaska has been roughly estimated at $400,000 per mile. Assuming costs on this scale, a 2009 transmission screening study by AEA looked at all village pairs in Alaska less than 25 miles apart to see if traditional AC transmission lines could reduce the cost of power to communities with existing diesel plants (96). Distances and rough order of magnitude (ROM) costs for Kodiak village pairs are shown in Table 35.

Table 35: 2009 Transmission Screening Study Results for Kodiak Village Pairs

Community A	Community B	Distance (miles)	Estimated Cost per kWh	Economic?
Kodiak	Ouzinkie	10.0	$0.69	No
Kodiak Station	Ouzinkie	12.8	$0.88	No
Port Lions	Ouzinkie	14.5	$0.99	No
Ouzinkie	Womens Bay	16.5	$1.13	No
Larsen Bay	Karluk	17.8	$5.19	No
Ouzinkie	Chiniak	24.6	$1.68	No

Sources: (53)

The study concluded that all village pairs in Alaska not already connected by a grid would have transmission costs greater than the potential savings of the line when capital costs, operations and maintenance, and utility margins are factored in. Grant-funded projects enjoyed better economics since only the cost of operating line needs to be covered through utility rates (96).

However, it should be noted that the screening study did not factor in savings from increased efficiency, economies of scale, reduced overhead costs, or the ability to attract new loads or tie in new renewable energy sources along routes. It looked simply at the difference in current generation costs in the two villages to see where relative savings existed. Nor did it place a value on social benefits from increased community and economic development or other quality-of-life factors. This is contrary to the recommendations of the transmission policy study prepared for the Denali commission by WHPacific in 2008:

> *Transmission lines should consider intangible criteria such as quality of life and economic development. The benefits and costs of transmission lines, often unforeseen, accrue over time frames much longer than most local or regional interests are capable of identifying and analyzing. Therefore, evaluations of the benefits and costs related to transmission systems must consider, in an integrated fashion, the multiregional effects of energy costs on quality of life and distant economic development.*

Even when socio-economic factors and economies of scale are considered, it is likely that the economics of new transmission lines longer than a few miles are challenging given current AC technology. One potential development that may change the equation in rural Alaska is the development of High-Voltage Direct Current (HVDC) transmission line for low power applications, which is discussed under the section on *Emerging Energy Technologies*.

The economics could also change in the future if there were new large loads or new large-scale generation opportunities ("value hubs") that create sufficient economies of scale to offset the high cost of building transmission lines in rural Alaska. New roads could also improve the economics by lowering the cost of constructing and maintaining transmission lines.

Opportunities

- Advocate for public funding of interties on the basis of their long-term public benefits and their value in promoting the sustainability of rural Alaska communities. Because these are not projects that will "pencil out" with private financing, there is a role for public funding or public-private partnership.
- Assess community interest in proposed interties, especially the interest of the "receiving" community. An intertie project should not be pursued without strong public support.
- Monitor developments in HVDC transmission for use in rural Alaska.

8 | Project Financing

There are four primary sources of project funding for energy projects: public funding, private equity, commercial debt and third-party tax-equity investment. While public financing through state and federal grant and loan programs is most common in Alaska, there is opportunity to expand into private financing in order to capture more project potential. Private financing options are being used successfully elsewhere and will become more important in Alaska if state and federal funding declines. While most programs are available to both taxable and tax-exempt organizations, it is important to consider tax status, project terms and ownership interest when considering financing options (97).

State and Federal Funding Options

Table 36: State Funding Options for Energy Projects

AEA	Bulk Fuel Upgrades (BFU)	Grants
Dave Lockard (907) 771-3062 www.akenergyauthority.org/programsenergysystemupgrade.html	AEA operates the Bulk Fuel Upgrades program, which replaces older bulk fuel tanks and infrastructure to bring them into compliance with state and federal regulations and reduces the risk of leaks and equipment failure. With significant funding from the Denali Commission, Bulk Fuel Upgrades have been completed in over 70 communities at a combined cost of over $200 million. AEA has another 30 projects on its list.	**Eligibility**: Communities that are served by AVEC, the North Slope Borough, Alaska Power and Telephone Co, or connected by roads are not part of the Bulk Fuel Upgrades program.
AEA	**Commercial Building Energy Audit (CBEA)**	**Grants**
Cady Lister (907) 771-3039 www.akenergyauthority.org/EfficiencyAudits.html	The CBEA program provides grants that cover up to 100% of the cost of an energy audit for privately owned commercial buildings. Grant amount is based on the size and complexity of the building. A stipend is available for the auditor to travel to locations. The maximum reimbursement ranges from $1,800 for buildings under 2,500 square feet up to $7,000 for buildings from 60,000 to 160,000 square feet.	**Eligibility**: Private owners of non-residential buildings up to 160,000 square feet. Both for-profit and nonprofit businesses are eligible.

AEA	Emerging Energy Technology Fund (EETF)	Grants
Alan Baldivieso (907) 771-3027 www.akenergyauthority.org/eetfundgrantprogram.html	The Emerging Energy Technology Fund was created by the Alaska Legislature to fund demonstration projects that test emerging energy technologies or methods that have a reasonable expectation to be commercially viable within five years. EETF funds can also be used to improve an existing technology or deploy one that has not previously been demonstrated in Alaska. Sixteen out of 70 applications were approved for funding in 2012.	**Eligibility**: EETF accepts applications from utilities, independent power producers, local and tribal governments, Alaska businesses and nonprofit organizations. Eligible projects must have a technology with a reasonable expectation of being commercial in five years and are designed to test emerging energy technologies or methods of conserving energy, improve on an existing energy technology or deploy an existing technology not previously demonstrated in Alaska.
AEA	**Industrial Energy Audits of Seafood Processing Plants**	**Service**
Cady Lister (907) 771-3039 www.akenergyauthority.org/eec-industrialenergyaudit.html	AEA launched an industrial energy audit program in 2010 to assist the seafood industry to better understand energy use in their plants in order to lower their carbon footprint and operating costs. The program has three parts: An energy audit kit (to measure power consumption of equipment and provide data to small and medium sized processors); an energy audit service for larger processors; an energy efficiency section on the Marine Advisory Program website to anonymously publish results of efficiency audits.	No subsidies currently available
AEA	**Power Cost Equalization (PCE) Program**	**Subsidy**
Jeff Williams (907) 771-3046 www.akenergyauthority.org/programspce.html	Alaska's Power Cost Equalization program provides economic assistance to residential customers and qualifying community facilities in rural areas of Alaska to offset the high cost of electricity compared with urban areas of the state. PCE pays a portion of approximately 30% of all kWh's sold by participating utilities. Participating utilities are required to reduce each eligible customer's bill by the amount that the State pays for PCE.	**Eligibility**: The Regulatory Commission of Alaska (RCA) determines if a utility is eligible and calculates the amount of PCE payable to the utility. AEA determines eligibility of community facilities and residential customers. Commercial customers are not eligible to receive PCE credit.
AEA	**Power Project Fund (PPF)**	**Loans**
Cady Lister (907) 771-3039 www.akenergyauthority.org/programsloan.html	The Power Project Fund provides loans to local utilities, local governments or independent power producers for the development or upgrade of small-scale electric power production. The loan term is related to the life of the project. Interest rates vary between zero, at the low end, and tax-exempt rates at the high end.	**Eligibility**: Small-scale (<10 MW) electric power production, including conservation, bulk fuel storage and waste energy conservation.

AEA	**Renewable Energy Fund (RE Fund)**	**Grants**
Shawn Calfa (907) 771-3031 www.akenergyauthority.org	The Renewable Energy Fund was created by the Alaska Legislature in 2008 with the intent to appropriate $50 million annually for five years. Actual appropriations have been around $25 million in recent years, and the program has since been extended through 2023. In Round VI, 23 out of 85 projects were recommended for funding. Individual awards ranged from $10,000 for a wind feasibility study to $6.7 million for hydroelectric project construction.	**Eligibility:** The Renewable Energy Fund accepts applications from utilities, independent power producers, and local and tribal governments for the purpose of developing renewable energy projects. It does not provide funding for energy efficiency improvements.
AEA	**Rural Power System Upgrades (RPSU)**	**Grants**
Kris Noonan (907) 771-3061 www.akenergyauthority.org/programsenergysystemupgrade.html	With significant funding from the Denali Commission, AEA operates the RPSU program, which replaces outdated, inefficient village powerhouse and electrical distribution systems, adds or upgrades heat recovery and remote monitoring systems, and improves overall diesel efficiency through other upgrades including electronic fuel injectors, switchgears and controls. RPSU projects have been completed in over 50 communities, and AEA plans to complete projects in over 50 more.	**Eligibility:** Communities that are served by AVEC, the North Slope Borough, Alaska Power and Telephone Co. or connected by intertie are not part of the RPSU program.
AEA	**Village Energy Efficiency Program (VEEP)**	**Discontinued in FY2015**
Rebecca Garrett (907) 771-3042 www.akenergyauthority.org/programsalternativeVEEP.html	AEA provides energy efficiency audits and improvements to community buildings primarily in rural Alaska through the Village Energy Efficiency Program.	
AHFC	**5-Star Plus New Home Energy Rebate**	**Cash Rebate**
(877) 257-3228 www.akrebate.com	A cash rebate of $7,500 is available for the purchase of a newly constructed 5-Star Plus home.	**Eligibility**: Must be original owner, not more than one year from time of completion. Individuals may not participate in a Home Energy Rebate and the Weatherization Program.
AHFC	**Energy Efficiency Revolving Loan Fund (AEERLP)**	**Loans**
Eric A. Havelock (907) 330-8245 www.ahfc.us/efficiency/energy-programs/energy-efficiency-revolving-loan-fund-aeerlp	AEERLP provides financing for permanent energy-efficient improvements to government-owned facilities. Financed improvements must be from the list of energy efficiency measures identified in an Investment Grade Audit. All improvements must be completed within one year of loan closing. Guaranteed savings from energy efficiency improvements are used to repay the loan. There is no maximum loan amount. The maximum loan term is 15 years.	**Eligibility**: Buildings must be owned by a government entity, such as the schools, local municipalities, state agencies, and University of Alaska buildings. Only improvements identified during an Investment Grade audit are eligible

AHFC	**Energy Efficiency Interest Rate Reduction (EEIRR)**	**Interest Rate Reduction**
www.ahfc.us/efficiency/energy-programs/interest-rate-reduction	AHFC offers an energy efficiency interest rate reduction (EEIRR) when financing new or existing 5-Star or 5-Star Plus rated homes or when borrowers purchase and make energy improvements to an existing home. Interest rate reductions apply to the first $200,000 of the loan amount. A loan over $200,000 receives a blended interest rate. The percentage rate reduction depends on the property's energy rating and whether there is access to natural gas.	**Eligibility:** Any property that can be energy rated and is otherwise eligible for AHFC financing may qualify for this program.
AHFC	**Home Energy Rebate (HER) program**	**Cash Rebate**
(877) 257-3228 www.akrebate.com	Homeowners receive rebates up to $10,000 after making energy-efficient improvements through AHFC's Home Energy Rebate program. Before ("As-Is") and after ("Post-Improvement") energy ratings are required. In January 2013, the program was changed to allow homeowners who previously used the HER or 5-Star Plus New Home Rebate programs to receive second rebates up to $10,000 for making recommended improvements.	**Eligibility**: The program is open to all owner-occupied, year-round Alaskan homeowners. There are no income requirements. Only one rebate per dwelling. Individuals may not participate in both AHFC's Weatherization and Home Energy Rebate Program.
AHFC	**Second Mortgage for Energy Conservation**	**Loans**
Alaska USA Federal Credit Union (888) 425-9813 www.ahfc.us/efficiency/energy-programs/second-mortgage-energy-conservation	Borrowers may obtain financing to make energy improvements on owner-occupied properties. All improvements must be completed within 365 days of loan closing (improvements not listed may not be included in the loan). For borrowers participating in the Home Energy Rebate Program, the rebate received will be applied toward the outstanding balance of loan. The maximum loan amount is $30,000. The maximum loan term is 15 years.	**Eligibility**: Homes must be owner-occupied, and only improvements on the list of energy upgrades included with an energy audit by an AKWarm™ Certified Energy Rater are eligible.
AHFC	**Weatherization Program**	**Cash Rebate**
(800) 478-808 www.ahfc.us/efficiency/energy-programs/weatherization/	Individuals who meet income guidelines may apply for the Weatherization Program through one of two weatherization service providers that serve specific communities in region. The weatherization provider will provide program services at no cost to qualified applicants. Every home receives health and safety measures, efficiency improvements and client education.	**Eligibility**: Homeowners and renters with household income equal to 100% of median income. Priority to households with people over 55 and under 6. Individuals may not participate in both Weatherization and Home Energy Rebate Program.
ADOT&PF	**STIP Community Transportation Program**	**Grants**
Irene Gallion (888) 752-6329 www.dot.state.ak.us/stwdplng/cip_stip	Community partners can take advantage of federal surface transportation improvement funding through a competitive process that generally runs on a 2-year cycle. Sponsors have to provide the required match, which generally runs approximately 10% of project costs.	**Eligibility**: Anyone can nominate a project, but it must have the support of the community that will eventually own the asset.

AIDEA	Sustainable Energy Transmission and Supply (SETS) Development Fund	Loans & Loan Guarantees
www.aidea.org /programs/specialtyfinancing/sets.aspx	The SETS fund was created with Senate Bill 25 as part of the Alaska Sustainable Strategy for Energy Transmission and Supply (ASSETS). The bill gave the Alaska Industrial Development Export Authority (AIDEA) the ability to directly finance energy infrastructure projects by issuing loans or to partner with banks or credit unions. AIDEA can also offer loan or bond guarantees, defer principal payments, and capitalize interest on project financing. Terms of 30 or 50 years are available to qualified hydropower or transmission line projects. Legislative approval is required if AIDEA finances more than one-third of the capital cost of an energy project or provides loan guarantees that exceed $20 million.	**Eligibility**: Qualified energy projects include: Transmission, generation, conservation, storage, or distribution of heat or electricity; Liquefaction, regasification, distribution, storage, or use of natural gas (except a natural gas pipeline project) for transporting natural gas from the North Slope or Cook Inlet to market; Distribution or storage of refined petroleum products.
ALASKA DCCED DCRA	**Bulk Fuel Revolving Loan Fund**	**Loans**
Jane Sullivan (907) 269-4614 commerce.alaska.gov/ dnn/dcra/ BulkFuelLoanProgram .aspx	The DCCED Division of Community and Regional Affairs (DCRA) now administers the state's single bulk fuel loan program. All loans must be paid within one year. The loan amount, added to the principle of all other bulk fuel revolving loans to the same borrower may not exceed $750,000. A cooperative organization representing more than one community may qualify for a loan amount not to exceed $1.8 million.	**Eligibility**: Loans may be made to a municipality or unincorporated village with a population under 2,000, or a private individual or company retailing fuel or electricity in such a community.
ALASKA DCCED DCRA	**Community Development Block Grants**	**Grants**
Pauletta Bourne (907) 451-2721 http://commerce.alaska.gov/dnn/dcra/GrantsSection/CommunityDevelopmentBlockGrants.aspx	DCRA administers the Alaska Community Development Block Grant Program (CDBG) to provide financial resources to Alaskan communities for public facilities and planning activities. CDBG competitive grants are single-purpose project grants; maximum of $850,000 per community. There are three basic funding categories: community development, planning and Special Economic Development.	**Eligibility:** Any Alaskan municipal government (except Anchorage) is eligible to apply for the grants. Non-profits may apply as co-applicants for these pass-through funds. Federal regulations require 51 percent of the persons who benefit from a funded project must be low and moderate income persons as defined by HUD.
Alaska DCCED DED	**Commercial Alternative Energy Conservation Loan Fund**	**Loans**
financing@alaska.gov (907) 269-8150 http://commerce.alaska.gov/dnn/ded/FIN/LoanPrograms/AlternativeEnergyLoanProgram.aspx	DCCED provides loans up to $50,000 to finance alternative energy systems or conservation in commercial buildings. Interest rates are fixed at time of loan approval. Maximum loan term is 20 years. Loan requests over $30,000 require a letter of denial from a financial institution.	**Eligibility**: Loans must be for the purchase, construction, and installation of alternative energy systems or energy conservation improvement in commercial buildings.

Alaska DEED	**Capital Improvement Projects (CIP)**	**Grants**
www.eed.state.ak.us /facilities /FacilitiesCIP.html	School districts can use CIP funds to address energy efficiency measures. Securing additional energy efficiency funds from another source may increase a CIP application's competitiveness.	**Eligibility**: Alaska school districts
Alaska DHSS	**Low Income Home Energy Assistance**	**Subsidy**
1-800-470-3058 dhss.alaska.gov/dpa /Pages/hap/	This federally funded program helps eligible families pay home heating bills and can assist with weatherization and energy-related minor home repairs. The federal Low Income Home Energy Assistance Program (LIHEAP) program is administered in Alaska by the Alaska Department of Health and Social Services (DHSS) through its Heating Assistance Program (HAP).	**Eligibility**: Families with incomes less than 225% of the federal poverty guidelines for Alaska may be eligible. Other factors that affect eligibility and final benefit amount include the family's community, type of dwelling and home heating system.

Table 37: Federal Funding Options for Energy Projects

BIA	**Energy and Mineral Development Program (EMDP)**	**Grants**
Dawn Chargin (720) 407-0652 www.bia.gov /WhoWeAre/AS-IA /IEED/DEMD/TT/TF	The Bureau of Indian Affairs (BIA) provides grants through an annual solicitation to help with the evaluation of conventional and renewable energy and mineral resources on Tribal lands. In return, the program provides Tribes and allottees with the information they need to promote their lands, negotiate the best agreements with partners or investors, and eventually develop their resources.	**Eligibility**: Activities can include initial exploration; market analyses; outreach and education to Tribes concerning energy or mineral development issues; economic evaluation and analyses; and promotion of completed projects at industry conferences and to prospective partners or investors.
BIA	**Indian Affairs Loan Guaranty, Insurance, and Interest Subsidy Program**	**Loan Guarantees and Interest Subsidies**
www.bia.gov /WhoWeAre /AS-IA/IEED /LoanProgram	The purpose of the BIA Guaranteed Loan program is to encourage eligible borrowers to develop viable Indian businesses through conventional lender financing. The direct function of the program is to help lenders reduce excessive risks on loans they make. That function in turn helps borrowers secure conventional financing that might otherwise be unavailable. BIA will guarantee a loan up to 90%. The interest subsidy covers the difference between the lender's rate and the Indian Financing Act rate.	**Eligibility**: Borrower must have 20% tangible equity in the project.

Denali Commission	Energy Program	Grants
Jodi Fondy (907) 271-3011 www.denali.gov	The Denali Commission is an independent federal agency with the authority to procure federal funding from Congress and a variety of federal agencies, such as the USDA. The commission has made energy its primary infrastructure theme since 1999. It primarily works with the AEA and AVEC to meet rural communities' energy infrastructure needs.	**Eligibility**: Projects include design and construction of replacement bulk fuel storage facilities, upgrades to community power generation, transmission and distribution systems, energy efficiency measures and alternative energy projects.
Denali Commission	**Transportation Program**	**Grants**
Tessa Axelson (907) 271-1624 | www.denali.gov	Denali Commission's Transportation Program assists rural roads and waterfront development. The waterfront portion of the program addresses planning, design and construction of port, harbor and other rural waterfront needs. Congress did not extend funding for the Transportation Program beyond 2012, but commission staff continues to administer the program in coordination with the Transportation Advisory Committee (TAC). The TAC is the body who, recommends projects and advises on rural surface transportation needs in Alaska.	**Eligibility**: Eligible road projects include, but are not limited to, ATV board roads, local community road and street improvements, and roads and board roads to subsistence use sites. Waterfront project types include, but are not limited to, regional ports, barge landings and docking facilities.
HUD	**Indian Community Development Block Grant (ICDBG)**	**Grants**
portal.hud.gov /hudportal/HUD?src= /program_offices /public_indian_housing /ih/grants/icdbg	The ICDBG Program provides direct grants for use in community and economic development, including housing rehabilitation, roads, water and sewer facilities, single or multipurpose community buildings, and a wide variety of commercial, industrial, and agricultural projects which may be recipient-owned and operated or which may be owned or operated by a third party.	**Eligibility**: Eligible applicants include any Tribe or Alaska Native village which has established a relationship to the Federal government as defined in the program regulations. In some instances, Tribal organizations may be eligible.
SBA	**7(a) Loan Program**	**Loans and Loan Guarantees**
www.sba.gov/category /navigation-structure /loans-grants /small-business-loans /sba-loan-programs /7a-loan-program	Congress established the 7(a) Loan Program under the Small Business Act to facilitate lending to small businesses. The program provides loan guarantees to for-profit businesses that are otherwise unable to secure funds through traditional lending. If the business is eligible, the Small Business Administration (SBA) will guarantee a maximum of 85% of the loan amount on loans up to $5 million, and repayment periods may extend up to 25 years.	**Eligibility**: A business must meet industry-specific size limitations. Loans guaranteed through the program may be used for a wide variety of business purposes.

USDA-NRCS	**EQUIP Seasonal High Tunnel Initiative**	**Grants and Technical Assistance**
www.nrcs.usda.gov/wps/portal/nrcs/detailfull/national/programs/?&cid=stelprdb1046250	The Seasonal High Tunnel Initiative provides financial and technical assistance to agricultural producers. Goals include extending the growing season and providing consumers with a local source of fresh produce. Maximum practice payment shall be for five percent of an acre and can be a single or multiple structures.	**Eligibility**: Individuals, legal entities, Tribes, or joint operations engaged in agricultural production.
USDA-RD	**Energy Programs**	**Grants, Loans and Loan Guarantees**
Energy Programs: www.rurdev.usda.gov/energy.html **Grants**: www.rurdev.usda.gov/RD_Grants.html **Loans**: www.rurdev.usda.gov/RD_Loans.html	USDA-RD has a $181.1 billion loan portfolio and expects to administer $38 billion in loans, guarantees, and grants in FY2013 (97). Several programs exist to promote the expanded use of biofuels and development of commercial-scale biorefineries.	**Eligibility**: Borrower must be rural small business or agricultural producer. Projects include feasibility, construction and energy efficiency improvements.
USDA-RD	**High Energy Cost Grant**	**Grants**
Kristi Kubista-Hovis (202) 720-9545 | www.rurdev.usda.gov/UEP_Our_Grant_Programs.html	USDA High Energy Cost Grants are available for improving and providing energy generation, transmission and distribution facilities serving communities with average home energy costs exceeding 275% of the national average. Grant funds may be used for on-grid and off-grid renewable energy projects, energy efficiency and energy conservation projects serving eligible communities. In Alaska, High Energy Cost Grants are made through the Denali Commission for energy generation, transmission, and distribution facilities serving rural communities with average home costs exceeding 275% of the national average. Grants range $75,000 to $5 million.	**Eligibility:** Communities in which average home energy expenditures exceed 275% of the national average.
USDA-RD	**Rural Energy for America Program (REAP)**	**Grants**
www.rurdev.usda.gov/BCP_Reap.html	The Rural Energy for America Program offers several grant opportunities, including: 1) the Energy Audit and Renewable Energy Development Assistance Grant; 2) the Renewable Energy System and Energy Efficiency Improvement Guaranteed Loan and Grant Program; and 3) the Feasibility Studies Grant. Grants grange from $2,500 to $500,000 or 25% of project costs, whichever is less.	**Eligibility**: Borrower must be rural small business or agricultural producer. Technologies include: biomass, solar, wind, hydro, hydrogen, geothermal. Applications include equipment, construction, permitting, professional service fees, feasibility studies, business plans, and land acquisition.

USDA-RD	Rural Utility Service (RUS)	Loans and Loan Guarantees
www.rurdev.usda.gov /UEP_About_Electric .html	The Rural Utility Service makes direct loans and loan guarantees to help finance the construction, improvement and replacement of rural electric utility infrastructure. RUS offers very low interest rate federal loans (~1%) with longer terms than banks, and they are willing to work with communities (98).	**Eligibility:** Borrowers must be electric utilities that serve customers in rural areas. Projects include electric distribution, transmission, and generation facilities.
US DOE	**Section 1703 Loan Guarantee Program**	**Loan Guarantees**
https://lpo.energy.gov /programs/1703-2	Section 1703 of Title XVII of the Energy Policy Act of 2005 authorizes the U.S. Department of Energy to support innovative clean energy technologies that are typically unable to obtain conventional private financing due to high technology risks. In addition, the technologies must avoid, reduce, or sequester air pollutants or anthropogenic emissions of greenhouse gases.	**Eligibility**: Must be pre-commercial technology. Technologies with more than three installations that have been active for more than five years are excluded.
US DOE-EERE	**Energy Efficiency & Renewable Energy (EERE)**	**Various**
www.eere.energy.gov **Funding Opportunity Exchange**: https://eere-exchange.energy.gov/ **Financial Opportunities by Audience**: www1.eere.energy.gov/financing/audience.html	The U.S. Department of Energy's Office of Energy Efficiency and Renewable Energy invests in clean energy technologies that strengthen the economy, protect the environment, and reduce dependence on foreign oil. The EERE website includes a database of funding opportunities and links to financial opportunities by audience (business, industry, universities, consumers, states and tribes, etc.)	
US DOE-IE	**START Alaska Program (START)**	**Technical Assistance / Grants**
Tracey LeBeau (202) 586-1272 | www.energy.gov/indianenergy/resources/start-program	The DOE Office of Indian Energy Policy and Programs (DOE-IE) partners with the Denali Commission to provide on-the-ground technical assistance (TA) and financial support to help participating tribes with renewable energy project development. Alaska Tribal governments, selected through a competitive application process, are paired with DOE, NREL, and other experts with experience relevant to the Tribe's clean energy technology and project development stage, including help conducting community-based planning and training. In the current round, each community can apply for $250,000 for a specific energy-related activity projects, including energy storage infrastructure, renewable energy deployment, and energy efficiency.	**Eligibility:** Tribal governments in Alaska.

US DOE-IE	Tribal Energy Program	Technical Assistance / Grants
apps1.eere.energy.gov /tribalenergy/about.cfm	The U.S. Department of Energy's Tribal Energy Program provides financial and technical assistance that enables tribes to evaluate and develop their renewable energy resources and reduce their energy consumption through efficiency and weatherization. The program also offers education and training opportunities designed to foster clean energy technology adoption, promote green jobs and growth, and strengthen Native communities.	**Eligibility:** Renewable energy and energy efficiency projects on tribal lands.

Private Equity and Commercial Debt

Private financing is typically used for the development of large-scale renewable energy projects that exhibit sufficient rates of return to offset perceived risk and high transaction costs. While private financing often requires a relatively large project scale for economic viability, many regional Native corporations have sufficient land holdings, earnings, and project development expertise to take advantage of private financing for renewable energy development. Although larger Native corporations may be best suited for private financing arrangements, smaller village corporations have potential to use private financing to fund portions of larger projects or group several projects together to attract capital (97).

Private equity can be used in conjunction with grants and federal and state tax credits to meet project funding requirements and bolster lender and investor confidence in overall project viability (97).

PRIVATE EQUITY INVESTMENT

The preconstruction phase of a large-scale project is typically funded with development equity, while capital for project construction is often provided through a combination of private investment and commercial debt (e.g., banks). Equity investors receive an ownership share in the project and are entitled to a portion of the distributable profits of the partnership (97).

Potential equity partners include Alaska Native corporations, village corporations, Tribal governments, federal and state government, local utilities and electric cooperatives, third-party developers, individual community members and nonprofit organizations.

DEBT FINANCING

In Alaska, debt financing for large projects can be sourced through entities such as commercial banks, credit unions, the U.S. Department of the Treasury (via its lending arm, the Federal Financing Bank), USDA, and now AIDEA (after passage of Senate Bill 25 in 2012).

While sources of bank debt do not have an ownership share in the project like equity investors, they do retain collateral claims on a project and may be required to approve major decisions in day-to- day management and operations. Still, if maintaining project ownership is a priority to a developer, it is preferable to structure the project's financing such that bank debt comprises a greater share of the capital structure than equity (97).

ENERGY SAVINGS PERFORMANCE CONTRACTING (ESPC)

Energy Savings Performance Contracting can be used to finance energy efficiency improvements through partnership with an Energy Savings Company or ESCO. ESCOs are often used by local governments and state and federal agencies to make improvements in government-owned buildings without up-front capital costs or budget appropriations. Typically, the ESCO conducts a comprehensive energy audit for the facility and identifies improvements. The ESCO designs and constructs a project that meets the agency's needs and arranges the necessary funding. The ESCO guarantees that the improvements will generate energy cost savings sufficient to pay for the project over the term of the contract. After the contract ends, all additional cost savings accrue to the agency. Contract terms up to 25 years are allowed (99).

Tax-Exempt Bonds

Local, state and Tribal governments also have the option of issuing tax-exempt bonds, which have the effect of lowering investment costs (compared with traditional borrowing), thereby lowering the cost of capital and the long-term cost of energy.

CLEAN RENEWABLE ENERGY BONDS (CREBS)

Clean Renewable Energy Bonds may be used by primarily public sector entities to finance a wide range of renewable energy projects. CREBs may be issued by rural electric cooperatives, municipal utilities, schools, and local, state and Tribal governments. The bondholder receives federal tax credits in lieu of a portion of the traditional bond interest, resulting in a lower effective interest rate for the borrower. The issuer remains responsible for repaying the principal on the bond. Congress has made over $1 billion available for CREBS. More information is available at www.dsireusa.org/incentives/incentive.cfm?Incentive_Code=US45F&ee=0

QUALIFIED ENERGY CONSERVATION BONDS (QECBS)

Congress authorized $800 million in tax-exempt Qualified Energy Conservation Bonds (QECBs) in 2008 to finance qualified energy conservation projects. Allocations were made state by state based on population. In Alaska, $7.1 million was allocated, but no bonds have been issued yet. When surveyed, many states indicated that they had not used the program due to high transaction costs associated with small allocations, debt aversion, and lack of awareness. More information is available at www.dsireusa.org/incentives/incentive.cfm?Incentive_Code=US51F

Tax Credits

Tax credits can lower capital costs by 40% to 50%. There are several federal tax credits currently available for qualified investments in renewable energy technologies, in addition to accelerated depreciation, which improves the economic viability of a project by reducing tax liability in the initial years of production. Current tax benefits are shown in Table 38. Note: Tax credits that expire in 2013 are not shown.

A 30% tax credit reduces the capital cost of a project by 30%. The federal government essentially pays for a third of the project. However, only taxable entities, such as Alaska Native corporations and third-party developers, can take advantage of these benefits. This provides an incentive for tax-exempt utilities and local governments to find ways to partner with taxable entities when developing renewable energy projects (98).

Table 38: Federal Tax Incentives for Renewable Energy

Tax Credit	Amount	Eligible Projects	Details
Investment Tax Credits (ITC)	30%	Solar, fuel cells (≤0.5 kW), small wind (≤100 kW), geothermal, microturbines (≤2 MW), and combined heat and power (≤50 MW)	Available when the project is placed in service. Expires 12/31/2016
New Market Tax Credit (NMTC)	39%	Investments in qualified community development entities (CDEs). Most Alaska villages qualify.	Claimed over a 7-year period. Starting in the year the investment is made
Modified Accelerated Cost Recovery System (MACRS)	NA	Accelerated depreciation is available to qualified investments in wind, geothermal, and solar technologies	Enables investment to be recovered over a 5-year schedule in lieu of the standard life of the asset.

Source: (97)

TAX-EQUITY PARTNERSHIPS

Tax-equity partnerships are financing arrangements that enable tax-exempt entities and taxable entities with insufficient tax liabilities, to take advantage of tax credits to lower a project's capital costs. While there are several variations on tax-equity partnerships, all require assigning project ownership to an investor with sufficient tax liability to fully capture available tax benefits. This is typically a large U.S. bank or insurance company. Google has also made such investments. The taxable entity must retain ownership of the project until the tax credits have been fully captured, after which ownership can be transferred to the public utility or other tax-exempt entity (97).

Financing through tax-equity partnerships typically requires more complex transactions than other options in order to allocate risk and return among the parties involved. There are several ways to structure a tax-equity partnership: partnership flip, sale-leaseback, and pass-through lease. For more information, see *Financing Opportunities for Renewable Energy Development* listed under Resources for Communities at the end of this section.

Power Purchase Agreements and Net Metering

Net metering and third-party power purchase agreements provide additional mechanisms for project developers to capitalize on renewable energy deployment.

POWER PURCHASE AGREEMENTS (PPA)

A Power Purchase Agreement (PPA) is a legal contract between an electricity generator (seller) and a power purchaser (buyer). The seller is typically an independent power producer (IPP).The buyer is often a utility or large power user, such as a business, municipality, university, school, or hospital. The buyer enters into a long-term contract to pay a predetermined rate for the kilowatt hours delivered from the renewable energy asset. The length of the contract can range from 5 to 20 years. The PPA rate is typically fixed or pegged to a floating index on par with or below the current electricity rate being charged by the local utility company.

The renewable energy developer uses the contract to attract private investors who are comfortable with the customer's ability to make payments over the term of the agreement. If the energy payments over the life of the contract plus any other incentives produce a desirable return on investment, then investors will provide the up-front capital to finance the project. Such agreements play a key role in financing independently owned electricity generating assets.

The PPA financing structure is most appropriately utilized for a planned major renewable energy installation, where speed is less critical, since it requires coordination from all stakeholders. They may also be appropriate where projected revenues are uncertain and so some guarantees as to quantities purchased and price paid are required to make the project viable, or where there is one or a few major customers who will be taking the bulk of the product and who want price certainty and security of supply (100) (101).

NET METERING

Alaska's net metering regulations require that all utilities with retail sales of at least 5 GWh (5 million kWh) offer net metering to their customers for renewable energy systems up to 25 kW in capacity. Net excess generation (NEG) is reconciled each month, with the utility issuing the customer a credit for NEG. The state's interconnection guidelines mandate that all utilities that are required to offer net metering must also issue tariffs incorporating interconnection (97).

Freeing the Grid, an annual scorecard rating state-level net-metering and interconnection standards, gives Alaska's net-metering regulations a "C," citing the arbitrary system size limits not based on on-site load, monthly NEG reconciliation instead of indefinite NEG carryover, and ambiguity regarding renewable energy credit (REC) ownership as areas that reduce the impact of this policy on driving investments in renewable energy generation (97).

Resources for Communities

FINANCING OPPORTUNITIES FOR RENEWABLE ENERGY DEVELOPMENT IN ALASKA

The DOE Office of Indian Energy and NREL have put together a handbook on financing renewable energy development in Alaska. It provides an overview of existing and potential financing structures with a focus on four primary sources of project funding: government financed or supported, developer equity capital, commercial debt, and third-party tax-equity investment. It is available electronically at http://energy.gov/indianenergy/downloads/financing-opportunities-renewable-energy-development-alaska

More information on private financing is available in *Renewable Energy Development in Indian Country: A Handbook for Tribes*, published by the U.S. DOE Tribal Energy Program and available at apps1.eere.energy.gov/tribalenergy/pdfs/indian_energy_legal_handbook.pdf

9 | Stakeholder Outreach

Stakeholder outreach, meaning engagement with the users and producers of energy in the region, spanned Phase I and Phase II of the energy planning process. This section details the steps taken to identify the regional and community energy priorities and the body established to transition energy planning from the Alaska Energy Authority to regional and community representatives.

Methodology

In Phase I and II of the Regional Energy Planning process for the Kodiak Region, significant effort has been made to ensure that interested parties in the region are not only aware of the process but involved in directing attention and support to the priorities and concerns at the regional and community levels. The outreach in Phase I served to identify tentative community priorities and informed the creation of key energy issues and recommendations. Outreach in Phase I included both stakeholder interviews and presentations and group discussions at regional events. Outreach in Phase II built on Phase I efforts to increase stakeholder input and action and identify priorities and support for particular energy strategies. The aim of Phase II outreach was the

- Revision of Phase I Resource Inventory and Profiles;
- Community-led inventory of public buildings;
- Collection of energy use and priorities from industry;
- Identification of community energy priorities and concerns;
- Prioritization of regional strategies; and
- Development of the Kodiak Energy Committee that with the support of SWAMC, AEA, and regional and community organizations will be able to take the lead on implementing energy priorities at the community and regional levels.

The Phase II outreach took the form of regional presentations, community meetings, community-led collection of benchmarking data, an industry survey, a regional Energy Summit, and Energy Committee teleconference.

Phase II Outreach

REGIONAL PRESENTATIONS

September 18, 2014: Kodiak Archipelago Rural Regional Leadership Forum

Project team members presented in person and via teleconference on Phase I: Resource Inventory findings and recommendations. This served as the release of the Phase I report in the region. The presentation informed community members of feedback forms and the need for input on the Phase I report and community profiles. Project team also announced the formation of an Energy Summit Steering Committee tasked with planning the January 2015 Energy Summit.

November 13, 2014: Kodiak Island Borough Work Session Presentation

Project team members presented for the Kodiak Island Borough Work Session on the Phase I findings and requested participation in the January 2015 Energy Summit.

COMMUNITY MEETINGS AND PRESENTATIONS

The project team visited and held meetings in all Kodiak Region communities. The purpose of the meetings was to outline the energy planning process, identify or affirm community energy priorities and concerns, and to enlist assistance with completing benchmarking forms for public buildings. The schedule of meetings is below and the information collected on community priorities and concerns is included in each community's profile. Benchmarking data, which is currently being collected, is stored with AEA for entry in the ARIS database.

November 10, 2014: Presentation City of Kodiak

December 9, 2014: Port Lions Presentation and Community Meeting

December 10, 2014: Akhiok Presentation and Community Meeting

December 11, 2014: Ouzinkie Presentation and Community Meeting

December 16, 2014: Larsen Bay Presentation and Community Meeting

December 17, 2014: Karluk Presentation and Community Meeting

December 18, 2014: Old Harbor Presentation and Community Meeting

COMMUNITY-LED BENCHMARKING

During the community meetings in December 2014, SWAMC and AEA worked with community volunteers to complete benchmarking forms for public buildings. Several communities completed and returned forms. The purpose of this inventory and data collection effort is twofold. First, spread awareness about the importance of benchmarking energy use not only for public buildings but for all buildings and facilities both publicly and privately owned. Second, update data in the AHFC ARIS database on the buildings, square footage, and energy use in Kodiak communities. This information will serve as a baseline of energy use against which all energy efficiency upgrades may be compared.

INDUSTRY SURVEY

December 2014 – February 2015: Kodiak Industry Survey

Project team members designed an online survey requesting information on energy usage, generation sources, expected load changes, and energy efficiency measures related to commercial facilities. Surveyed businesses were primarily fish processors. The survey tool is presented in Appendix A. Significant outreach in the form of phone calls and emails was conducted. Three businesses and facilities completed the survey. Due to the small pool of responses, additional data on energy usage was not collected or analyzed for this report.

ENERGY SUMMIT

October 2014 – January 2015: Kodiak Energy Summit Steering Committee

Project team members facilitated four teleconference meetings of the Kodiak Energy Summit Steering Committee. The purpose of the Steering Committee was to plan the Energy Summit. The Steering Committee made decisions on which agencies should attend, topics to be addressed, speakers to present, agenda review, and confirmation of regional strategies for polling at the January 2015 Energy Summit. The committee was composed of one to three community representatives from Akhiok, City of Kodiak, Karluk, Larsen Bay, Old Harbor, Ouzinkie, Port Lions and representatives from Kodiak Island Borough, Kodiak Electric Association, AVEC, Koniag, Inc., Kodiak Area Native Association, Denali Commission, Alaska Energy Authority, U.S. Dept. of Energy, SWAMC, and Information Insights.

January 27, 2015: Kodiak Energy Summit

Full day Kodiak Energy summit provided resources for energy project development and funding. This includes projects on electricity generation, heating, and energy efficiency and conservation. Presenters from the Kodiak Region and other parts of Alaska also provided information on systems, technologies, and funding models that may be used effectively in the region. The final agenda is in Appendix B.

The regional strategies discussed and prioritized during the Kodiak Energy Summit in January 2015 are below.

Regional Energy Strategies and Example Projects

- DO WHOLE VILLAGE RETROFITS OF DIESEL-DEPENDENT COMMUNITIES
  Example:
  - Prioritize efficiency programs; powerhouse upgrades; community wide weatherization targets for homes, public buildings, and commercial buildings; audit/energy efficiency upgrades to water and sewer system; replace street lights and exterior lighting with LEDs; and install smart meters in every building – bundle all as a single project

- ENCOURAGE ENERGY EFFICIENCY AND CONSERVATION OF HOMES AND BUSINESSES
  Examples:
  - Set targets for energy audits, weatherization, energy efficiency upgrades, and dedicate staff or funding to facilitate upgrades in homes and businesses
  - Support region wide energy conservation programs, such as Energy Wise
  - Use AK Energy Smart curriculum in K-12 classes throughout KIBSD

- MAXIMIZE ENERGY EFFICIENCY OF PUBLIC INFRASTRUCTURE
  Examples:
  - Prioritize funding and action on implementing efficiency measures in KIBSD buildings
  - Coordinate effort to apply for AHFC public facility audits and funding to implement most cost effective measures across region
  - Conduct inventory of public outdoor lighting and apply for a single form of financing to replace conventional lights with LEDs in all communities

- Work with ANTHC to audit water and sanitation systems and identify funding to implement most cost effective measures in all communities

❖ ADDRESS RURAL UTILITY ISSUES AND NEEDS THROUGH COLLABORATION

Examples:

- Create committee or planning group to identify and address training needs and share information
- Invest in remote monitoring, SCADA, to improve diesel efficiency

❖ INVESTIGATE AND DEVELOP REGIONAL RENEWABLE ENERGY GENERATION OPPORTUNITIES

Examples:

- Support communities in submitting financing applications for energy projects
- Bundle related community energy projects into regional level projects
- Dedicate regional staff to energy project development
- Biomass – wood pellet manufacturing and pellet stove installation in public/private buildings across the region
- Wind – standardization, bundling, and implementation
- Solar Thermal – implementation in public and private buildings
- Solar PV – implementation for small scale electricity generation

❖ MONITOR EMERGING TECHNOLOGIES

Example:

- Tidal, ocean, and others

❖ REPAIR AND MAINTAIN CURRENT INFRASTRUCTURE

Example:

- Region wide assessment of powerhouses and transmission and distribution lines to identify priority needs and possibility of bundling projects

❖ ADDRESS MARINE INFRASTRUCTURE NEEDS

Example:

- Conduct feasibility study on dock or harbor infrastructure to improve fuel supply and distribution efforts

❖ MAXIMIZE DIESEL EFFICIENCY AND HEAT RECOVERY

Example:

- Work with ANTHC to identify heat recovery potential and funding options in communities throughout the region

Energy summit participants answered two questions on each of the above strategies: 1) Is this an immediate, medium term or long term priority and 2) What support would you, your community, or regional organization offer to assist with implementation of this strategy? After the first round of questions, participants were asked to rank their top three priorities out of all strategies identified as immediate priorities. The results of this are in Table 39.

Table 39: Top 3 Immediate Energy Priorities for Kodiak region

26%	Encourage energy efficiency and conservation of homes and businesses
24%	Maximize energy efficiency of public infrastructure
20%	Repair and maintain current infrastructure
14%	Investigate and develop regional renewable energy generation opportunities
12%	Address rural utility issues and needs through collaboration
3%	Maximize diesel efficiency and heat recovery

Based on input from Kodiak Energy Summit participants and additional community concerns and priorities collected at the Summit, a revised list of program goals based on regional energy priorities was developed.

Table 40: Kodiak Program Goals

1. Encourage energy efficiency and conservation of homes, businesses and private capital
2. Maximize energy efficiency of community buildings and infrastructure
3. Strengthen utilities to ensure maintenance of current infrastructure, with a focus on maximizing diesel efficiency, heat and electric supply and incorporating new power
4. Investigate and develop local energy generation and monitoring emerging technologies for both supply and efficiency
5. Investigate and develop local energy generation and monitoring emerging technologies for both supply and efficiency

KODIAK ENERGY COMMITTEE

February 11, 2015: First Meeting of the Kodiak Energy Committee

SWAMC with the support of Information Insights and AEA hosted the first Kodiak Energy Committee in February. The first committee meeting, which had members from Kodiak communities and regional organizations, focused on interest areas and actions already being implemented. The goal of this committee is to take the lead on implementing community and regional energy priorities. The program goals in Table 40 serve as a mission statement for the work of the committee. This is a flexible set of program goals, which will be refined and modified based on the energy needs at the regional and community levels.

The next step for the Kodiak Energy Committee is adding members to ensure all communities and energy stakeholders are represented. With organizational and community support, Kodiak Energy Committee members will be expected to take these program goals and turn them into discrete energy projects, identifying tasks, funding, and coordination opportunities, with the support of the larger Energy Committee and associated federal, state, and regional programs.

Phase I Outreach

STAKEHOLDER INTERVIEWS

Interviews with community and regional leaders and utility managers have been conducted for the purposes of data collection and soliciting input on local and regional priorities. Names of those interviews are listed in the Acknowledgments.

PRESENTATIONS

January 29, 2014: Kodiak Archipelago Rural Regional Leadership Forum

Project team members participated in the January forum via teleconference with the goal of introducing the project, outlining the data collection process and gathering preliminary input on local priorities and energy champions from communities represented at the Forum.

March 5, 2014: Southwest Alaska Municipal Conference Annual Economic Summit

Regional energy planners for all three regions of Southwest Alaska (Kodiak, Bristol Bay and Aleutian-Pribilofs) gave a joint presentation at the energy workshop of SWAMC's annual conference. Planners provided an update on the status of the regional energy planning process in each region, including a snapshot of energy resources and opportunities in the region. Participants provided input on local and regional energy priorities through breakout discussions and by audience polling using handheld electronic keypads. Participants from the Kodiak region were primarily from the City of Kodiak and Old Harbor.

April 24, 2014: Kodiak Archipelago Rural Regional Leadership Forum

Project team members attended the April leadership forum in person, presenting findings from the first phase of the regional energy planning process. Again, audience response keypads were used to collect input from community and regional leaders on energy priorities and policy preferences. See Table 41 for a summary of results. Participants at the forum represented five rural communities in the region (the number in parentheses equals the number of participants): Akhiok (11), Ouzinkie (11), Larsen Bay (4), Old Harbor (4) and Port Lions (3). Responses were cross-tabulated by community, however only Akhiok and Ouzinkie had enough participants at the forum to make community-specific results meaningful.

Participants were also asked to review energy goals adopted in the 2009 Kodiak Island Borough Regional Energy Plan and provide their opinions on whether the desired outcomes had been accomplished or should still be goals. Results are shown in Table 42.

Table 41: April Leadership Forum Responses

What do you think has the greatest potential to lower your community's energy costs?	
35%	Wind
21%	Hydro
13%	Energy Efficiency
11%	Solar
6%	Biomass
6%	Diesel Efficiency
6%	Port/Dock Facilities
2%	Transmission Lines
0%	Heat Pumps
What is most important to your community in terms of energy planning?	
33%	Community Sustainability
24%	More reliable energy

18% Saving money
12% Saving energy
12% Price stability

Has a heat recovery system been installed in your community's diesel powerhouse?

3% Yes **66%** No **31%** Don't Know

What do you think is the biggest barrier to more participation in residential EE&C programs in your community?

39% Need to pay upfront and wait for reimbursement
39% Lack of information
19% Other
3% Hard to find auditors

Do you think we should look at an in-region approach to promoting EE&C?

74% Yes **6%** No **19%** Don't Know

Should our Regional Energy Plan include goals for energy efficiency?

93% Yes **7%** No **0%** Don't Know

If you could only invest in one project, which would you favor?

50% Long-term project (20 year development) that reduced energy costs significantly
50% Near-term project with more modest savings that could be built in 3-5 years

Should strategies to encourage local food production be included as part of an energy plan?

81% Yes **6%** No **13%** Don't Know

When considering limited public funding, how should the state prioritize projects?

52% Community sustainability criteria
23% Balance state funding efficiency with community benefits
13% Projects that can't be privately financed
13% State funding efficiency

Why do you think Kodiak communities have not participated in some of these community-wide energy-related programs yet?

50% Lack of time or grant writers
50% Lack of leadership or cooperation
0% Lack of need
0% Lack of information

Table 42: Status of Goals from the 2009 Kodiak Island Borough Regional Energy Plan

Encourage energy conservation (through energy efficient lighting and energy saving devices and behaviors)

Has there been Progress in Your Community?					Is this Still a Goal?		
No Action	Initial Steps	Substantial Progress	Mostly Complete	I have no idea	Yes	No	Don't Know
4%	48%	19%	4%	26%	86%	0%	14%

Upgrade building heating systems for energy efficiency and cost savings

Has there been Progress in Your Community?					Is this Still a Goal?		
No Action	Initial Steps	Substantial Progress	Mostly Complete	I have no idea	Yes	No	Don't Know
17%	27%	20%	0%	37%	83%	0%	17%

Study feasibility of passive and active solar residential hot water heating

Has there been Progress in Your Community?					Is this Still a Goal?		
No Action	Initial Steps	Substantial Progress	Mostly Complete	I have no idea	Yes	No	Don't Know
13%	29%	19%	13%	26%	83%	3%	13%

Assess need for upgrades to rural electrical grids (transmission /distribution lines, transformers)

Has there been Progress in Your Community?					Is this Still a Goal?		
No Action	Initial Steps	Substantial Progress	Mostly Complete	I have no idea	Yes	No	Don't Know
16%	13%	13%	16%	42%	81%	3%	16%

Assess potential to increase power generation from existing hydro facilities

Has there been Progress in Your Community?					Is this Still a Goal?		
No Action	Initial Steps	Substantial Progress	Mostly Complete	I have no idea	Yes	No	Don't Know
11%	22%	19%	11%	37%	76%	14%	10%

Assess need for active recycling program and designated recycling building in each community

Has there been Progress in Your Community?					Is this Still a Goal?		
No Action	Initial Steps	Substantial Progress	Mostly Complete	I have no idea	Yes	No	Don't Know
22%	38%	13%	6%	12%	74%	6%	19%

Install Met towers in communities to assess feasibility for wind power generation

Has there been Progress in Your Community?					Is this Still a Goal?		
No Action	Initial Steps	Substantial Progress	Mostly Complete	I have no idea	Yes	No	Don't Know
47%	19%	3%	3%	28%	72%	3%	24%

Work with KIHA and utilities to do energy rating on all homes

Has there been Progress in Your Community?					Is this Still a Goal?		
No Action	Initial Steps	Substantial Progress	Mostly Complete	I have no idea	Yes	No	Don't Know
20%	23%	10%	3%	43%	60%	8%	32%

Assess heat recovery potential in diesel-fired power plants

Has there been Progress in Your Community?					Is this Still a Goal?		
No Action	Initial Steps	Substantial Progress	Mostly Complete	I have no idea	Yes	No	Don't Know
45%	19%	6%	0%	29%	59%	16%	25%

Institute "Cash for Clunkers" style program for older appliances (refrigerators, dryers, etc.)

Has there been Progress in Your Community?					Is this Still a Goal?		
No Action	Initial Steps	Substantial Progress	Mostly Complete	I have no idea	Yes	No	Don't Know
45%	19%	3%	0%	32%	53%	7%	40%

Study feasibility of emerging technologies for harnessing tidal and wave energy

Has there been Progress in Your Community?					Is this Still a Goal?		
No Action	Initial Steps	Substantial Progress	Mostly Complete	I have no idea	Yes	No	Don't Know
48%	14%	0%	0%	38%	50%	13%	37%

Study feasibility of low-head hydro

Has there been Progress in Your Community?					Is this Still a Goal?		
No Action	Initial Steps	Substantial Progress	Mostly Complete	I have no idea	Yes	No	Don't Know
46%	11%	0%	7%	36%	29%	39%	32%

What are the top three priorities from the 2009 energy goals?

20% Energy Conservation
18% Grid Upgrade Needs
14% Met Towers for Wind
11% Home Energy Audits
8% Building Heating

7% Cash for Clunkers
7% Ocean/Tidal Energy
6% Community Recycling
6% Solar Hot Water
2% Low-head Hydro

APPENDIX A

KODIAK INDUSTRY SURVEY

Online survey sent to fish processors and major industry groups in the Kodiak region. Due to the small number of responses (3), information is not able to be used without revealing the source of the data.

Kodiak Energy Plan - Industry Survey

Contact Information	
Please verify the following information:	
***First Name:**	
***Last Name:**	
***Email Address:**	
Work Phone:	
All fields with an asterisk (*) are required.	

1. Name of company:

2. Location of facilities in Kodiak region:

3. What is your current annual energy use?	
Electricity (kWh/year):	
Fuel/Heating Oil (gallons/year):	
Other (gallons/year):	

4. If your company's energy demand is seasonal, in what month(s) is your demand for energy highest?

*5. To increase the quality of our load projections, would you be willing to share the last 2 years of electricity and/or fuel purchase data with our data analysts? (Your data will be kept strictly confidential.)(*Required)

○	Yes	(Answer question number 5.1.)
○	No	(Go to question number 6.)
○	Maybe	(Answer question number 5.1.)

5.1 Who should we contact to request your data?

Name:	
Phone or email:	
Notes:	

6. Does your company self-generate any electricity?

○	Yes	(Answer question number 6.1.)
○	No	(Go to question number 7.)

6.1 Please check all that apply.

☐	Diesel generator
☐	Solar P/V
☐	Wind turbine
☐	Waste-to-energy
☐	Other:

7. Does your company have plans to self-generate electricity in the next 5 years? Explain.

8. What does your company use for space heating? (check all that apply):

☐	Fuel Oil
☐	Electricity
☐	Natural Gas
☐	Propane
☐	Wood
☐	Coal
☐	Biodiesel (fish oil, other)
☐	Other:

9. How many buildings does your company currently heat?

Number:	
Total Square Footage:	

10. Have any of your company's buildings had a professional energy audit in the past 10 years?

○	Yes	(Answer question number 10.1.)
○	No	(Go to question number 11.)

10.1 Please enter information on the audited facility(s).

What is the name and address?:	
What energy efficiency and conservation measures were implemented following the audit?:	

11. Has your company conducted audits on overall energy use (machinery/process flow/energy conversion)?

○	Yes
○	No

12. Have energy efficiency and conservation measures been implemented in any of your facilities - whether audited or not?

○	Yes	(Answer question number 12.1.)
○	No	(Go to question number 13.)

12.1 Check all energy efficiency retrofits that apply:

☐	All implemented measures reported in Question 10
☐	Conservation measures / changes in energy behaviors (e.g. manually setting back thermostats, turning off computers)
☐	Installed energy efficient indoor lighting
☐	Installed energy efficient outdoor lighting
☐	Installed energy efficient refrigeration or other appliances
☐	Tightened up building envelope (e.g. insulation, roof, windows)
☐	Installed building sensors or programmable controls (e.g. occupancy sensors or programmable thermostats)
☐	Machinery/Equipment upgrades
☐	Other:

13. Looking ahead 5 years, how do you think your company's electricity use will change?

○	Increase significantly
○	Increase modestly
○	Stay the same
○	Decrease modestly
○	Decrease significantly

14. Looking ahead 5 years, how do you think your company's energy use for heating will change?

○	Increase significantly
○	Increase modestly
○	Stay the same
○	Decrease modestly
○	Decrease significantly

15. What do you think will drive these changes in energy use? (check all that apply):

☐	Changes in size of business operations
☐	Changes in technology
☐	Energy efficiency or conservation measures
☐	Other:

16. List any energy projects or priorities your business has for reducing or stabilizing the cost of energy for heating, electricity or transportation.

17. Which of the following energy goals would help your business the most?

○	Reducing the cost of electricity
○	Reducing the cost of space heating
○	Reducing the cost of transportation
○	Stabilizing the overall cost of energy
○	Stabilizing the supply of energy
○	Other:

18. Have you seen the Draft Kodiak Regional Energy Plan?

○	Yes	(Answer question number 18.2.)
○	No	(Answer question number 18.1.)

19. We are planning an Energy Summit for January 27, 2015 in Kodiak at which energy opportunities will be presented and regional priorities set. Is someone from your company likely to attend?

○	Yes	(Answer question number 19.1.)
○	No	(Go to question number 20.)
○	Maybe	(Answer question number 19.1.)

19.1 Who should we send the energy summit invitation to?

Name:	
Email or phone:	

20. Comments?

APPENDIX B

KODIAK ENERGY SUMMIT

The Kodiak Energy Summit agenda is included.

Kodiak Energy Summit
January 27, 2015 • Boardroom, Koniag Building
Kodiak, Alaska

8:00 Registration & Continental Breakfast
8:15 Opening and Welcome, SWAMC & Information Insights
8:30 Starting an Energy Project

- Energy Visioning: Darron Scott, KEA
- Community Planning A Step-by-Step Guide: US Dept. of Energy: Givey Kochanowski
- Determining Resource Potential: Cady Lister and Josh Craft, AEA

9:15 Break
9:30 Technology Review

- Integrating Renewable Technologies with the Powerhouse
  - Considerations: Josh Craft, AEA
  - Opportunities: Clarissa Quinlan, Marsh Creek
- Assessing Heat Pumps: Rob Simpson, Altherma MFDG
- Storing Cheap Excess Power: Steve Gilbert, AVEC & Darron Scott, KEA

10:30 Break
10:45 Coordination is Key to Success

- What works in other regions?: Nathan Hill, Lake and Peninsula Borough
- Regional Technical Training and Support: Tyler Kornelis, KANA
- People - The Most Important Component: Bud Cassidy, Kodiak Island Borough

11:30 Break
11:45 Kodiak Island Energy Success Stories (Lunch Provided)

- Larsen Bay - Systems Retrofit: Sam Kenoyer
- Ouzinkie - Using Water to Our Advantage: Dan Clarion
- Old Harbor - Planning for the Future: Bobbi Barnowsky
- Leveraging Projects – ANTHC: Gavin Dixon, ANTHC

12:45 Break
1:00 Paying for Projects

- Public & Private Funding Options: Cady Lister, AEA
- Roadmap to Implementation - Lake and Peninsula School District Efficiency Project: Amber McDonough, Siemens

2:00 Break
2:15 Efficiency Matters

- Efficiency Upgrades Equals Big Savings: Mayor Jerrol Friend, KIB
- Residential Savings, Energy You Don't Use: Ian Sharrock, Alaska Community Development Corporation
- Public Infrastructure and Commercial Buildings: Scott Waterman, AHFC
- Energy Conservation Outreach Resources: Eric Milliken, RurAL CAP

3:30 Break

3:45 Nominating Regional Energy Strategies
Information Insights

4:30 Your Energy Priorities – Closing Comments

APPENDIX C

PHASE I CORRECTIONS

Volume I

- Pg. 18, actually 90% of the region's population is on the road system, not 60% as it currently states. Number in report misses Mill Bay, Woodland Acres, Trinity, Monashka Bay, and Spruce Cave, among others.
- Table 30: A new dock was installed in Old Harbor in 2012 with a control depth of 28 ft, Maximum Berthing of 280 ft, and facilities are in "Good" condition.
- Figure 8, Pg. 44: Question on where the 2009 data was obtained for Retail Price of #1 Heating Oil in Old Harbor. There is a large jump in the data which is believed to be incorrect.
  - Source: ISER Alaska Energy Data Gateway: Fuel Price Survey Data from semiannual survey conducted by AHFC. Prices are reported by vendors at the time of the survey.
- p. 73, Road between Akhiok and Alitak – 7 miles, not Kodiak and Alitak.

Volume II

CITY OF KODIAK PROFILE

- Price of electricity on KEA grid is not $0.19/kWh.

Larsen Bay Profile

- Electric boiler info:
  - We use 3412 BTU/kWh. For electric heat we assume 100% utilization. For oil boilers we use 75% to 80% efficiency. To be conservative, let's assume 80% boiler efficiency and 136,000 BTU/gal (that is value for #2 diesel winter blend which is greater than #1).
  - 1 gal oil = 136,000*0.80/3412 = 31.89 kWh/gal
  - 29204 kWh/31.89 = 915 gal saved to date.
  - I am convinced that excess hydro to heat is one of the better energy saving ideas available for the limited sites where it is possible.

OLD HARBOR PROFILE

- Wind (p. 66): Old Harbor is participating in AEA's Anemometer Loan program with Met Tower installation planned. Also working with KIBSD and Old Harbor School to use the project and data collection as an educational experience for the secondary education science class. The community's hope is to find a good location with steady wind flow to support wind generated power.

OUZINKIE PROFILE

- LED light change out is an on-going process as funds allow.

PORT LIONS PROFILE

- Pg. 88, Bulk Fuel delivered 2 to 3 times/year NOT 6 times/year
- Pg. 88, Kizhuyak Oil Sales is ceasing sale of #2 fuel oil.
- Pg. 88, Bulk Fuel Capacity: Capacity is three 30,000 gallon tanks and one 6,000 gallon tank separated into three 2,000 gallon dispensing tanks. The three large tanks can only fill to a max of 28,000 each.

- Pg. 124, Corrections on building list - name, number, year, heat, EE&C measures.
- The median income listed in the community profile is very high because the community has many retired people living there part or most of the year. The young families have much smaller incomes, and they are struggling with the cost of all utilities.

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