NWALT
Northwest Arctic Leadership Team

Northwest Arctic
REGIONAL ENERGY PLAN

ORIGINAL PLAN PREPARED BY: NANA Regional Corporation

REVISON ENDORSED BY: Northwest Arctic Leadership Team

OVERSIGHT BY: Northwest Arctic Energy Steering Committee

August 2015
FINAL DRAFT

VISION FOR THE FUTURE

Northwest Arctic Regional Energy Plan

Serving the communities of:

Ambler ~ Ivisaappaat
Buckland ~ Nunachiaq
Deering ~ Ipnatchiaq
Kiana ~ Katyaak
Kivalina ~ Kivaliñiq
Kobuk ~ Laugviik
Kotzebue ~ Qikiqtaġruk
Noatak ~ Nautaaq
Noorvik ~ Nuurvik
Selawik ~ Akuliġaq
Shungnak ~ Issingnak

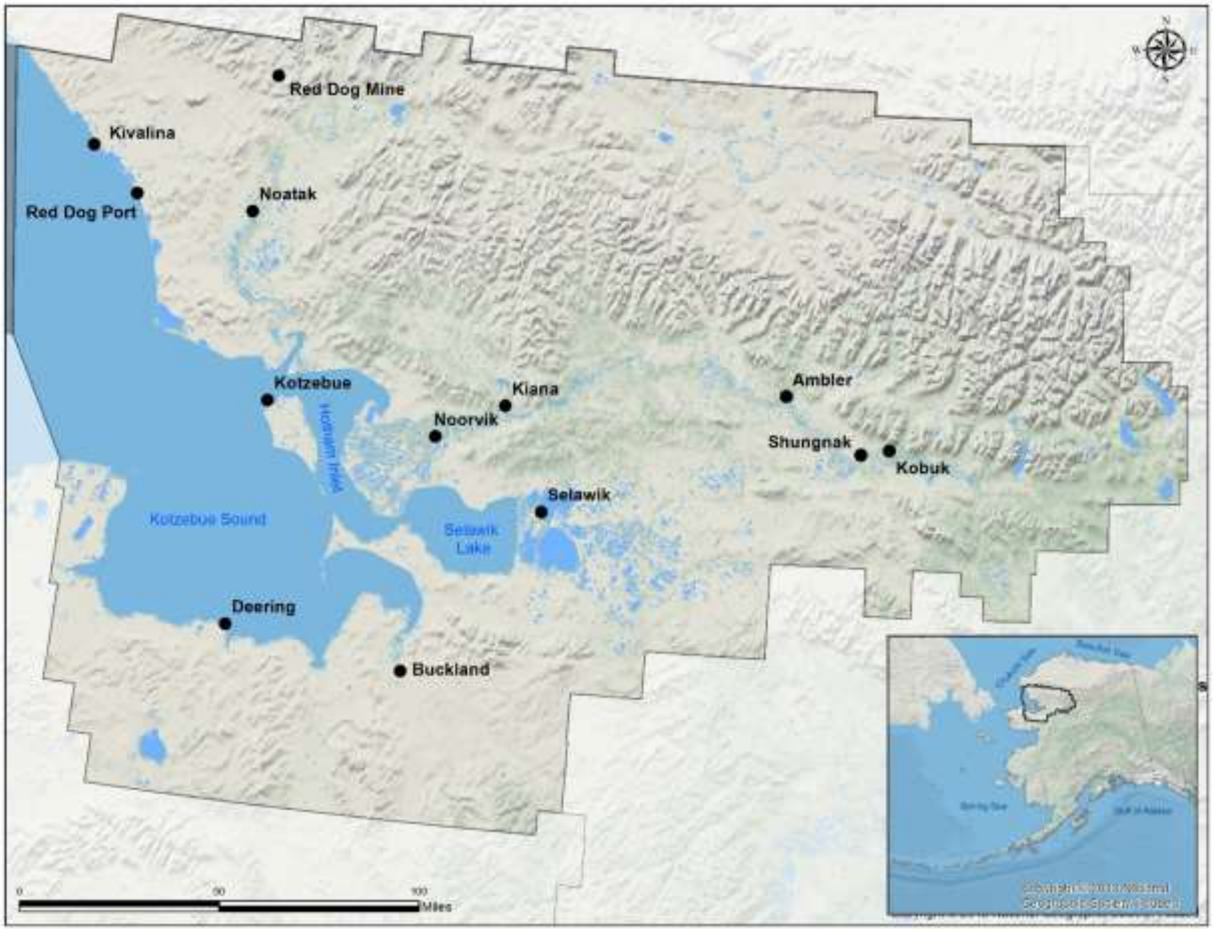
Original Plan Prepared by:
NANA Regional Corporation

Revision Endorsed by:
Northwest Arctic Leadership Team

Oversight by:
Northwest Arctic Energy Steering Committee

Revision Funded by:
Alaska Energy Authority

Northwest Arctic Region: Planning Area



Acknowledgements

NANA Regional Corporation (NANA) developed the first Northwest Arctic Strategic Energy Plan which was endorsed by the Northwest Arctic Leadership Team (NWALT, and was funded by the Alaska Energy Authority for revision and Phase II and III. In this plan, NANA and NWALT continue to play an important role along with other individuals and groups as shown below:

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Cover designed and produced by NANA Corporate Communications.

Acronyms and Abbreviations

ACEP	Alaska Center for Energy and Power
AEA	Alaska Energy Authority
AHFC	Alaska Housing Finance Corporation
AIDEA	Alaska Industrial Development and Export Authority
AMR systems	Automated Meter Reading systems
ANCSA	Alaska Native Claims Settlement Act
ANGDA	Alaska Natural Gas Development Authority
ANTHC	Alaska Native Tribal Health Consortium
APT	Alaska Power and Telephone
ARDOR	Alaska Regional Development Organizations
ARECA	Alaska Rural Electric Cooperative Association
ARIS	Alaska Retrofit Information System
ARRA	American Recovery and Reinvestment Act
ARUC	Alaska Rural Utility Collaborative
AVEC	Alaska Village Electric Cooperative
BIA	Bureau of Indian Affairs
BLM	Bureau of Land Management
CETF	Community Energy Task Force
CIAP	Coastal Impact Assistance Program
CFL	compact fluorescent light
EfW	Energy From Waste
DCCED	Department of Commerce, Community and Economic Development
DOE	U.S. Department of Energy
DOL	Alaska Department of Labor (and Workforce Development)
DOT&PF	Alaska Department of Transportation and Public Facilities
EPA	U.S. Environmental Protection Agency
ETF	Emerging Technology Fund
FERC	Federal Energy Regulatory Commission
FHWA	Federal Highway Administration
HUD	U.S. Department of Housing and Urban Development
HVDC	High Voltage Direct Current
ICDBG	Indian Community Development Block Grant
IPP	Independent Power Producer
ISER	Institute for Social and Economic Research
KEA	Kotzebue Electric Association
kW	Kilowatt
kWh	Kilowatt hour
MWh	Megawatt hours
NAB	Northwest Arctic Borough

NAHASDA	Native American Housing and Self Determination Act
NANA or NRC	NANA Regional Corporation
NDC	NANA Development Corporation
NIST	National Institute for Standards and Technology
NOAA	National Oceanic and Atmospheric Administration
NOSI	NANA Oilfield Services, Inc.
NRECA	National Rural Electric Cooperative Association
NREL	National Renewable Energy Laboratory
NWABSD	Northwest Arctic Borough School District
NWALT	Northwest Arctic Leadership Team
ORC	Organic Rankine Cycle
PFD	Permanent Fund Dividend
PCE	power cost equalization
PD&R	Policy Development and Research
PV	Photovoltaic
REAP	Renewable Energy Alaska Program
REF	Renewable Energy Fund
RUBA	Rural Utility Business Advisor
TED	The Energy Detective
UAF	University of Alaska Fairbanks
UCG	Underground Coal Gasification
VED	(NANA) Village Economic Development
WtE	Waste to Energy
WTP	Water Treatment Plant

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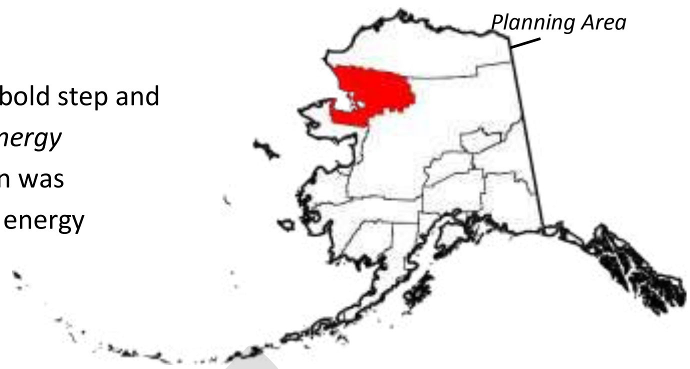
A. Funding Opportunities for Energy Projects

EXECUTIVE SUMMARY

EXECUTIVE SUMMARY

This section provides a condensed version of the Northwest Arctic Energy Plan

Executive Summary



In 2008, the NANA Regional Corporation took a bold step and developed the first *Northwest Arctic Strategic Energy Plan*. Through that plan, a regional energy vision was formulated that would provide a framework for energy development throughout the Northwest Arctic. The Northwest Arctic Energy Steering Committee was formed so that all stakeholders would have representation in the process. It is on that foundation that the 2013 *Northwest Arctic Regional Energy Plan* has been developed, which is funded by the Alaska Energy Authority, as part of a statewide regional energy planning effort.

This revision of that plan represents the continuing process of documenting the current status of energy resources in the Northwest Arctic Region of Alaska and presents options for reducing energy costs while maintaining or improving the current level of service. The plan, developed by the Northwest Arctic Energy Steering Committee, was built upon analysis done previously by state and regional energy specialists and relied heavily on the assistance of a team of village and electrical utility representatives, as well as federal, state and regional participants. It is an expansion of previous studies and reports, notably the 2010 *Northwest Arctic Strategic Energy Plan*. The Northwest Arctic Energy Steering Committee, Northwest Arctic Leadership Team, and other stakeholders verified background data, prepared goals and prioritized energy projects through a series of meetings and document reviews.

This plan is organized in the following chapters:

1. Introduction – an overview of the regional energy vision, regional energy issues and challenges, the goals of the plan, methodology, and stakeholders involved
2. Regional Background – presenting the physical, demographic, and energy use characteristics of the region
3. Regional Resources – a detailed look at the energy resources of the Northwest Arctic region
4. Subregional Summaries – a closer look at the five subregions, their communities, resources and potential energy-related projects
5. Implementation Plan – project tables, partners, funding sources and timelines
6. Works Cited – resources for energy information

The *Northwest Arctic Regional Energy Plan* is a dynamic, living document. It must be reviewed and updated as technology evolves and stakeholders contribute to regional energy understanding. By building on past actions, plans and research, moving forward with practical current solutions, and continually working to maximize new and more beneficial technology, the *Northwest Arctic Regional Energy Plan* will continue to be a practical and useable document.

Funding is always a critical aspect in accomplishing a project. An additional benefit of the plan is that it can be used to support grant applications and to show community and regional support for energy projects.

Current Conditions

Alaska's Northwest Arctic villages' energy prices are much higher than the national average and among the highest in Alaska. Residents purchase diesel fuel – the primary heat source – for an average of about $9.00 per gallon, according to the Northwest Arctic Borough. With the soaring cost of energy, many villagers find themselves in a position of having to choose between heating their homes and feeding their families.

The leadership in the region has been proactive in seeking alternative sources of energy and formed an energy steering committee which has been active since 2008. Northwest Alaska has many options when it comes to producing renewable energy including wind, biomass (wood), solar, hydroelectric and geothermal potential. The region's leaders are working together with state and federal organizations to explore and develop alternative sources of energy to reduce the energy costs in the Northwest Arctic (NRC, 2010).

Vision

The vision is for the Northwest Arctic region to be 50 percent reliant on regionally available energy sources, both renewable and non-renewable, for heating and generation purposes by the year 2050. The progression is planned as follows:

- 10 percent decrease of imported diesel fuels by 2020
- 25 percent decrease of imported transportation diesel fuels by 2030
- 50 percent decrease of imported diesel fuels by 2050

Issues, Goals and Recommendation

Table 1 summarizes the issues and goals that drive energy planning in the Northwest Arctic, as well as the proposed projects and timeframe for action related to them. The projects include both ongoing projects and those that have been identified by the Energy Steering committee or stakeholders. Identified projects are not yet funded and additional investigation and planning may be needed before they can be advanced. A more detailed list of projects is available in Table 40: Short Term Priority Energy Actions for the Northwest Arctic Region and Table 41: Medium and Long Term Priority Energy Actions for the Northwest Arctic Region.

Table 1: Energy Project Priority Summary

ISSUES	GOALS	PROJECTS	TIMEFRAME Short Term = 1-5 years Medium term = 5-10 years Long Term = > 10 years	PROJECT STATUS
Energy Costs - The region is dependent on diesel fuel, the cost of which continues to rise and consume more and more of the household income.	*Maximize the use of the region's renewable energy resources and mitigate the high cost of energy through regional strategies and energy efficiency efforts.*	Remain informed and participate in meetings that have long term energy implications such as road or pipeline access into the region.	Short-Medium-Long	Ongoing
		Continue to pursue natural gas as an energy source as it becomes available.	Short-Medium-Long	Ongoing
		Pursue Upper Kobuk biomass project	Short-Medium	Ongoing
		Complete Cosmos Hills hydroelectric project	Short-Medium-Long	Ongoing
		Kiana, Noorvik, Shungnak/Kobuk: Complete wind studies	Short	Ongoing
		Noorvik and Kiana: Install Smart meters	Short	Ongoing
		Kotzebue: Pursue municipal Waste to Energy	Short	Ongoing
		Kotzebue: Install smart grid	Short	Ongoing
		Kotzebue: Initiate Eocycle turbine testing	Short	Ongoing
		Identify and analyze future resource development projects that will require power	Short-Medium-Long	Identified
		Implement a bulk fuel buying program to utilize economy of scale (at Red Dog)	Short-Medium	Identified
		Conduct feasibility study of local tank farms, including inspection, deficiencies, capacity and recommendations.	Short	Identified
		Implement tank farm study recommendations.	Short	Identified

ISSUES	GOALS	PROJECTS	TIMEFRAME Short Term = 1-5 years Medium term = 5-10 years Long Term = > 10 years	PROJECT STATUS
		Kotzebue: Complete hydrokinetic study (tidal device in trench – estimated cost $150,000)	Short-Medium	Identified
Maintenance and Operations - Many operators lack the proper training needed to maintain and operate new technology and energy equipment installed in the villages. There is also a lack of readily available trained personnel to repair new energy and heating systems.	*Develop a well-trained workforce of operators and repair technicians that keep the new energy systems operating in communities and individual buildings continually and efficiently.*	Complete water/wastewater energy upgrades	Short-Medium	Ongoing
		Work with agency partners to identify classes/training courses needed and funding to pay for them	Short-Medium-Long	Identified
		Identify operators and communities that could benefit from training	Short-Medium-Long	Identified
		Conduct operator training	Short-Medium-Long	Identified
		Train regional repair technician	Short-Medium-Long	Identified
		Train local repair technician for each subregion or village	Short-Medium-Long	Identified
Inadequate Infrastructure - Inadequate infrastructure remains a prevailing deficit throughout the region, including roads, transmission lines, sewer and water systems and inefficient building performance.	*Lower energy costs through improved access.*	Connect Kotzebue to Cape Blossom via road with adequate right of way to accommodate all utilities	Short-Medium	Ongoing
		Construct deep-water port at Cape Blossom	Medium-Long	Ongoing
		Identify and construct roads or ice roads to connect villages to energy/fuel distribution points	Short-Medium-Long	Identified
		Design and construct Kivalina-Noatak-Red Dog Port road	Medium-Long	Identified
		Design and construct Noorvik-Kiana road	Medium-Long	Identified
		Connect villages by roads or ice roads to facilitate fuel transport	Short-Medium-Long	Identified
	Maximize the use of the region's renewable energy resources.	Buckland, Kiana, Kivalina, Selawik: Install solar photovoltaic (PV) at WTP.	Short	Ongoing
		Kobuk: Install and test biomass boiler at WTP	Short	Ongoing
		Selawik: Repower wind diesel	Short	Ongoing
		Design and install residential solar thermal and electric	Short-Medium	Identified

ISSUES	GOALS	PROJECTS	TIMEFRAME Short Term = 1-5 years Medium term = 5-10 years Long Term = > 10 years	PROJECT STATUS
		NWABSD Solar Thermal - Provide commercial grade solar thermal units for school district buildings	Short-Medium	Identified
		Kivalina: Construct wind diesel	Medium-Long	Identified
	Increase energy efficiency and lower costs through consolidated energy production and interties within subregions.	Design and construct region-wide intertie system	Short-Medium-Long	Ongoing
		Construct Ambler/Kobuk/Shungnak intertie	Medium	Ongoing
		Construct Kiana, Noorvik and Selawik intertie	Medium Long	Ongoing
		Construct Cosmos Hills wind resource and intertie	Short-Medium-Long	Ongoing
		Construct Kivalina/Red Dog port intertie	Short-Medium-Long	Identified
		Construct a regional tank farm to accommodate bulk fuel program	Short-Medium	Identified
	Improve sewer and water systems to optimize energy usage.	Complete Water/Wastewater System Energy Upgrades	Short- Medium-Long	Ongoing
		Kivalina, Noorvik, Selawik: Pursue heat recovery system	Short	Ongoing
		All Systems: Upgrade monitoring of energy use, system operating pressures, flows, temperature, pump power loads, and feedback control loops	Short	Identified
		Add insulation to above ground water and sewer systems	Short-Medium-Long	Identified
		Conduct operator training	Short-Medium-Long	Identified
	Increase energy efficiency for residential and commercial buildings.	Make Alaska Housing Finance (AHFC) revolving loan program more accessible by lobbying for variances on Level 3 audit requirements	Short	Ongoing
		Noatak: Relocate power plant	Short	Ongoing

ISSUES	GOALS	PROJECTS	TIMEFRAME Short Term = 1-5 years Medium term = 5-10 years Long Term = > 10 years	PROJECT STATUS
		Seek funding and implement measures to fill data gaps: metering, fuel consumption, space heating, etc. at the building, local and regional levels	Short	Identified
		Seek funding, design and construct additional cold climate houses	Short-Medium-Long	Identified
		Retrofit current structures to improve energy efficiency	Short-Medium-Long	Identified
Education - A more thorough understanding of energy systems, conservation measures, and available programs is needed.	*Educate energy users on how their actions impact energy consumption, how their energy/heating system operates, and what energy resources are available to them.*	Lobby school district personnel to provide energy education in the schools	Short	Ongoing
		Seek funding for and implement local energy education and continuation of the Energy Wise program	Short-Medium-Long	Identified
		Educate all residential users on the operation of their heating system and how to perform basic system maintenance	Short-Medium-Long	Identified
		Develop and distribute a resource list of contacts for users in case of system problems	Short	Identified
		Develop and distribute a user's manual for home maintenance of household energy/heating system	Short	Identified
		Implement K-12 Alaska smart energy curriculum	Short-Medium-Long	Identified
		Train educators in energy efficiency practices and promote energy efficiency through energy fairs in the schools	Short-Medium-Long	Identified

Energy Financing - Energy project financing resources are limited and becoming highly competitive.	*Develop and implement a comprehensive financial strategy for maximizing energy funding.*	Continue to lobby for congressional changes to the HUD funding eligibility requirements	Short	Ongoing
		Seek match funding and coordinate projects to reduce costs where feasible	Short-Medium-Long	Identified
		Consider forming a regional energy authority or independent power producer (IPP) to access bond funding	Short-Medium	Identified
Communication - The Northwest Arctic Region is large and there is much unmet need that benefits from meeting face to face. Funding for the energy committee and for the planning effort to continue is threatened. End users may not feel included in the process.	*Continue collaboration between Northwest Arctic stakeholders.*	Seek funding to continue the Energy Steering Committee efforts	Short	Ongoing
		Seek funding for village planning meetings to present the draft energy plan	Short	Ongoing
		Integrate energy planning with village comprehensive plans	Short-Medium-Long	Ongoing
		Seek input from residents regarding their energy and heating needs and best solutions for their homes	Short-Medium-Long	Ongoing

2014 Capital Project List for Energy

The following table represents a list of the energy projects currently in the funding cycle. (This table will be updated in the next iteration of the plan).

Table 2: 2014 Energy Capital Projects

Project Name	Partners*	Funding Agency*	Project Status
Heat Recovery	ANTHC/AVEC/NAB	ANTHC	In progress
Smart Grid Kotzebue	KEA/NRECA/DOE	NRECA/DOE	In progress
Biomass Upper Kobuk	NAB	AEA	In progress
Biomass Kobuk WTP	ANTHC	AEA	In progress
Cosmos Hills Hydroelectric	NAB/AVEC/NANA	AEA	Studies funded and complete pending funding
Wind Diesel Buckland	NAB/NANA/AVEC	AEA	In progress
Wind Diesel Deering	NAB/NANA/AVEC	AEA	In progress
Waste to Energy Kotzebue	AEA/City of Kotzebue	AEA	In progress

* AEA: Alaska Energy Authority, ANTHC: Alaska Native Tribal Health Consortium, AVEC: Alaska Village Electric Cooperative, CIAP: Coastal Impact Assistance Program, DOE: Department of Energy, KEA: Kotzebue Electric Association, NAB: Northwest Arctic Borough, NANA: NANA Regional Corporation, REF: Renewable Energy Fund, National Rural Electric Cooperative Association, NRECA.

Table 3 is a list of regional energy priority projects that are being promoted for funding in the 2014 funding cycle.

Table 3: 2014 Regional Energy Priority Projects

Priority List	Projects	Specifics
Transportation	▪ Interties ▪ Air ▪ Barge	▪ Ambler-Shungnak, Noorvik, Kiana ▪ In-river operation Kobuk River
Bulk Fuel Buy-in	▪ Red Dog	▪ Tank Farm
Hydroelectric	▪ Cosmos Hills	▪ Kogoluktuk River
Natural Gas	▪ Kotzebue Basin	▪ Multiple test drillings
Wind	▪ Regional	▪ Kivalina, Kiana

INTRODUCTION

INTRODUCTION

This chapter introduces the plan, describes what it is and what it is not, outlines the methodology, presents the plan organization and summarizes the energy issues and goals.

1. Introduction

The Northwest Arctic Borough (NAB) worked with the Northwest Arctic Energy Steering Committee and WHPacific to develop this document to serve as the foundation of the Northwest Arctic regional energy strategy. It builds upon previous studies and reports, notably the 2010 *Northwest Arctic Strategic Energy Plan*, and is intended to facilitate improved planning, coordination and implementation of energy strategies in the region, focusing on new energy sources and savings through efficiency. Once again, the Northwest Arctic Energy Steering Committee and the Northwest Arctic Leadership Team were very involved in the planning process, as they were for the 2010 *Northwest Arctic Strategic Energy Plan.* These two groups and other stakeholders verified background data, prepared goals and prioritized energy projects through a series of meetings and document reviews. The revision of the plan was funded by the Alaska Energy Authority as part of a statewide regional planning effort.

The *Northwest Arctic Regional Energy Plan* is a dynamic, living document. It must be reviewed and updated as technology evolves and stakeholders contribute to regional energy understanding. By building on past actions, plans and research; moving forward with practical current solutions; and continually working to maximize new and more beneficial technology, the *Northwest Arctic Regional Energy Plan* will continue to be a practical and useable document.

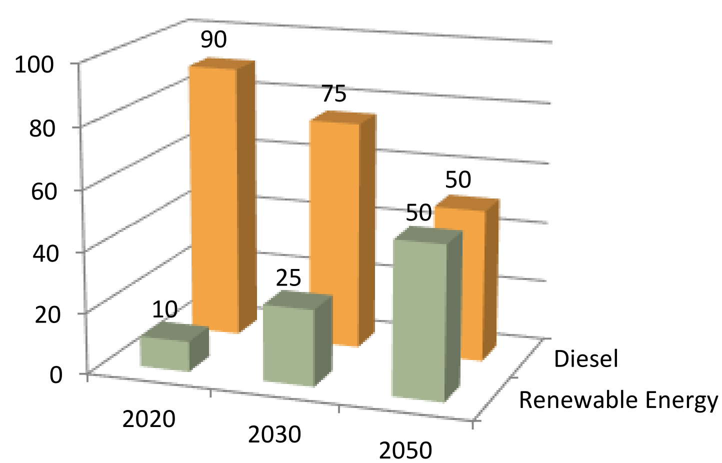
By providing information to prioritize local and regional energy projects, this report will assist stakeholders in choosing the best options for maximum benefit with limited available funding. An additional benefit of the plan is that it can be used to support grant applications and to show community and regional support for energy projects.

1.1. Vision

It is the vision of the Northwest Arctic Energy Steering Committee to be 50 percent reliant on regionally available energy sources, both renewable and non-renewable, for heating and generation purposes by the year 2050. This progress is shown in Exhibit 1 and is planned as follows:

- 10 percent decrease of imported diesel fuels by 2020
- 25 percent decrease of imported transportation diesel fuels by 2030
- 50 percent decrease of imported diesel fuels by 2050

Exhibit 1: Vision of Local Renewable and Non-Renewable Energy vs. Imported Diesel by Percentage



1.2. Regional Issues and Challenges

Below is a summary of the primary issues discussed at the energy steering committee meetings and with stakeholders.

1.2.1. Cost of Energy

As is the case throughout Alaska, the Northwest Arctic Region is heavily reliant on diesel fuels for energy. The high cost of imported fuel creates a severe hardship in the Northwest Arctic communities, where home heating fuel costs on average $6.26 per gallon. (DCEED, July 2014). The result is that, at times, residents must choose between heating their homes and other necessities such as food for their families. The high cost of energy in the Northwest Arctic is one of the leading threats to the long term sustainability and well-being of the region (NWALT, 2010).

The skyrocketing cost of energy in the region is not expected to subside and in fact, the costs remain unstable and continue to rise. Individual households in the region struggle directly with their ability to pay for utilities, particularly for heating fuel. While utilities have begun to bring renewable energy sources on line, the cost of energy per household has not seen any demonstrable reduction. Recent energy efficiency projects such as energy education and installation of energy TED meters have proven to provide the most immediate and effective way to reduce household energy use.

1.2.2. Maintenance and Operations

As new systems come on-line, operators need a new set of skills to properly maintain and operate the systems. Many operators lack the proper training needed to maintain and operate new technology and energy equipment installed in the villages. Employee turnover and lack of training in effective energy maintenance, operation and management result in inefficient and costly energy systems. There is an absence of current “best practices” for efficiently operating energy systems in rural Alaska.

There are no trained service personnel readily available to work on home heating/energy systems that malfunction and in some cases, secondary heat sources have been removed, leaving residents with no source of heat.

1.2.3. Inadequate Infrastructure

Inadequate infrastructure remains a prevailing deficit throughout the region, including bulk fuel storage, power generation (renewable, alternative, diesel), roads, transmission lines, sewer and water systems and inefficient building performance. Overland transportation infrastructure to deliver fuel, goods, people, and building materials is absent, resulting in high energy costs. Aged infrastructure, deferred maintenance, construction without concern for energy use, antiquated technologies, shrinking subsidies, extreme construction costs and other conditions contribute to high energy use and delivery costs in the Northwest Arctic Region.

1.2.4. Education

A more thorough understanding of energy systems, conservation measures, and available programs is needed. Users are sometimes at a loss as to how the new technology in their homes works. They fear inadvertently damaging the system and may indeed do so. Additionally, tinkering with high tech products can void the manufacturer’s warranty. Energy curricula are available for classroom use, but have not been utilized. The many programs and their eligibility requirements for dealing with energy conservation and power can be confusing to residents.

1.2.5. Financing

Project financing resources are limited and requirements defined and often limiting. AEA remains a source for many energy infrastructure projects, but with the state's current budget issues funding is not expected to remain stable.

Likewise, the Alaska Industrial Development and Export Authority (AIDEA) provides development funding from the state to increase economic growth and diversity in Alaska. AIDEA supports projects that develop Alaska's natural resources, establish and expand manufacturing, industrial, energy, export, small business, and business enterprises, through a variety of financing and loan programs.

Frequently, funding is allocated by agencies on the basis of a cost-benefit ratio, which causes larger communities to receive more than smaller more rural villages. As a result of these projects, energy costs can be reduced in larger cities, which can cause more people to move to larger communities. Although population is denser in cities, the Northwest Arctic's subsistence and economic resources are dispersed throughout the region. It is, therefore, important that regional stakeholders and planners carefully prioritize projects to best foster the sustainability of all of the villages as the Northwest Arctic Region works toward self-sufficiency. By coordination and cooperation, the Northwest Arctic Region's villages may be able to tap into the economies of scale and develop projects that benefit multiple villages at a lower cost per person.

1.2.6. Stakeholder Collaboration

The Northwest Arctic Region is large and there is much unmet need that benefits from meeting face to face. Funding for the energy committee and for the planning effort to continue is threatened. End users do not always feel included in the process, allowing critical information to be missed.

1.3. Goals

Residents in the Northwest Arctic Region recognize that fossil fuels will eventually be depleted and the communities must seek to be self-reliant and sustainable. To this end, the people of the Northwest Arctic want to explore and use energy resources within the region, retaining imported diesel fuel as a backup power source only.

Stakeholders in the region have been proactive in developing alternative energy that will, over time, allow them to reduce their dependence on imported fuels. Only by widespread understanding of the energy options and a strong commitment on the part of all stakeholders can the Region move forward toward a comprehensive and implementable energy strategy. Individual residents as well as governmental entities and agencies must all be willing to work together to promote energy efficiency and the use of alternative fuel sources.

Energy conservation and end-use energy efficiency initiatives are needed to more effectively utilize all forms of energy in Northwest Alaska, regardless of source. A leading approach is to promote energy efficiency. By doing so, energy-related costs and utility solvency will be addressed.

To meet the needs identified in the issues listed in section 1.2, the stakeholders of the Northwest Arctic region developed the following goals:

- Maximize the use of the region's renewable energy resources and mitigate the high cost of energy through regional strategies and energy efficiency efforts.
- Develop a well-trained workforce of operators and repair technicians that keep the new energy systems operating in communities and individual buildings continually and efficiently.
- Lower energy costs through improved access.
- Increase energy efficiency and lower costs through consolidated energy production and interties within subregions where appropriate.
- Improve sewer and water systems to optimize energy usage.
- Increase energy efficiency for residential and commercial buildings.
- Educate energy users on how their actions impact energy consumption, how their energy/heating system operates, and what energy resources are available to them.
- Develop and implement a comprehensive financial strategy for maximizing energy funding.
- Continue collaboration between Northwest Arctic stakeholders.

The *Northwest Arctic Regional Energy Plan* is a living document. It must be reviewed and updated as technology evolves and stakeholders contribute to regional energy understanding. By building on past actions, plans and research, moving forward with practical current solutions, and continually working to maximize new and more beneficial technology, the Northwest Arctic Regional Energy Plan will continue to be a practical and useable document.

1.4. Methodology

This report follows the AEA recommended regional methodology outline and is organized according to the tasks outlined in the approved scope. Specifically, the report presents a summary of local and regional conditions, energy use, and priority energy projects in communities within the Northwest Arctic Region. Projects include those focused on energy efficiency and alternative energy options. The top priority projects were ranked using the methodology developed by AEA and tailored for the region.

The data collected for this report was gathered from existing data in published reports including the 2010 *Northwest Arctic Strategic Energy Plan*, Alaska Energy Authority *Energy Pathways* and *End Use Survey*, the AHFC Alaska Retrofit Information System (ARIS), Alaska Home Energy Rebate Program, Power Cost Equalization Reports, Department of Community and Economic Development (DCCED) Alaska Fuel Price Report, Institute of Social and Economic Research (ISER) information and data collected by numerous stakeholders.

The plan is developed in two phases with the first phase resulting in a draft document that energy specialists presented in meetings throughout the region in phase two. To complete the analysis, the report consisted of three simultaneous activity tracks including planning, community and stakeholder involvement, and preparation of deliverables. Throughout the process, stakeholder input was solicited and the project team and AEA staff met to discuss progress. The Northwest Arctic Borough contracted with WHPacific, Inc. to assist in preparation of this report. The timeline for the plan is illustrated in Exhibit 2.

Exhibit 2: Timeline

1.5. Stakeholders

Energy stakeholders in the Northwest Arctic Region are diverse and well engaged in energy discussions. The Northwest Arctic Energy Steering Committee, made up of representatives from each of the area villages and Kotzebue, the NAB, Maniilaq Association – the regional nonprofit association, the Northwest Arctic Borough School District (NWABSD), the Alaska Village Electric Cooperative (AVEC), the Kotzebue Electric Association (KEA), Ipnatchiaq Electric Company (IEC) and the Northwest Inupiat Housing Authority (NIHA) played a significant role representing a majority of the stakeholders and had extensive involvement in the development of the plan. The Northwest Arctic Energy Steering Committee met on May 14, 2013 to discuss and offer comments on the draft plan.

Another existing group that has advocated for energy planning is the Northwest Arctic Leadership Team (NWALT) who also sponsored the development of the 2010 *Northwest Arctic Strategic Energy Plan*. This group is a partnership among the NAB, Maniilaq, NWABSD, and NANA Regional Corporation (NANA). NWALT's mission is to work on issues affecting education, health, land management, tribal issues, energy solutions and social services that affect the people of the region while honoring and preserving the Inupiat cultural heritage.

Other stakeholders key to the development of this energy plan include local city, tribal, NANA Village Economic Development (VED), AVEC, KEA, IEC, federal and state agency staff; businesses such as Teck Alaska, Inc., NANA Oilfield Services, and Crowley Maritime Corporation; and the general public. Near the beginning of the project, industry participants were interviewed to provide information and input into a wide array of energy related issues as they pertain to their particular fields.

REGIONAL BACKGROUND

REGIONAL BACKGROUND

This chapter summarizes relevant physical, demographics and energy use characteristics of the Northwest Arctic region.

2. Regional Background

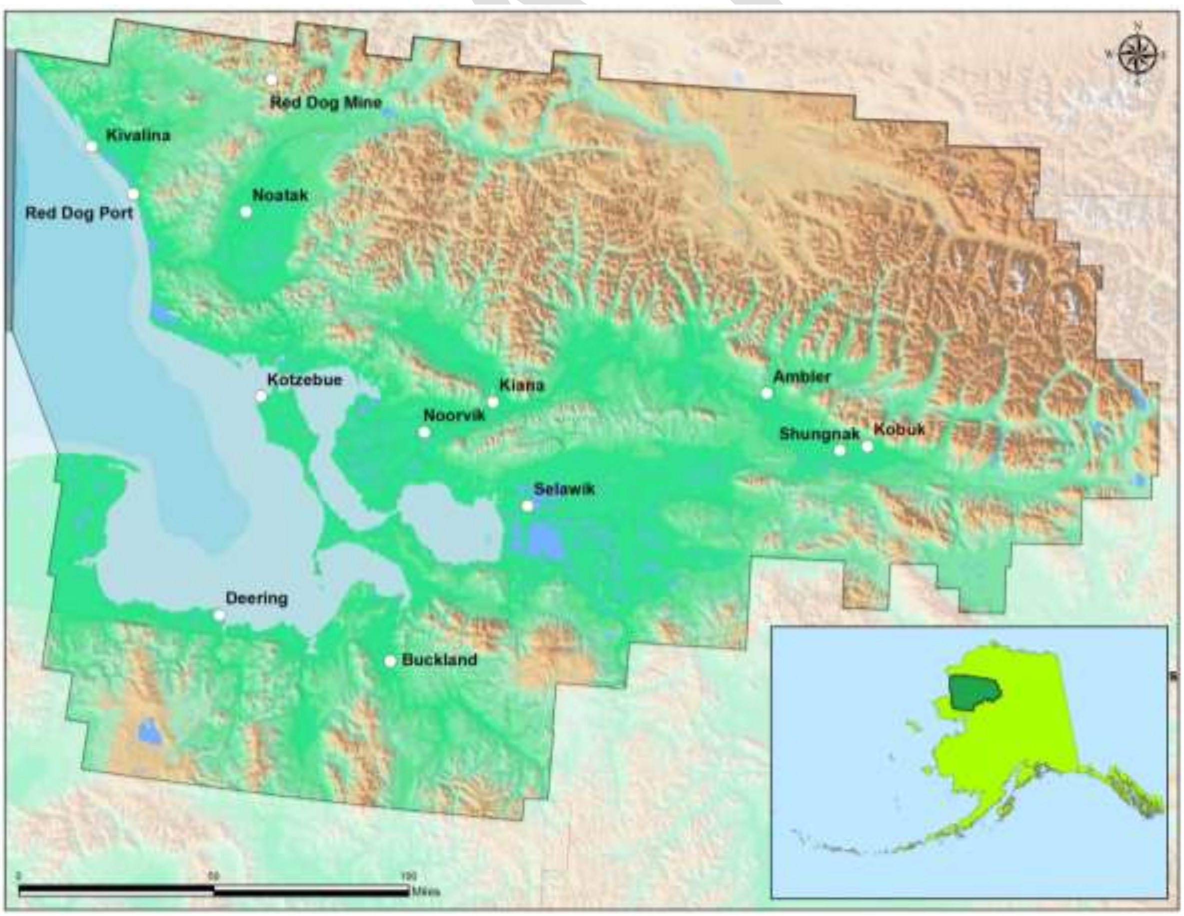
This section provides regional background information and describes current energy supply and demand benchmarks and projects for the region and individual communities.

2.1. Physical Conditions

2.1.1. Location

The Northwest Arctic region is comprised of approximately 39,000 square miles (35,898.3 square miles of land and 4,863.7 square miles of water) along the Kotzebue Sound and Wulik, Noatak, Kobuk, Selawik, Buckland and Kugruk Rivers. Much of the area is situated above the Arctic Circle. The City of Kotzebue is the "hub" of the Northwest Arctic and is the transfer point between ocean and inland shipping. Kotzebue does not have a natural harbor and is ice-free for only three months each year. Deep draft vessels must anchor 15 miles off shore, and cargo is lightered to the docking facility. Local barge services provide cargo to area communities. Ralph Wien Memorial Airport supports daily jet service and air taxis to Anchorage (NAB, 2013). The eleven villages in the region are not connected by a road system, nor is there a unified electrical grid. The Northwest Arctic Region is shown in Figure 1.

Figure 1: Northwest Arctic Region



2.1.2. Geology

The geology of the Northwest Arctic region is dominated by the Brooks Range fold-and-thrust belt to the north and the Yukon-Koyukuk basin to the south. The Brooks Range, like most of the North American Cordillera, formed during a compressional tectonic event during Jurassic-Cretaceous time (approximately 100-200 million years ago). This compressional event thrust older Paleozoic rocks over younger rocks to the north, creating the Brooks Range and the North Slope foreland basin. These Paleozoic rocks contain the zinc-lead-silver deposits at the Red Dog mine and the copper deposits at Bornite in the upper Kobuk River. Crustal extension occurred in the south part of the NANA region forming the Cretaceous Yukon-Koyukuk basin. This basin is represented by a thick package of Cretaceous marine and non-marine sedimentary rocks and includes some coal-bearing strata. Extension continued with the opening of the Kotzebue basin in Tertiary time (40-50 million years ago). At around the same time, large volumes of basaltic lava poured onto the southern NANA region on the Seward Peninsula up until at least 5 million years ago. During the Pleistocene glaciation, large glaciers flowed out of the Brooks Range, scouring out valleys and depositing sand and gravel through the major river valleys. Large volumes of wind-blown sand and silt covered the region adjacent to the glacial sediment (Kobuk Sand Dunes) and the major rivers continued to rework these sediments as the ice receded, forming more modern features like the Kobuk delta.

The Red Dog Mine, near Kivalina, is one of the largest lead and zinc mines in North America. Areas near the Baird Mountains may contain copper, gold, lead and zinc.

2.1.3. Hydrology

Hydrology in the Northwest Arctic consists of streams and rivers that flow westward into Kotzebue Sound. The principal rivers are the Kobuk and Noatak Rivers, each of which drains an area of about 12,000 square miles. Selawik Lake, a tidal, saline lake is the largest in the region. The Noatak National Park and Preserve protects the largest pristine river basin in the United States; in 1976 it was designated as an International Biosphere Reserve by the United Nations Educational, Scientific, and Cultural Organization (UNESCO) (Brabets, 1996).

2.1.4. Climate

Most of the Northwest Arctic area—including Kotzebue, Buckland, Deering, Kiana, Kivalina, Noatak, Noorvik, and Selawik—experiences a transitional climate, characterized by long, cold winters and cool summers. The more inland communities, Ambler, Kobuk and Shungnak, are in the continental climate zone, also characterized by long, cold winters but with milder summers. Temperatures in the region range from -52 to 85 °F. Total precipitation averages 9 inches per year, and average annual snowfall is 47 inches. Table 3 shows average climate date for the Northwest Arctic region. Break-up (when rivers and sea ice melt) has typically occurred around late May in recent years and freeze-up in late October in the inland communities of Ambler, Kobuk and Shungnak. Break-up and freeze-up generally occurs later in the more coastal communities.

In the past few years the regional snowfall has decreased, causing less runoff in the rivers and streams, which is needed to flush out silt. As a result, the silt has built up and prevented barge service from reaching the Upper Kobuk Sub-Region communities.

Table 3: Climate Data in the Northwest Arctic

	Extreme summer high, °F	Avg. summer high, °F	Avg. summer low, °F	Avg. winter high, °F	Avg. winter low, °F	Extreme winter low, °F	Annual precip. inches	Annual snowfall, inches	Break-up, avg.	Freeze-up, avg.
Ambler	92	65	40	15	-10	-65	16	80	Late May	Mid-October
Buckland	85	-	-	-	-	-60	9	40	-	-
Deering	85	63	-	-	-18	-60	9	36	Early July	Mid-October
Kiana	87	60	40	15	-10	-54	60	16	Late May	Early October
Kivalina	85	57	-	-	-15	-54	8.6	57	Mid June	Early Nov.
Kobuk	90	65	40	15	-10	-68	17	56	Late May	Late October
Kotzebue	85	58	-	-	-12	-52	9	40	Early July	Early October
Noatak	75	60	40	15	-21	-59	10 to 13	48	Early June	Early October
Noorvik	87	65	40	15	-10	-54	16	60	Early June	Mid-October
Selawik	83	65	40	15	-10	-50	10	35 to 40	Early June	Mid-October
Shungnak	90	65	40	15	-10	-60	16	80	Late May	Mid-October

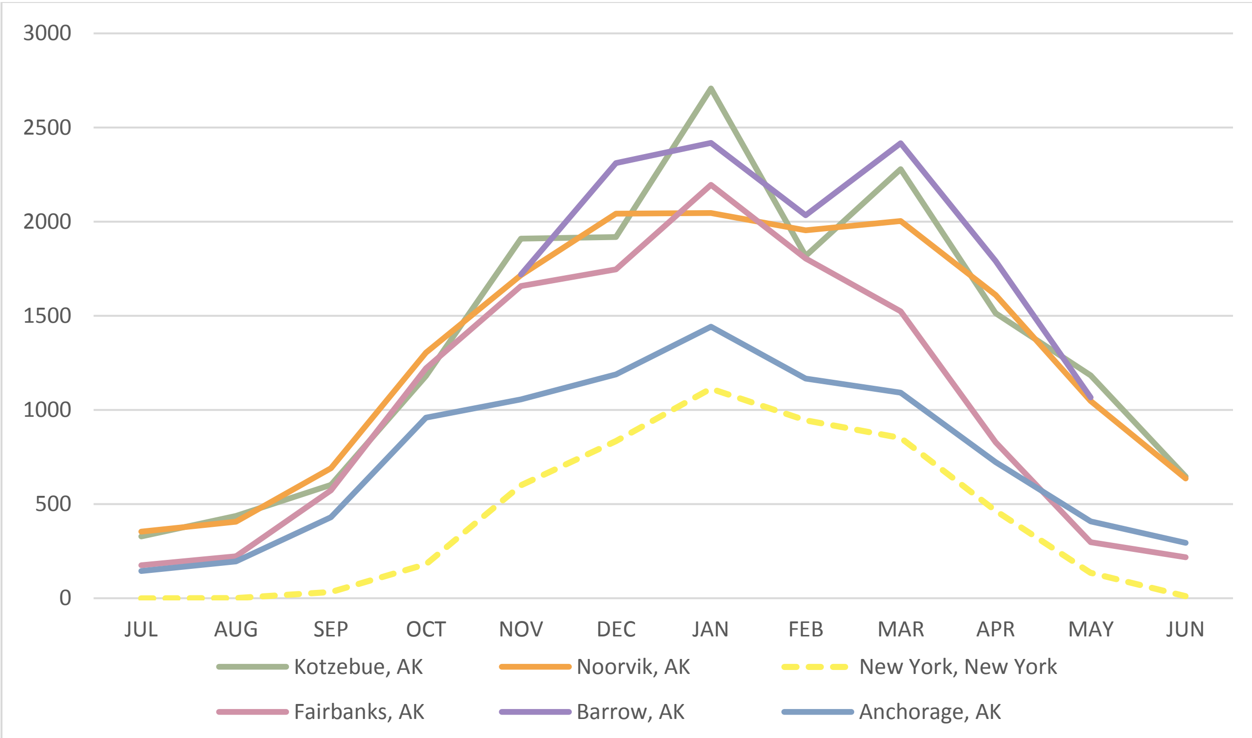
Source: Division of Community and Regional Affairs (DCRA), 2012

Heating Degree Days

The outside temperature plays a big role in how much energy it will take to keep a structure warm. Heating degree days are one way of expressing how cold a location is and can help in understanding how much fuel might be required at the village level. Heating degree days are a measure of how much (in degrees), and for how long (in days), the outside air temperature was below a certain level. They are commonly used in calculations relating to the energy consumption required to heat buildings. The higher the number the more energy will be required. The figures in **Error! Reference source not found.** ndicate average heating degree days annually in select Northwest Arctic communities. In comparison, New York averages about 5,000 heating degree days and therefore needs much less energy to heat their buildings.

While the more northern communities experience slightly colder winters, the weather is similar throughout the region. Daylight extends for almost 24 hours a day during the summer and in the winter the sun is barely seen. Heating fuel usage increases dramatically in the winter months and Alaska's northern and northwestern communities are particularly hard hit.

Exhibit 3. Average Heating Degree Days



Sources: Kotzebue: NOAA, 2012, and Noorvik: Fraser, 2012

Climate Change

Climate change describes the variation in Earth's global and regional atmosphere over time. The impacts of climate warming in Alaska are already occurring. In the Northwest Arctic region, some of these impacts include coastal erosion, increased storm effects, sea ice retreat and permafrost melt.

The effects of climate change can potentially exacerbate natural phenomena. For example, melting permafrost contributes significantly to ground failure or destabilization of the ground in a seismic event and changing weather patterns can cause unusual and severe weather. Climate change also can cause structural failure in energy infrastructure, buildings, airports, and roads due to thawing permafrost. This leads to increased maintenance costs and disruption in services.

Adapting to the impacts of climate change before they become critical is important to the wellbeing of the people and infrastructure of the Northwest Arctic. Energy infrastructure will be vulnerable to more extreme weather events, rising sea levels, and thawing permafrost. Climate changes may result in different growth patterns of existing plant species that are used as biomass energy sources. Likewise, new species may become viable where they have not existed in the past. Strategies for adaption to climate change will need to be developed and continually updated as new information becomes available.

2.2. Demographics

Table 4 presents an overview of the demographics of the Northwest Arctic Region.

Table 4: Demographic Statistics for the Northwest Arctic Region

Total Population	7,523
Percent Female	46.3%
Percent Male	53.7%
Percent Native	81.1%
Percent of population under the age of 18 [perceived as indicator of dependency]	35.3%
Percent persons ages 18 to 64 [perceived as the labor force]	58.7%
Percent of persons over the age of 65 [perceived as indicator of dependency]	6.0%
Median age of total population	25.7
Number of persons age 18 to 64 with permanent, full time employment and % of labor force	2578/74.1%
Number and percent of persons 18 to 64 who are unemployed	900/25.8%
Total number of households	1,919
Average number of persons per household	4
Total number of dwelling units	1,919
Number of vacant units	788
Number vacant due to seasonal use	542

Source: 2010 U.S. Census

Seasonal use can include residents who live elsewhere but come into a village for subsistence seasons, those who must live elsewhere for educational reasons and return for portions of the year, and other diverse reasons.

2.2.1. Current Population

According to the 2010 US Census, the total population of the Northwest Arctic Region was about 7,500. Kotzebue residents make up about 43 percent of the region's population. Individual community populations are presented in Table 5.

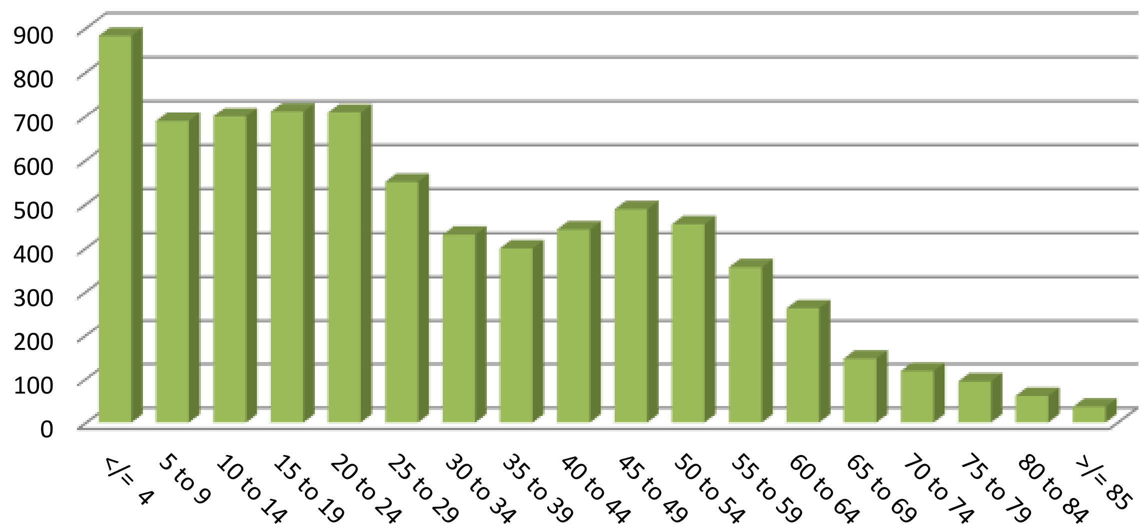
Table 5: 2010 Population by Community

Community	Population
Ambler	258
Buckland	416
Deering	122
Kiana	361
Kivalina	374
Kotzebue	3,201
Noatak	514
Noorvik	668
Selawik	829
Kobuk	151
Shungnak	262

Source: U.S. Census

The median age for the Northwest Arctic Region is 25.7, about ten years younger than for Alaska as a whole (36.1). The median age is the age at the midpoint of the population: half the population is older than the median age and half of the population is younger. The median age is often used to describe the age of a population as a whole. In 2010, the US median age increased to a new high of 37.2 years, rising from 35.3 years in 2000, with the proportion of the population at the older ages increasing similarly. This indicates that the US population is aging. While the Alaska and Northwest Arctic Region median age is lower than that of the US as a whole, it is higher than it was in the 2000 Census. The portion of the population in each 5-year age bracket is illustrated in Exhibit 4.

Exhibit 4: Northwest Arctic Regional Population by Age

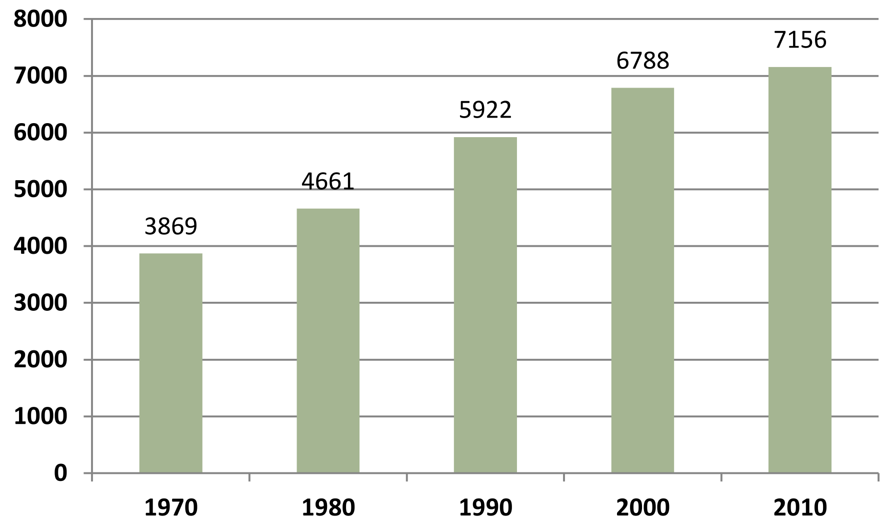


Source: U.S. Census

2.2.2. Trends

Historical U.S. Census data for the region reveals that between 1970 and 2010, the population grew from 3,869 to 7,156 as shown in Exhibit 5.

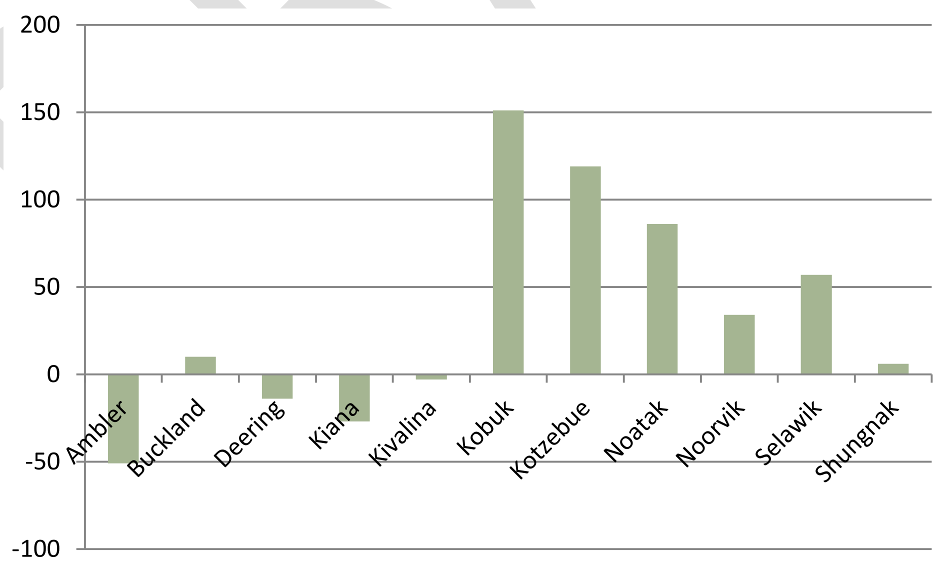
Exhibit 5: Population Growth 1970-2010



Source: U.S. Census

Generally, birth rates in the region are relatively high, exceeding mortality rates. Despite this, populations sometimes decline due to residents moving out of the region (outmigration), or sometimes exceed their natural population growth due to residents moving into the community (in-migration). This occurs in communities for a variety of reasons including job opportunities and social influences such as changes to family or health concerns. The population changes in the last ten years are shown by community in Exhibit 6.

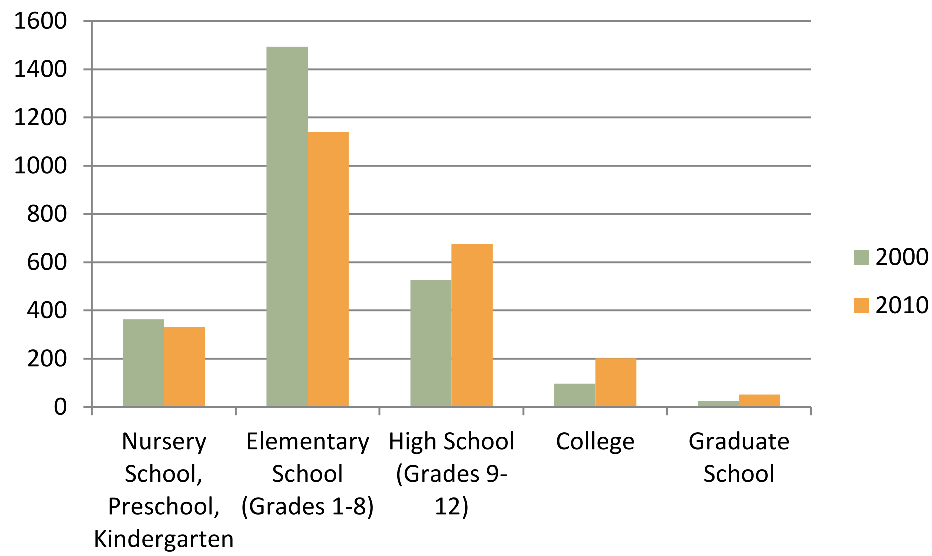
Exhibit 6: Population Change 2000-2010



Source: U.S. Census

The overall school population saw a decrease between 2000 and 2010 from 2,505 to 2,398 with the largest decreases occurring in the younger students (USA.com, 2013). The data also reveals a larger portion of students in high school and attending college as shown in Exhibit 7.

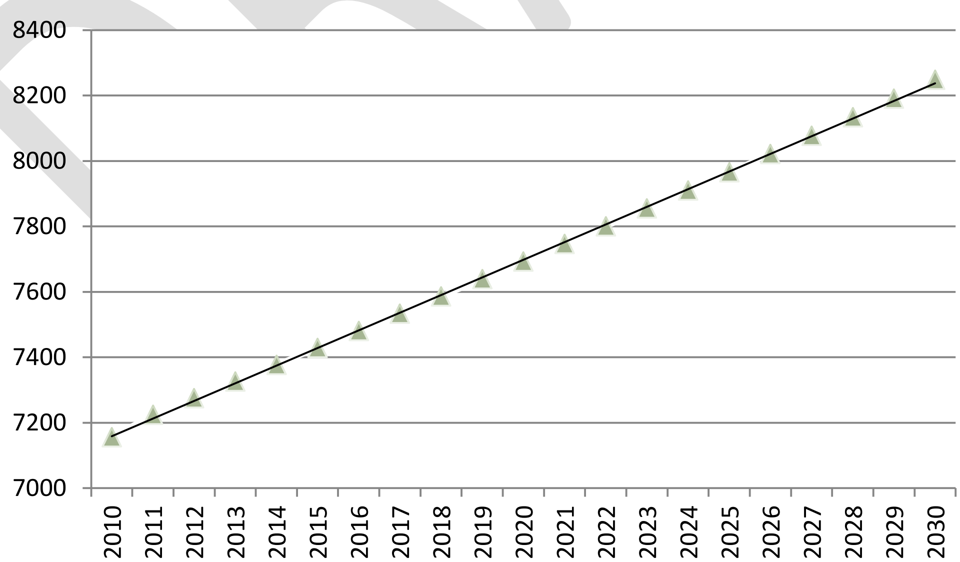
Exhibit 7: Changes in School Population, 2000-2010



Source: USA.com

In the past twenty years, the overall population in the region has increased about 1%. Given this population trend, the population will exceed 8,250 persons in 2030 as shown in Exhibit 8.

Exhibit 8: Projected Population Growth 2010-2030



Source: U.S. Census

2.2.3. Economy

The Northwest Arctic Region's population is primarily Inupiat Eskimo, and subsistence activities are a vital part of the lifestyle. Residents rely on caribou, moose, reindeer, beluga whale, birds, four species of seals, berries, greens and fish.

Transportation services, oil and mineral exploration and development are the focus of economic activity in the region. The Red Dog Mine, jointly run by the Cominco Corporation and NANA Development Corporation (NDC), is the largest zinc mine in the world. It is the largest economic project in the region, providing 360 direct jobs. Maniilaq Association, the Northwest Arctic Borough School District, NDC, and the Cominco Corporation are the largest employers in the area (Maniilaq, 2003). The Alaska Department of Labor and Workforce Development provided the following information about regional employment.

Table 6: 2011 Northwest Arctic Region Workers by Industry

	Number of workers	Percent of total employed	Female	Male
Natural Resources and Mining	169	5.6	31	138
Construction	146	4.8	17	129
Manufacturing	15	0.5	0	15
Trade, Transportation and Utilities	314	10.3	139	175
Information	63	2.1	26	37
Financial Activities	127	4.2	24	103
Professional and Business Services	302	9.9	186	116
Educational and Health Services	502	16.5	345	157
Leisure and Hospitality	64	2.1	33	31
State Government	69	2.3	43	26
Local Government	1,141	37.6	562	579
Other	123	4.1	40	83
Unknown	1	0	0	1

Source: U.S. Census

NDC is the business arm of NANA Regional Corporation, Inc. All of NANA's business operations are owned by NDC. Headquartered in Anchorage, NDC employs 11,500 individuals throughout the US and around the globe. NDC operations extend from the Arctic Circle to Australia, across the continental US, to the Middle East and the South Pacific. NDC and its subsidiaries perform in a wide variety of industries including oil and gas, mining, healthcare, hospitality, and federal and tribal sectors. Through NDC's efforts, NANA shareholders receive a wide variety of educational, training, and employment opportunities.[1]

[1] *About NANA Development Corporation*, http://nana-dev.com/about. Accessed 4/12/2013.

In 2012, NRC's board of directors distributed a dividend totaling $11.8 million dollars at a rate of $7.72 per share. Dividends are issued annually in November. In addition, in 2012, the NANA Elders' Settlement Trust trustees voted to issue a $2,000 per elder distribution. This distribution totaled $1.3 million. This trust provides a regular, modest, special distribution to assist shareholders who are 65 or older.[2]

As with the rest of Alaska, the Permanent Fund Dividend plays an important role in the Northwest Arctic Region's economy. The 2012 PFD paid out $878 to each eligible adult and child in Alaska. Over the course of its history PFDs have ranged from a low of $331.29 in 1984 to a high of $2,069 in 2008. The PFD frequently allows residents to make major purchases they would otherwise be unable to make. Some put money into college or other savings plans, as well.

Kotzebue Electric Association wind turbine being raised. Photo courtesy of KEA.

2.3. Energy Use

According to the 2010 *Northwest Arctic Strategic Energy Plan*, "total annual (non-transportation) energy consumption by communities in the Northwest Arctic is estimated to be 5.3 million gallons in diesel fuel or the equivalent, not including the operations of the Red Dog mine and port. The majority (53%) of this energy consumed in the Northwest Arctic is in the form of heating fuel" (NWALT, 2010).

2.3.1. Electricity

Diesel fuel is the primary source of electrical power in the region. However, it is worth noting that both Kotzebue and Selawik increased the percentage of electricity generated through wind power in recent years. Table 7 shows the amount of power generated from diesel fuel and from wind resources in kilowatt hours for each community in the region. Though not represented in Table 7, solar power generation is increasing in the region and will contribute more to the power grid in coming years.

[2] *Annual Report,* 2012. NANA

Table 7: Power Generation Comparison, FY 2013/14*

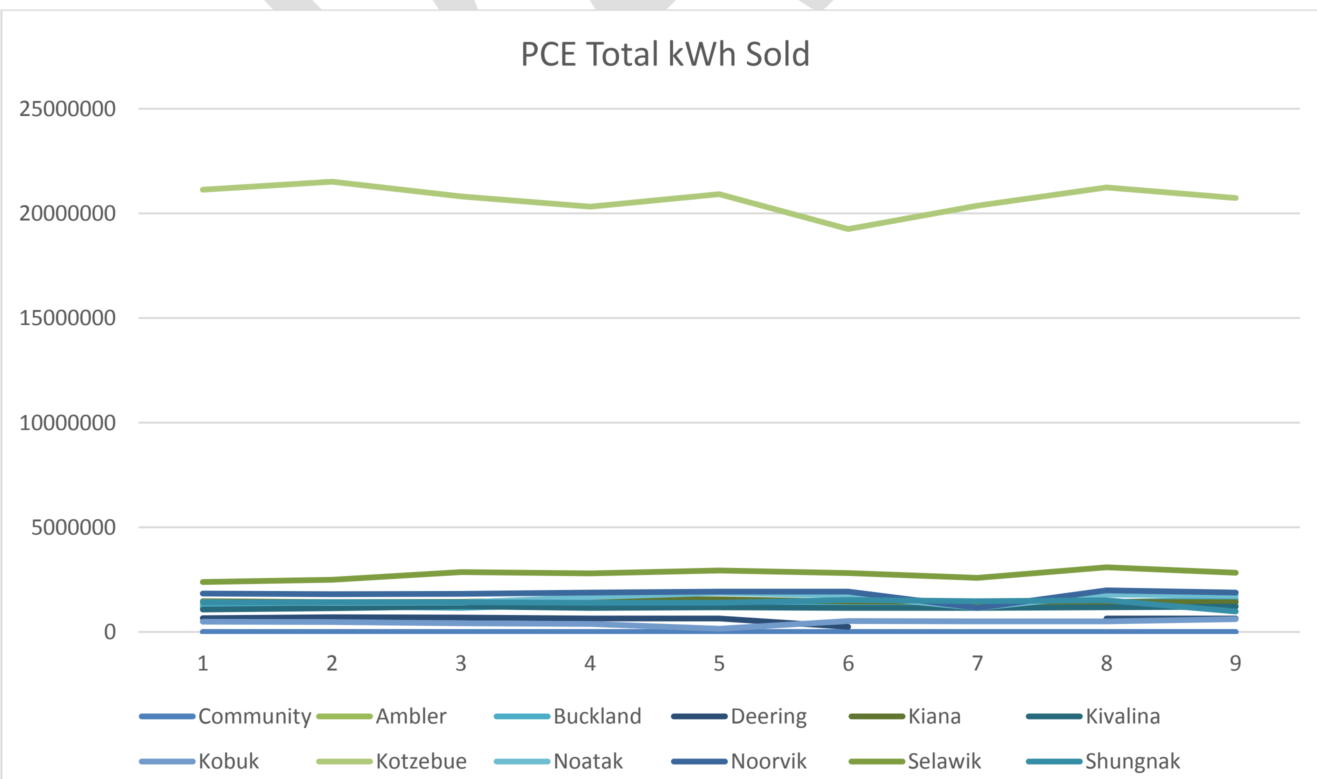
Community	FY2013 Diesel (kWh)	FY2014 Diesel (kWh)	FY2013 Wind (kWh)	FY2013 % Wind	FY2014 Wind (kWh)	FY2014 % Wind	FY2013 Total Generation	FY2014 Total Generation
Kotzebue	18,396,423	17,900,120	4,155,486	22.59%	3,768,108	21.05%	22,551,909	21,668,228
Ambler	1,709,342	1,693,004	*	*	*	*	1,709,342	1,693,004
Buckland	719,099	473,140	*	*	*	*	719,099	473,140
Deering	1,542,820	1,562,863	*	*	*	*	1,542,820	1,562,863
Kiana	1,285,613	1,259,478	*	*	*	*	1,285,613	1,259,478
Kivalina	1,318,829	1,249,892	*	*	*	*	1,318,829	1,249,892
Noatak	1,896,365	1,869,341	*	*	*	*	1,896,365	1,869,341
Noorvik	1,966,403	1,911,548	*	*	*	*	1,966,403	1,911,548
Selawik	2,891,097	2,644,107	95,609	3.31%	21,408	0.80%	2,891,097	2,665,515
Shungnak-Kobuk	1,732,010	1,721,352	*	*	*	*	1,732,010	1,721,352
Total	33,458,001	32,284,845	4,251,095	11.30%	3,789,516	10.50%	37,613,487	36,074,361

Source: AEA, 2013 and 2014

* Information not available.

The Power Cost Equalization program helps offset the cost of electricity to rural communities. Exhibit 9 shows each community's total electrical usage in total kilowatts sold by the local utility.

Exhibit 9: Electrical usage by kWh sold by local utilities



Source: AEA, PCE Reports 2005-2013
* Information not available at gaps

Some of the larger consumers of electricity in rural Alaska are water and sewer systems. Energy costs associated with water and sewer utilities place a huge burden on villages. A recent study of the water and sewer systems in Ambler, Noorvik, Kiana and Kobuk reveals that operation of the sewage system, raw water energy, water buildings and tanks, loops and services and raw water heating requires between about 4,350 in smaller communities to 18,625 gallons of diesel fuel a year in Kotzebue. This is a significant portion of the overall energy use. Above ground water and sewer systems have the greatest heat loss and are the highest energy users. Recovered heat from the power plant can offset all of the heat required at the water plant at most communities.

Solar generation from the arrays installed in Ambler and planned for each of the other communities in the region will contribute to power generation in subsequent years. Already the arrays at Ambler and the UAF Chukchi Campus have contributed to offsetting diesel fuel use for power generation. Solar power generation, or other renewable energy options, do not replace energy efficiency measures which can often be implemented at low or no cost.

2.3.2. Propane

Propane may be a cost effective choice for household use, such as for cooking. In the early '80s when electricity costs were high, 90 percent of Northwest Arctic residents used propane for cooking. Over time, propane-fired appliances were replaced and by the early 2000s, that number had dropped to only 16 percent. Lately, interest has renewed in propane as a power source for household appliances such as stoves, refrigerators and dryers. Although, propane is more efficient than diesel, the cost of propane shipped into Kotzebue remains too high to be an affordable option. It is anticipated that by 2015 the costs of propane in Fairbanks could be reduced by as much as 30%, which may make propane more economical than electricity for some applications in households with electrical usage over 500 kWh/month.

2.3.3. Diesel Fuel

Because of the cost of transporting and storing diesel fuel in remote locations of the Northwest Arctic, retail fuel costs are very high, creating correspondingly high electricity prices. Rising fuel cost impacts are magnified if one considers the additional costs associated with the limited logistical options for bulk fuel shipping, the poor economies of scale in fuel transportation, power generation and distribution, and possible reduction and/or elimination of Alaska's Power Cost Equalization (PCE) program and the State of Alaska Community Revenue Sharing programs. Along the Noatak River, as well as the upper stretches of the Kobuk River, the summer river depth in recent years has been insufficient to allow for annual delivery of fuel by barge. As a result, all of the fuel for the communities of Noatak, Ambler, Shungnak and Kobuk must be shipped in by airplane, greatly adding to the cost of energy (NWALT, 2010).

Table 8: September 2014 Fuel and Power Costs in the Northwest Arctic Region

Community	Gasoline $/gallon	Diesel #2 (heating) $/gallon	Propane $/100 lb bottle	Diesel for Power Generation $/gallon	Residential Electric Rate (pre-PCE) $/kWh	Commercial Electric Rate
Ambler	$11.07	$11.33	$250.00	$5.73	$0.61	$0.6186
Buckland	$7.00	$7.00	$295.00	*	$0.47	*
Deering	$6.75	$6.75	$285.00	*	$0.75	*
Kiana	$6.50	$6.00	$350.00	$3.59	$0.57	$0.6443
Kivalina	$6.72	$6.45	$404.00	$3.36	$0.56	$0.6522
Kobuk	$10.03	$9.53	-	-	$0.60	
Kotzebue	$6.80	$6.16	$198.28	$3.19	$0.45	**
Noatak	$9.99	$9.99	-	$6.76	$0.77	$0.8743
Noorvik	$8.03	$7.60	$307.00	$3.69	$0.57	$0.6455
Selawik	$8.25	$7.99	$320.19	$3.41	$0.52	$0.6175
Shungnak	$9.00	$9.00	$320.00	$6.13	$0.60	$0.6792
Average	**$8.19**	**$7.98**	**$303.27**	**$3.26**	**$0.59**	**$.675943**

Source: NAB, September, 2014

* No information available.

** Small commercial rate is roughly $0.37/kWh, Large commercial is roughly $.035/kWh.

In addition to the increasing cost of petroleum and diesel fuels, the burning of these hydrocarbon fuels results in air pollution and the risk of fuel spills during transportation and storage. In particular, many people living in the region are becoming increasingly aware of the effects of greenhouse gases on climate change and the resulting coastal erosion along the Chukchi Sea. The goal of reducing greenhouse gas emissions from the region's communities should be integrated into the regional energy planning process (NWALT, 2010).

In September 2013, AVEC reported that they had made 52 fuel deliveries to the NANA villages they serve. Over one million gallons were delivered at a total cost of $3,754,362 as shown in the following table.

Table 9: Fuel Delivery and Costs, September 2013

Village	Gallons Ordered	Gallons Received	Number of Deliveries	Average Cost Per Gallon	Total Cost
Ambler	109,000	18,000	5	$7.7500	$139,502
Kiana	117,000	114,178	2	$4.3207	$493,329
Kivalina	102,000	102,061	1	$4.3207	$440,975
Noatak	134,360	125,770	28	$7.4330	$934,843
Noorvik	148,000	96,946	1	$4.2096	$408,104
Selawik	230,000	230,572	3	$4.2617	$982,635
Shungnak	167,000	50,308	12	$7.0560	$354,974
Totals	**1,007,360**	**737,835**	**52**	**$5.62**	**$3,754,362**

Source: NWAB, 2013

Note: Kobuk is served from the Shungnak power plant.

2.3.4. Heat

According to the survey administered in researching the 2010 *Northwest Arctic Strategic Energy Plan*, nearly half of the households in the region use a combination of energy sources to heat their homes. Other heat sources included furnaces, wood stoves, Toyo or Monitor stoves, and boilers.

An estimated 2,273,385 gallons of diesel #2 heating oil is used annually throughout the region. In 2008, it was estimated that about 124,000 gallons of heating oil was displaced through the burning of local wood resources for heat. While fuel consumption remains relatively stable and in some cases has gone down, the escalating price of imported fuels continues to dramatically increase overall energy costs for Northwest Arctic communities.

2.3.5. Transportation Access

Residents of the Northwest Arctic Region use diesel or gas powered snowmachines, four wheelers, and boats for subsistence hunting and fishing activities. People travel to hunting areas, fish camps and to neighboring communities by skiffs and small boats on rivers and along the coast during the summer. In the winter, they use snowmachines for hunting, trapping, ice fishing and intercommunity travel. Barge delivery of fuel and deck freight, the aviation-based bypass mail system, and the delivery of freight and fuel to Noatak, Ambler, Shungnak and Kobuk by plane are critical transport services in the region. Air travel is the only year-round mode of transport into and out of most villages for passengers and many goods.

Nearly all regional supplies arrive in Kotzebue by ocean shipments between June and September. Kotzebue serves as a transportation and economic center for the Northwest Arctic. Currently, all loads are lightered to Kotzebue from larger vessels that are restricted to waters 15 miles offshore, due to shallow water depths. This method of delivery results in increased costs for the region for goods and energy needs. The Alaska Department of Transportation and Public Facilities (DOT&PF) has proposed a port site with deeper water at Cape Blossom, located ten miles to the south of Kotzebue. This would result in a way to more economically deliver fuel and commodities to the community and in turn, the region. DOT&PF intends to finalize documentation necessary to complete the environmental documentation for the Cape Blossom access road in the winter of 2013. Construction contracts could be awarded in 2014 depending on funding availability and the environmental approval schedule. It is anticipated that the completion of the road and port at Cape Blossom will reduce goods and energy costs in the region.

The cost of gasoline for transportation in 2013 averages $8.29/gallon.

REGIONAL RESOURCES

REGIONAL RESOURCES

This chapter provides details about energy resources and potential opportunities in the Northwest Arctic region.

3. Regional Resources

The following sections describe the potential energy resources and energy efficiency opportunities in the region. Table 10 provides contact information for entities serving the Northwest Arctic Region as a whole.

Table 10: Regional Entities Serving the Northwest Arctic

Regional Entities Serving the Northwest Arctic	
Native Corporation	NANA Regional Corporation, Incorporated P.O. Box 49 Kotzebue, AK 99752 Phone: 907-442-3301 Fax: 907-442-2866 Website URL http://www.nana.com
Borough	Northwest Arctic Borough PO Box 1110 Kotzebue, AK 99752 Phone: 907-442-2500 Fax: 907-442-2560 Website URL http://www.nwabor.org
Non-profit Native Association	Maniilaq Association PO Box 256, 733 Second Avenue Kotzebue, AK 99752 Phone: 907-442-3311 Website URL http://www.maniilaq.org

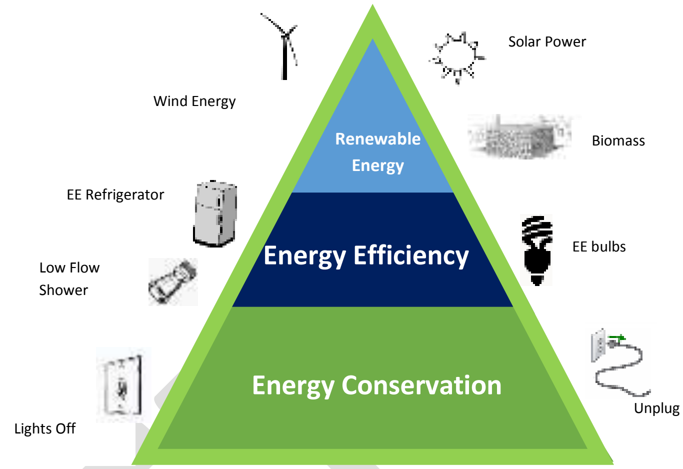
3.1. Energy Efficiency and Conservation Opportunities

Energy efficiency and conservation (EE&C) measures can result in significant savings on heating and electricity costs for both residential and non-residential buildings. “Energy conservation" and "energy efficiency" are often used interchangeably, but there are differences. Energy conservation means using less energy and is usually a behavioral change, such as turning your lights off or unplugging your coffee maker when not in use. Energy efficiency means using energy more effectively, and is often a technological change, such as replacing your light bulbs with more energy efficient light bulbs or replacing old refrigerators with more energy efficient refrigerators that use less energy. Using renewable energy is another way to reduce dependence on non-renewable energy. These concepts are illustrated in Exhibit 10.

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.

Reducing energy demand through EE&C provides both current savings through avoided fuel purchase, transportation and storage costs, and future savings by reducing or postponing the need for new capital investments in energy production.

Exhibit 10. Energy Pyramid



EE&C plays a critical role in decreasing energy costs in the world's arctic regions. Improving the energy efficiency of structures and changing the behavior of users saves money, conserves fuel and resources and reduces pollution.

> **Energy Efficiency for Regional Planning**
>
> …The benefits of efficiency are many; reduced capital costs by not overbuilding energy generation systems, reduced annual operating and resource costs by not generating more energy than a community actually needs, decreased impact of emissions associated with the non-renewable resources, and increased comfort and control in buildings.
>
> *AEA Regional Planning Methodology Guidelines*

The 2010 *Northwest Arctic Strategic Energy Plan* survey asked residents about ways they thought they could improve their energy efficiency. "People were asked how they could reduce the amount of energy that they used to heat and light their homes. Almost three quarters (73.8%) suggested that they could reduce electricity use by turning off or unplugging lights, electronics, and appliances. Over 11% (11.5%) said they should just use less energy, while over half (50.9%) thought they could reduce energy by getting more energy efficient appliances.

"People were also asked about ways that they could reduce their use of stove oil. Almost 40% (39.4%) thought they could do this by supplementing their stove oil home heating systems with wood heat. Over one quarter of the respondents (26.8%) suggested that they could reduce the amount of stove oil that they used by lowering the temperature of their homes.

"More information about energy efficiency could help households in the Northwest Arctic reduce energy use. Just over one half of the respondents reported that they knew a lot about energy efficiency. The remaining 47% of households had no knowledge or just some knowledge of energy efficiency. An expanded educational program may be valuable in helping households reduce energy costs (NWALT, 2010)." Table 11 shows the average household energy consumption in kilowatt hours.

Table 11: Average Annual Household Residential Energy Consumption, kWh

Community	kWh
Ambler	5,522
Buckland	6,593
Deering	4,545
Kiana	4,988
Kivalina	6,281
Kobuk	5,548
Kotzebue	6,750
Noatak	7,159
Noorvik	6,701
Selawik	6,140
Shungnak	6,416

Source: AEA Power Cost Equalization Data, reporting period 7/1/13-6/20/14 http://www.akenergyauthority.org/.

3.1.1. Smart Meters

One successful program, initiated through the 2009 Coastal Impact Assistance Program (CIAP) grant, teaches energy efficiency and awareness through providing feedback on electrical energy usage. Studies have shown that an average of 20% can be saved on electric bills with The Energy Detective (TED) device. Through this program, a "smart" energy meter was allocated to households in all communities except Kotzebue so that each individual could monitor energy usage and predict monthly electric cost. The meter shows energy use in real time and also warns when the power cost equalization (PCE) limit has been reached (500 kWh), the point at which the cost dramatically increases.

A follow up study is under way, with interns in each community who evaluate and reprogram the installed units. KEA is currently installing a slightly different model called an ECO-meter due to a different meter base system in Kotzebue (NAB, 2013). Additionally, a prototype commercial grade meter is planned for installation in the NAB school buildings in 2013.

In addition to installation of TED meters, NANA and RurAL CAP partnered to implement the Energy Wise program throughout the region. This program engaged rural Alaskan communities in behavior change practices resulting in energy efficiency and energy conservation. This tested model used a multi-step educational approach involving residents in changing home energy consumption behaviors. Locally hired crews were trained to educate community residents and conduct basic energy efficiency upgrades during full-day home visits. Through Energy Wise, rural Alaskans reduce their energy consumption, lower their home heating and electric bills, and save money. (RurAL CAP, 2012). Energy Wise has been implemented in all the Northwest Arctic communities, with only about 450 homes in Kotzebue remaining to be served. One year after the program was implemented, the region's villages reported a 20 to 30 percent reduction in residential energy consumption.

3.1.2. Smart Grids

A smart grid consists of components that add features to bring energy efficiency to an existing power grid by allowing repairs to be made to sections of the power grid. KEA has obtained grant funding from the National Rural Electric Cooperative Association (NRECA) and the Department of Energy for system upgrades in Kotzebue. These smart grid upgrades add three features to the KEA grid:

1. Upgrade power meters with TED meters, which have two-way communication capability – allowing KEA to retrieve data remotely, as well as disconnect or limit customers' electrical consumption for non-payment.
2. Install IHD (In Home Display) units (ECO meters) that allow in-home displays of current electricity usage – kWh/day, kWh/week, kWh/month – bringing customer awareness of electric consumption.
3. Install smart distribution switches throughout the power grid to enable KEA to shut down small portions of the grid for repairs or upgrades instead of shutting down the entire grid.

3.1.3. Weatherization

There are several weatherization and energy efficiency programs available to rural Alaska residents including the following:

- Housing Authority Weatherization (AHFC Service Providers – i.e. Northwest Inupiat Housing Authority) – combined state and federal dollars used to provide weatherization to residential homes in Alaska. This is an income based program.
- RurAL CAP Weatherization – Private and federal funds are used to provide weatherization to homes not weatherized by AHFC. Like the Housing Authority Weatherization program, this is an income-based program.
- RurAL CAP Energy Wise – This program provides education on behavior change and energy-efficiency. There are no income restrictions on this program.
- AHFC Home Energy Rebate Program – State of Alaska funded program that reimburses homeowners when energy-efficiency ratings are improved and energy conservation projects are completed. The program has no income restrictions. Participants cannot participate in both the Weatherization and Home Energy Rebate Programs.
- AHFC New Home Efficiency Rebate Program – This is a loan reduction program for new construction. There are no income restrictions on this program.
- AKEnergySmart Curriculum is a K-12 educational tool available through a collaboration from AHFC, Renewable Energy Alaska Project (REAP) and Alaska Center for Energy and Power (ACEP). It can be accessed at: http://www.akenergysmart.org/.

AHFC administers weatherization programs that have been created to award grants to non-profit organizations for the purpose of improving the energy efficiency of low-income homes statewide. These programs also provide training and technical assistance in the area of housing energy efficiency. Funds for these programs come from the U.S. Department of Energy as well as AHFC; however, state money makes up the bulk of the funding (Weatherization Programs, 2013).

The focus of weatherization is to increase the energy efficiency, safety, comfort and life expectancy of homes. Typical improvements include the caulking and sealing of windows and doors, adding insulation to walls, floors and ceilings, and improving the efficiency of heating systems. By making homes more energy-efficient, families spend less for heating, freeing up more household income for other basic necessities and expenditures which help support local economies (RurALCap Weatherization Services).

3.1.4. Benchmarking

Using American Recovery & Reinvestment Act (ARRA) funds through the State Energy Program, the AHFC conducted an extensive benchmarking program that included 1,200 public facilities statewide including two in the Northwest Arctic region—the Alaska Technical Center Dormitory in Kotzebue and the school in Buckland. By benchmarking a facility, owners and managers can identify trends in a building's energy use and compare use and operating costs to other buildings. Benchmarking allows facility owners to become more aware of how their decisions on design, construction and operations dramatically affect energy usage and costs throughout the life of the building. In 2011 and 2012, AHFC also funded 327 audits statewide using ARRA funds through the State Energy Program.

3.1.5. Water and Sewer Improvements

The Alaska Native Tribal Health Consortium (ANTHC) Division of Health and Engineering also has an active program to increase energy efficiency focusing on decreasing energy costs in water and sewer systems, which have a great potential for energy efficiency improvements. Energy costs associated with sewer and water utilities place a huge burden on villages. A recent study of water and sewer systems in northwest Alaska revealed that the energy needed to effectively operate the sewage system, raw water energy, water buildings and tanks, loops and services and raw water heating at -8° F can consume between 4,350 and 18,625 gallons of diesel fuel a year. This is a significant portion of the overall village energy use. Communities with above ground systems experience the greatest heat loss and are the most inefficient.

In 2009, ANTHC formed the Energy Projects Group to help address energy issues in rural Alaska. The Alaska Rural Utility Collaborative (ARUC) is an ANTHC program to manage, operate and maintain water and sewer systems in rural Alaska. Currently, five communities in the region have joined the ARUC: Ambler, Deering, Kiana, Kobuk, Noorvik and Selawik. ARUC works with each community to make its water and sewer systems as sustainable as possible.

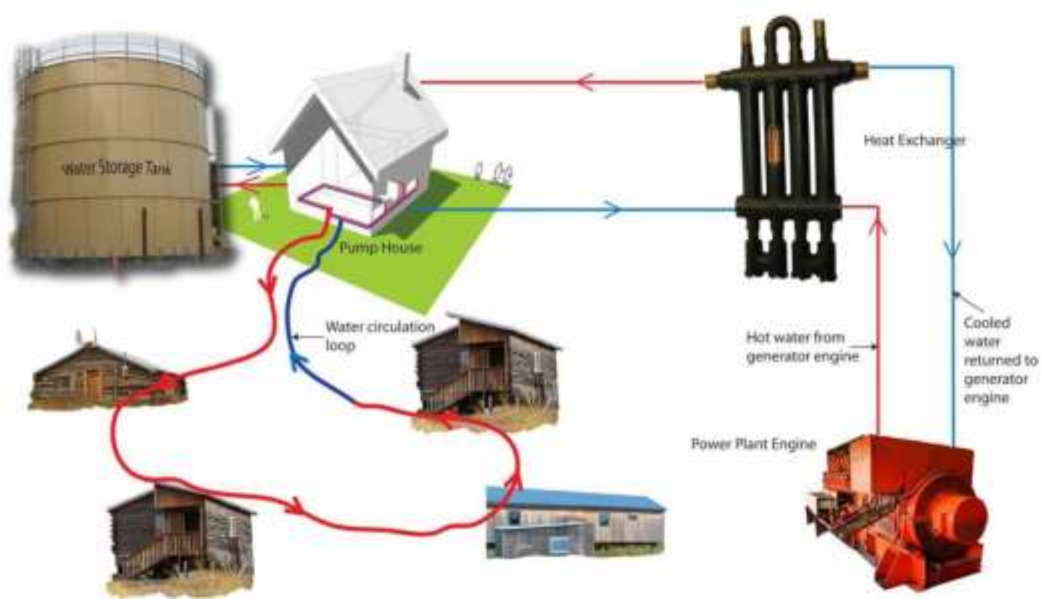
In the last five years, ARUC has implemented or expects to complete energy audits, energy efficiency training, heat recovery systems and installation of remote monitoring equipment to help identify problems and prevent catastrophic failure (see Table 12) in many communities in the region. ANTHC receives funding for these energy efficiency improvements from a variety of sources including Alaska Energy Authority, Denali Commission, U.S Department of Energy, and U.S. Rural Development program.

Table 12: ANTHC Energy Efficiency Projects

Community	EE Project	EE Training	Heat Recovery System	Remote Monitoring
Ambler	Energy Audit 2015 EE Improvements 2015	2015	2013	2013 Improvements 2015
Buckland	Energy Audit 2016	2015	2013	2015
Deering	EE Audit and Improvements 2013		2013	2015
Kiana	Energy Audit 2016		2012	2015
Kivalina				2015
Kobuk	Energy Audit 2014, EE Improvements 2015	2015		2015
Kotzebue	Energy Audit 2016		2013	
Noatak	Energy Audit 2016		2012	2015
Noorvik	Energy Audit 2016		2016	2014
Selawik	EE Improvements 2013 Energy Audit 2016	2015	2013	2013
Shungnak	Energy Audit 2016		2012	2013 Improvements 2015

The largest single energy saving measure is the implementation of waste heat recovery from a community's diesel power generation plants. When the water infrastructure is near the power plant, waste heat can be used to offset much or all of the fuel oil required to heat the water system.

Exhibit 11: Heat Recovery System Illustration



Source: www.anthctoday.org

The 2012 Department of Commerce, Community and Economic Development (DCCED) fuel price report indicates that Ambler, Selawik and Shungnak have seen significant savings because of their recent heat recovery projects as shown in Table 13.

Table 13: Heat Recovery Project Energy Savings

Community	Energy Savings	Annual Cost Savings (DCCED fuel price report January 2012)	Present Value of Lifetime Savings
	(annual gallons of fuel)		(20 years, 3.5% real cost increase of fuel)
Ambler	10,300	$63,551	$1,871,200
Selawik	11,875	$73,268	$2,157,000
Shungnak	10,400	$64,168	$1,889,400
Totals	32,575	$200,987	$5,917,600

Source: DCCED

In the Northwest Arctic Region, ANTHC has conducted energy audits on public buildings particularly in the water treatment plants and health clinics. They have also completed heat recovery studies to identify opportunities to capture recovered heat and thus reduce energy costs. A list of these projects is shown in Table 14.

Table 14: Heat Recovery Studies and Energy Audits

Community	ANTHC Reports	AHFC Energy Audit
Buckland	-	Buckland School
Kiana	Kiana, Alaska Heat Recovery Study	-
Kotzebue	-	Alaska Technical Center Dormitory
Selawik	Comprehensive Energy Audit for Selawik Water and Sewer Systems	-
Shungnak	Shungnak Heat Recovery Analysis	-

Source: ANTHC today

In the *Kiana Heat Recovery Analysis*, the new water treatment plant was evaluated for heat recovery potential. Total estimated annual heating fuel was approximately 5,000 gallons. Estimated fuel savings realized by implementing a heat recovery system was nearly 5,000 gallons. The estimated cost for the heat recovery project was $265,714. The simple payback based on a fuel cost of $6.00/gallon was 8.9 years. They also determined that the AVEC power plant is capable of providing nearly double the amount of recovered heat the water treatment plant requires. Additional facilities near AVEC or the water treatment plant could be evaluated for potential to receive recovered heat to better utilize the available resource.[3]

The ARUC audit of the water and sewer systems in Selawik found that, based on fiscal year 2010 electricity, fuel oil and recovered heat prices, the annual energy costs for the systems analyzed were

[3] ANTHC-Kiana Heat Recovery Analysis, December 6, 2010.

approximately $199,041 for electricity, $57,701 for fuel oil, and $7,688 for recovered heat, giving a total energy cost of $264,430 per year. Fourteen Energy Conservation Measures (ECMs) were recommended for implementation. By implementing these fourteen projects, the utility cost could be reduced by approximately $175,995 per year or 66 percent of the $264,430 annual energy cost. Implementation costs for these measures would be approximately $508,955 for an overall simple payback of 2.9 years.[4] ANTHC reports an actual 5-year energy savings for Selawik of $1,126,850 as a result of their efforts to improve the water and sewer system and the use of heat recovery (ANTHC, 2012).

3.2. Interties

One means of reducing the cost of energy production is to share expenses and resources across a cluster of communities. Such an intertie exists between Kobuk and Shungnak and an intertie linking Ambler to them is planned. But in much of the Northwest Arctic and across rural Alaska, distances between communities can be so great that interties are not economically practical. The Alaska Center for Energy and Power (ACEP) is studying technology to mitigate this problem. They are engaged in a High Voltage Direct Current (HVDC) transmission project to "assess and demonstrate the technical and financial feasibility of low-cost small-scale HVDC interties for rural Alaska. The objective is to demonstrate that small-scale HVDC interties are technically viable and can achieve significant cost savings compared to the three-phase AC interties proposed between Alaskan villages. Because these AC interties are very costly to construct and maintain, very few have been built in Alaska. As a result, most villages remain electrically isolated from one another, which duplicates energy infrastructure and thereby contributes to the very high cost of electricity. HVDC technology has the potential to significantly reduce the cost of remote Alaskan interties, reducing the costs to interconnect remote villages and/or develop local energy resources" (ACEP, 2012). This type of system may be practical in the Northwest Arctic.

Ambler-Shungnak Intertie. AVEC is interested in constructing an intertie between Shungnak and Ambler. Shungnak and Ambler experience the second and third highest fuel costs of all of AVEC's communities, respectively. Often the Kobuk River water level is so low that barges are unable to deliver fuel, and fuel must be flown into communities. When this occurred in Shungnak in 2010, the cost of delivered fuel went up considerably. Crowley has indicated that fuel delivery to Shungnak via barge will be inconsistent or impossible in the future because of the river level and the sand bar that has formed below the community. Crowley believes that fuel delivery to Ambler will continue to be successful in the future.

Considering the issues with barge fuel delivery and high cost of flying fuel in Shungnak, AVEC is investigating constructing a new power plant in Ambler and an intertie between Ambler and Shungnak. With a larger power plant, able to serve three communities, efficiencies will improve, thereby helping to stabilize rising energy costs in the area (AVEC email, 6/4/2013).

Kiana, Noorvik and Selawik Intertie. AVEC is requesting funding from the AK State Legislature to study the feasibility and complete the preliminary design of a joint power plant and intertie serving the communities of Kiana, Noorvik and Selawik. An intertie system and joint power plant could enable the three villages to share costs of power and reduce the burden on them individually. The study could be

[4] ANTHC, *Comprehensive Energy Audit for Selawik Water and Sewer Systems*, June 21, 2011.

the first step in determining whether this project is economically feasible. A joint prime power plant could allow the older less efficient power plants and tank farms to be decommissioned. Also the power plant and intertie could be capable of incorporating alternative energy sources, which could help stabilize energy costs in the area.

3.3. Oil and Gas

The goal in the Northwest Arctic Region is to displace as much diesel fuel as possible with renewable and climate-friendly energy sources, but it is also necessary to look to traditional fuels that are or may be available in the region as well.

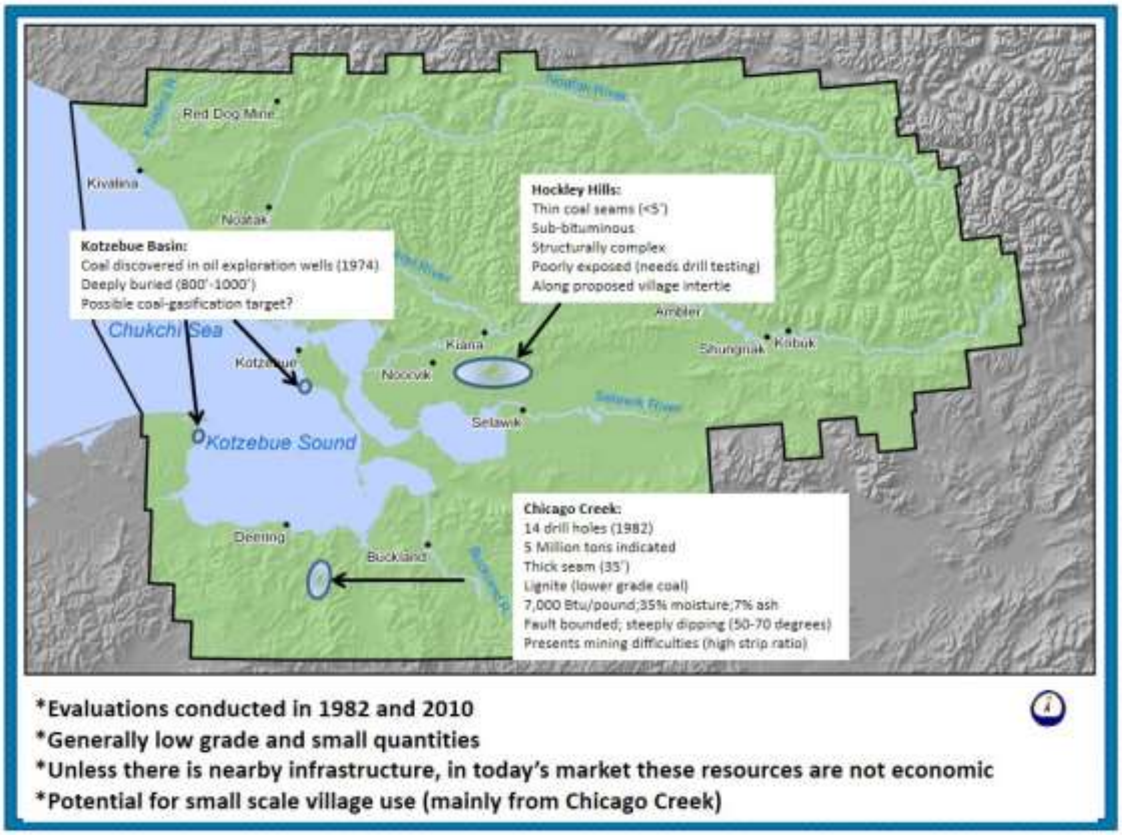
Very little oil and gas exploration has been done in the Northwest Arctic Region. SOCAL (now Chevron), conducted seismic exploration in the Kotzebue basin, and drilled two exploration wells in 1974-75. These are the Cape Espenberg No. 1 and Numiuk Point No. 1 wells, drilled to 8,360 feet and 6,315 feet respectively. These wells encountered some coal and oil and gas showings but never produced any hydrocarbons. The deeply buried coal could provide the potential for coal-bed methane production. There has been no significant oil and gas exploration data acquired since 1977 and the region remains largely unexplored. NANA is pursuing potential investors for further development of natural gas opportunities in the Kotzebue basin.

3.4. Coal

Massive coal reserves exist north of the region in the Deadfall Syncline located near Point Lay. Coal quantities there are estimated to be approximately 25% of known US reserves. This is a high thermal yield (12,500 BTU), low sulfur bituminous coal. In the past, coal was used for home heating in the region. The use of high efficiency coal-powered heaters should be reviewed. There are also projects currently underway to demonstrate the use of coal for electric generation. Also, the efforts for developing cleaner burning synfuels from coal should be monitored. Underground coal gasification (UCG) has been identified as a possible means of extracting the regions coal energy in an environmentally sensitive manner (NWALT, 2010).

Evaluations of potential coal resources in the Northwest Arctic Region were conducted in 1982 and 2010. In the Kotzebue Basin, coal was discovered in oil exploration wells. It is located at 800 to 1,000 feet below ground, but could potentially be a target for coal gasification. In the Chicago Creek region between Deering and Buckland, a 35-foot seam of lignite (lower grade coal) was discovered. Its location and structure makes it difficult to mine. In the Hockley Hills southeast of Kiana, thin seams of sub-bituminous coal were located along a proposed village intertie route. These are poorly exposed and additional test drilling would be required. In the current market, these resources were not deemed economically feasible; however, there is potential for small scale local village use or coal gasification. Figure 2 shows the locations and additional information about these coal resources.

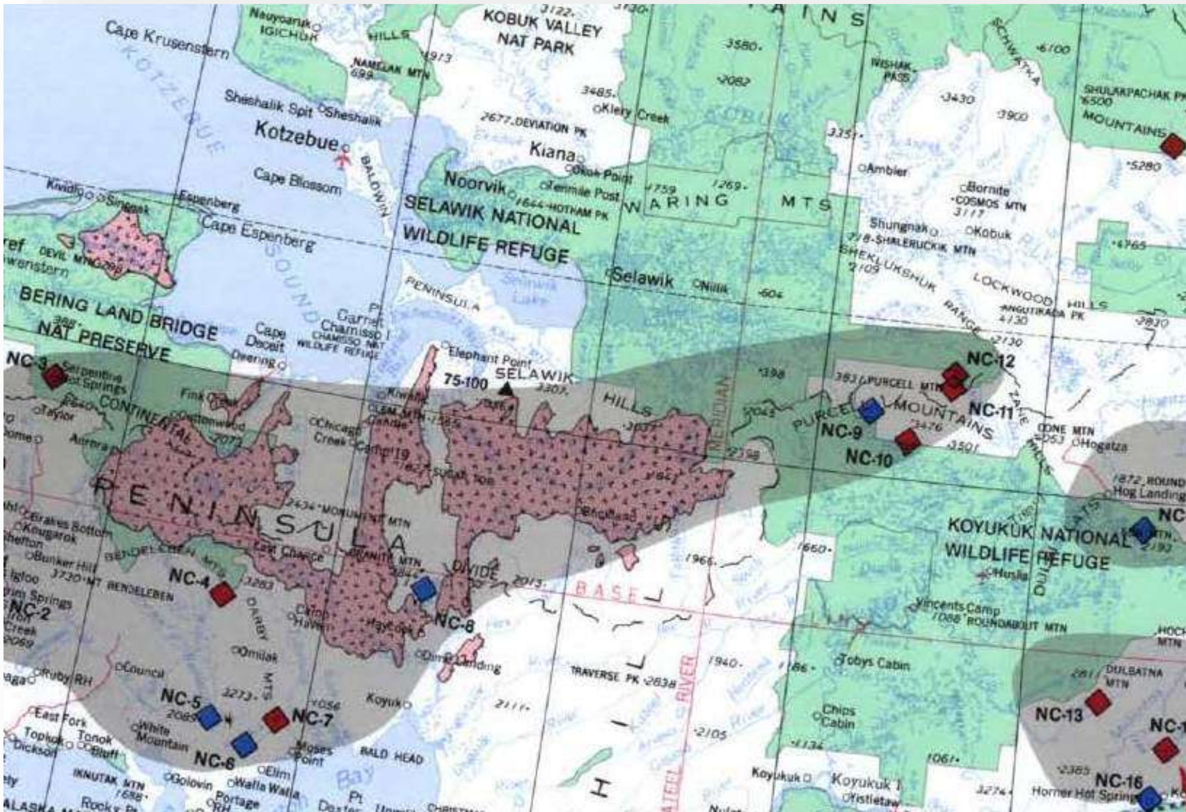
Figure 2: Potential Coal Resources



3.5. Geothermal

Geothermal potential has been identified in the region for the Buckland and Upper Kobuk (Ambler, Kobuk and Shungnak) areas. There are important geo-scientific and drilling feasibility studies that could further define the potential of this resource. Figure 3 shows known hot springs in the Northwest Arctic, as identified by the 1983 *Geothermal Resources of Alaska Map*. In this figure, red diamonds indicate hot springs above 50 degrees Celsius; blue diamonds indicate hot springs below 50 degrees Celsius. Shaded areas indicate regions favorable for geothermal energy; however, it is likely that only small areas are viable for production (NWALT, 2010).

Figure 3: Map of Hot Springs in Northwest Alaska



3.6. Hydroelectric

Hydroelectric power, Alaska's largest source of renewable energy, supplies 21 percent of the state's electrical energy in an average water year (Alaska Energy Authority, 2011). In the Northwest Arctic Region, small-scale hydroelectric power plants, with minimal environmental impact, may prove to be economical at sites on the upper tributaries of the Kobuk River. Although power output would be minimal October through March when the rivers ice over, hydropower production would be substantial for the rest of the year.

Run-of-river hydroelectric plants rely on the natural flow volume of the stream or river. Such facilities tend to have fewer environmental impacts compared to conventional dam-storage hydroelectric plants because of the lack of a large artificial reservoir. With proper siting, construction techniques, and operation and maintenance, run-of-river hydropower in the region could have minimal impacts on fisheries and other subsistence resources (Lilly, 2010).

Ambler may be able to utilize hydroelectric power (Alaska Energy Authority, 2010). Studies have been ongoing since about 2010, when year-round stream gauging began in the Cosmos Hills between Kobuk and Shungnak. Fisheries and geotechnical studies were performed and a feasibility study is underway to assess economical and practicable hydroelectric generation at Wesley Creek, Dahl Creek or the

Kogoluktuk River. “Run-of-river hydro sites in this area could provide electricity from about mid-April until early November, and the Kogoluktuk River may be able to provide power later into the winter, and earlier in the spring (Lilly, 2010).”

3.7. Biomass

Biomass is organic matter that was alive a short time ago and can be used as fuel. In the Northwest Arctic Region, the most common sources for biomass fuel are wood, wood byproducts, and peat. Additionally, solid waste to energy is being investigated as a possibility for area landfills. With innovation and research, biomass can be used for power generation and district heating. Wood products, such as pellets, may also provide economic development opportunities for the region’s residents and businesses by creating local vendor and sales opportunities (NRC, 2010).

Currently there is a biomass conceptual design project for the Upper Kobuk. If the concept proves viable, then a business model could be implemented to use biomass to help lower energy costs in this area. The *NANA Forest Stewardship Plan* assessed the vegetation in the Upper Kobuk Valley. Table 15 presents that information.

Table 15: Acres per Vegetation Type in Upper Kobuk Valley

Vegetation Type	Ambler (Acres)	Kobuk-Shungnak (Acres)
Alder Shrubland	2901	3050
Balsam Poplar-Aspen Woodland	0	0
Birch-Aspen Forest	1394	3237
Black Spruce Forest and Woodland	6043	3312
Dry Aspen-Steppe Bluff	0	0
Floodplain Forest and Shrubland	936	1362
Peatland Forest	7881	3787
Transitional Forest Vegetation	0	0
White Spruce Forest and Woodland	43030	21048
White Spruce Hardwood Forest and Woodland	549	741
Willow Shrubland	7132	9721

Source: NANA Forest Stewardship Plan, 2011

Alaska Wood Energy Associates developed a harvest analysis for the Upper Kobuk in 2011. Analysis of the forest types in the upper Kobuk River valley, showed it to be at the northwestern edge of the range of white spruce (*Picea glauca*) and black spruce (*Picea mariana*), as well as aspen (*Populus tremuloides*), cottonwood (*Populus balsamifera*) and birch (*Betula papyrifera*). The spruces are the only conifer tree species in the area, but in addition to aspen, cottonwood, and birch (the largest hardwoods) there are a variety of willows and alders that grow principally in wet areas, such as flood plains and braided stream channels. In all cases, each of these species could be suitable to use as wood fuel for both stick-fired boilers and for chip fired boilers. Moisture content is the key issue; and for that reason, cottonwood may not be as desirable as other hardwoods for stick-fired boilers. The report went on to discuss equipment needed for such systems. Key findings included:

1. There should be two sets of harvest equipment for the Upper Kobuk: one for Ambler and one for Shungnak and Kobuk to share;
2. All pieces of equipment should be able to multi-task and there should be some redundancy in the equipment for working in remote conditions;
3. A team of two can operate the equipment components suggested to produce the entire amount of wood needed for Ambler and a team of three would be required for Kobuk/Shungnak;
4. Harvesting may occur in both summer and winter; however most wood will be moved during the winter when the ground is frozen;
5. A system of harvesting based on time of year and summer vs. winter harvesting sites should be developed through a five-year harvest plan;
6. Modeled costs of wood production for either chip or cordwood production is much lower than costs used in the feasibility studies. This creates a very robust conservative model for development of a harvest system, with plenty of room for learning how best to produce wood locally; and
7. A very robust harvest system for Amber will cost just under $500,000 and for Kobuk/Shungnak $700,000. This is based on an all-new maximum productivity system linked with the largest chip system. If cordwood boilers are selected, there is not a need for a chipper and costs would be decreased by $70,000.[5]

Due to the small average tree size, a harvest system that could handle stem diameters up to 14 inches would be adequate to process most of the woody biomass found in the project area.

Communities identified by AEA as potentially benefitting from a biomass energy program include: Ambler, Buckland, Kiana, Kobuk, Noatak, Noorvik, Selawik, and Shungnak (Alaska Energy Authority, 2010).

Carefully planned harvesting of wood is needed to have a sustainable woody biomass project. The Tanana Chiefs Conference (TCC) prepared the *NANA Region Native Allotment Forest Inventory* for Maniilaq in January 2013. The areas inventoried are for native allotments located in the Noatak Valley and Upper and Lower Kobuk subregions. This document will be valuable in determining guidelines for sustainable biomass systems.

One of the primary monetary benefits of using biomass as a fuel source is that the money spent on heating fuel will remain in the local economy. This will promote economic sustainability in communities that have struggled to maintain healthy local economies. In addition, using biomass for heat will stabilize heat energy costs with future costs rising much less than projected oil costs. Other benefits of using wood as an energy resource include that it can provide wildfire mitigation, cause a reduction in fuel spills and enhance wildlife habitat if managed correctly. Biomass heating could also heat greenhouses which would help offset the costs of produce.

Challenges of biomass include:

[5] Wall, Bill, PhD, Alaska Wood Energy Associates Sustainability, Inc. *Wood Harvest Systems for the Upper Kobuk Valley*. 2011.

- Lack of access to the wood resource. New trails may be needed or transport of harvested wood may need to occur before spring thaws;
- Harvested wood takes time to cure, a minimum of one summer season to reduce moisture content to optimize burning efficiency;
- Requires planning and management of resources;
- Land owner permission is needed to cut wood;
- Reforestation is a slow process as trees at the extremes of their ranges grow more slowly than in more favorable conditions;[6]
- Driftwood may be saltwater saturated, presenting additional challenges; and
- Space must be allocated for boiler, wood processing, and resource storage.

In 2014 Tetra Tech, Inc. and project partner DOWL HKM, under contract with the NWAB, completed a Biomass Feasibility Study and initial Engineering Design for the Upper Kobuk. The study showed high potential for biomass use to help offset the cost of energy in this sub-region.

"The Upper Kobuk Valley region has some of the highest cost-of-living expenses in Alaska, which is the most expensive state in the US. There are no contiguous roads connecting villages within the Upper Kobuk Valley or outside of the borough. All resources must either be gathered from the land or flown into each village's airport. Use of the Kobuk River for transport is extremely limited and has only been used once in the last 2 years. Fuel oil is currently over ten dollars per gallon, airlifted into the villages. Considering the cost of a cord of firewood is approximately $210 (based on $70/sled load, equivalent to 1/3 cord), one million Btu's (MMBtu) of heat from fuel wood will cost residents of the Upper Kobuk area approximately $16.00. To make the same energy from fuel oil costs $87.33, a savings of over $70 per MMBtu when fuel oil use is displaced with locally-available biomass." (Upper Kobuk Biomass Project Study)

3.8. Wind

The Northwest Arctic has always been on the cutting edge of harnessing the power of wind. Since 1997, wind turbines have supplemented power in Kotzebue, the first testing ground for wind power in the region. The first three turbines were commissioned that year and seven more commissioned in 1999.

Financed under the Emerging Energy Technology Fund (EETF) from AEA, Kotzebue will test a turbine made by "Eocycle" out of Quebec Canada. It is a 25kW turbine that fits well with the local needs for wind power. The testing site for the Eocycle turbine will be Kotzebue Electric Association's (KEA) wind site just outside of Kotzebue. It is hoped that the test will certify the turbine for use under Arctic -40°F conditions. If the Eocycle proves viable under these conditions, it could benefit many rural Alaska communities. The new turbine has been ordered and foundation work was performed in May/June 2013.

In Noatak, instruments have been installed to monitor both wind and solar potential. Final assessments for wind power in Buckland, Deering and Noorvik are in progress. At Red Dog Mine, meteorological towers (MET) are already in place, with three different sites monitoring for wind at the mine (NRC,

[6] *NANA Forest Stewardship Plan*, 2011.

2010). Wind classification at the village sites is listed in Table 16. Wind speeds at Red Dog have been monitored as high as 99 miles per hour. These winds have been from one direction, making the resource more reliable.[7]

The quality of a wind resource is critical to determining the feasibility of a wind project. But other important factors to consider include the size of a community's electrical load, the price of displaced fuel such as diesel, turbine foundation costs, the length of transmission lines, and other site-specific variables. Potential wind power is rated on a scale of one to seven with seven being strongest (Alaska Energy Authority, 2011).

Six of the communities in the Northwest Arctic Region have a Wind Power Class of 3-5 and therefore have the potential to benefit from wind projects. Table 16 lists the communities and their power class ratings along with the best potential wind areas identified.

Table 16: Northwest Arctic Region Community Wind Power Class Ratings

Community	Estimated Wind Power Class (Location)	Project and Status (if any)	Feasibility Study
Kotzebue	5 (Airport)	10 turbines 2 900 kW turbines	Yes Yes Eocycle Testing 2013/2014
Buckland	1 (Airport), 4 (7 miles west)	Construction 2014	Yes
Deering	3 (Airport)	Construction 2014	Yes
Kiana	N/A	None	No
Noorvik	3	None	Yes
Selawik	3 (Airport), map forecasts class 2 in region	4 turbines are installed in Selawik – AVEC to restart 2014	Yes
Kivalina	5 (Airport)	Met Tower	Yes
Noatak	4	Met Tower	Yes
Kobuk	N/A	Met Tower going up near Shungnak May 2013 for feasibility study	May 2013-May 2014 Report June 2014
Shungnak	N/A		
Ambler	1-2	Wind Study complete 2011-12	Yes

Source: Alaska Energy Authority, 2011

Cost estimates for wind power systems in Deering, Buckland and Noorvik place costs including turbines, transition lines, parts and engineering at almost $11 million dollars for all three communities.

[7] *Red Dog Mine, the next 20 years*. Teck, 2009.

3.9. Solar

Alaska boasts great fluctuations in sunlight throughout the year. Solar power has potential in the Northwest Arctic Region. In the summer months, near 24-hour sunlight can be harvested for power. However, during the dark winters, other energy sources would be needed to generate electricity as the land above the Arctic Circle is cast in almost 24-hour darkness (NRC, 2010).

A pilot project was commissioned in Ambler in March 2013, with an installation of a 10 kW Solar Photovoltaic system (PV) to power the water plant and sewer system. The system cost approximately $75,000. Solar PV system use solar panels to convert sunlight into electricity. On sunny days the utilities are wholly powered by solar generated electricity. Production in the first two months of operation was about 800 kWh per month, providing an estimated savings of $6,500 to $7,500 per year off the operation of the plant, offsetting approximately 750 Gallons of fuel. For a lifetime of about 25 years, it is estimated to save a minimum of $230,000 and offset 27,000 gallons of fuel.

Ambler pilot solar project

During phase 2, solar arrays were constructed at Deering, Noatak, Noorvik, Shungnak, Kobuk and Ambler and are expected to be fully operational shortly. In phase 3 (summer/fall of 2014) the plants at Kivalina, Selawik, Kiana, Buckland and Kotzebue will receive their solar panels. This project was funded with a CIAP grant.

The UAF Chukchi Campus in Kotzebue operates a Solar PV for power generation. It produced 1.02 megawatt hours of energy in the first four months of 2013. In April alone, the solar production was 597 kWh. Solar PV for heat is not needed in the summer time when school is out and the need is not there.

Another technology being explored in the Northwest Arctic is solar thermal energy. In 2008 KEA partnered with the Kotzebue Community Energy Task Force (CETF) to explore alternative methods for hot water and home space heating. The result was a project funded by the Denali Commission to install the first solar thermal systems above the Arctic Circle.

Solar thermal systems are different from PV in that they harness the heat from the sun and transfer that heat to residential hot water systems, and in some cases base board heating systems as well. The goal for solar thermal systems in Kotzebue is to reduce heating fuel consumption. By Christmas 2010, six systems were installed and commissioned in elders' homes in Kotzebue.

In order to determine the best usage of this technology above the Arctic Circle, it was decided to experiment with different designs and applications: three of the systems are for domestic hot water only and three of the systems are for combined domestic hot water and hydronic base board heating. KEA and CETF hope to realize a 30% reduction in heating fuel usage for hot water and space heating with these systems (KEA, 2013). KEA reports that the pilot project has proven successful and that these systems could be installed in homes throughout the region.

The following data comes from the Ambler Solar Array Project between March and September 2013.

Jesse Logan (KEA) adjusts a flat plate solar thermal panel on Mary Omnik's house. Photo courtesy of KEA.

Evacuated tube solar thermal system installed on Kassie Drigg's house. Left- David Lindeen (Susitna Energy Systems). Right- Jesse Logan (KEA). Photo courtesy of KEA.

Table 17: Energy Produced: Ambler Water Plan Solar Array

	March	April	May	June	July	August	September	TOTAL
kWh Produced	863	1395	1330	1011	781	695	406	**6481**
Value of Electric in $	510.85	726.13	676.48	524.30	405.03	360.43	Est. 215	**3057.79**
Gallons of Diesel Offset	63.46	102.57	97.79	74.34	57.43	51.10	29.85	**476.54**
Pounds of Co2 Offset	1420.14	2295.60	2188.63	1663.69	1285.20	1143.68	668.11	**10,665.06**

Between March 2013 and April 2015, a total of 13.4 MWh have been generated by the five arrays. Additionally 40,612 pounds of CO^2 (a greenhouse gas) was not released into the environment.

Table 18: Solar array data from five villages, June 2, 2014

Community	Commissioned	Size Kw	Kwh produced	Rate	Value $	Diesel offset G.	CO2 offset metric tons
Ambler	Jan 2013	8.4	9,500	0.62	5,890	703	13.08
Shungnak	Oct 2013	7.49	2,900	0.68	1,972	214	4.03
Kobuk	Nov 2013	7.38	3,100	0.68	2,108	230	4.20
Noatak	Nov 2013	11.5	4,100	0.87	3,567	304	5.67
Noorvik	Oct 2013	12	4,100	0.65	2,665	304	5.67
Deering	Nov 2013	11.1	3,400	0.71	2,414	252	4.67
Total		57.87	27,100		18,616	2007	37.32

Table 19 shows the current and planned solar projects in the Northwest Arctic Region.

Table 19: Northwest Arctic Region Community Solar Installation

Community	Solar PV	Solar Thermal	Project and Status (if any)
Kotzebue	Yes, 2014	Yes	Solar PV on the water and sewer Solar thermal on 6 homes 2010 – ACEP/KEA Chukchi College Solar PV – current and operating Kotzebue Technical Center – 3kW array currently disconnected for ATC remodel project. Reinstall TBD.
Buckland	TBD	No	Funded - no site selected
Deering	Yes, 2013	No	Installed at the Water & Sewer Plant
Kiana	2015	No	To be installed at the Water & Sewer Plant
Noorvik	Yes, 2013	No	Installed at the Water & Sewer Plant
Selawik	Yes, 2014	No	To be installed at the Water & Sewer Plant
Kivalina	TBD	No	Funded - no site selected
Noatak	Yes, 2013	No	Installed at the Water & Sewer Plant
Kobuk	Yes, 2013	No	Installed at the Water & Sewer Plant
Shungnak	Yes, 2013	No	Installed at the Water & Sewer Plant
Ambler	Yes, 2013	No	Installed at the Water & Sewer Plant

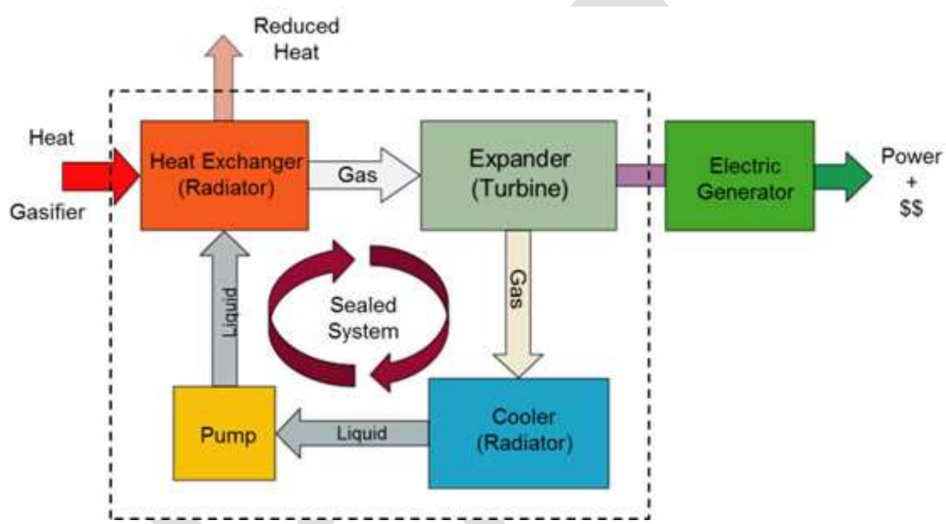
The existing solar flat-plate and evacuated tube panels in this region should continue to be monitored and analyzed for their energy and economic performance.

3.10. Emerging Technology

Several new technologies to capture renewable energy are being considered in the region. The in-stream (hydrokinetic) turbines are an emerging hydroelectric technology which could also find applications in the region's rivers and streams (NRC, 2010). Other emerging technologies that are being discussed are an organic rankine cycle waste heat to energy system, waste to energy (WtE) conversion and high voltage direct current (HVDC) discussed in section 3.2.

An 'Organic Rankine Cycle' (ORC) turbine can convert what would otherwise be waste heat streams to electrical power. ORC units produce electricity by recovering heat from industrial processes, reciprocating engines, and gas turbines. The electric power range in heat recovery applications is generally from 1 MW to 10 MW. They are commercially available today at a variety of sizes. The ORC process is illustrated in Exhibit 12.[8]

Exhibit 12: ORC Process

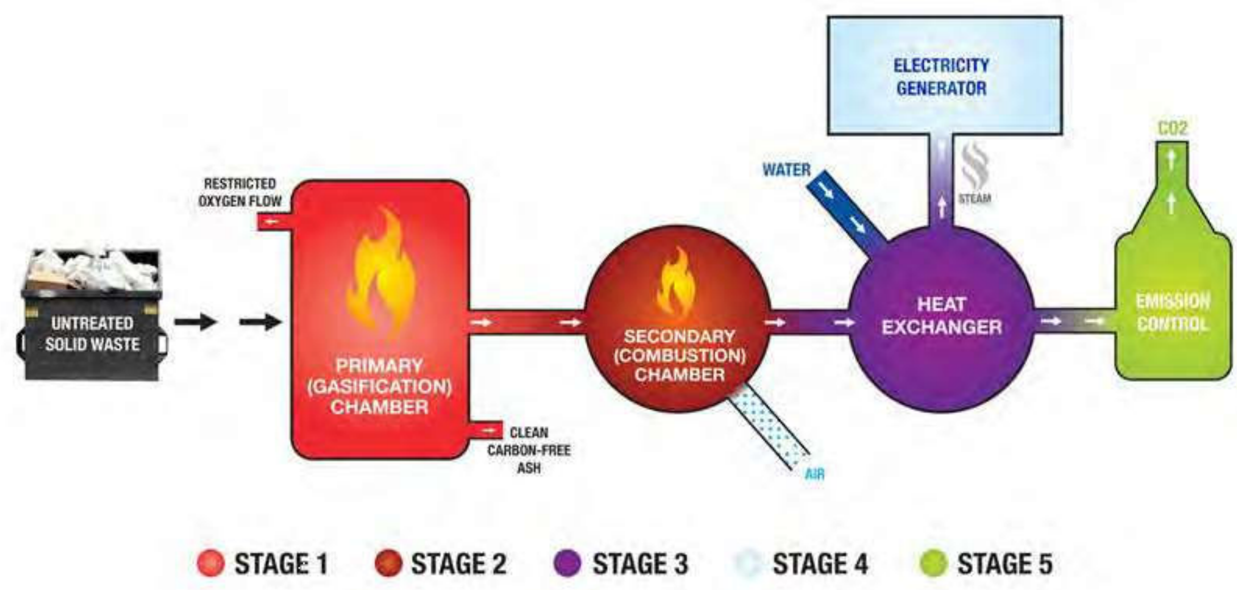


Source: wastetogaspower.com

The WtE (or energy-from-waste (EfW)) is the process of generating energy in the form of electricity and/or heat from the incineration of waste. WtE is a form of energy recovery. Most WtE processes produce electricity and/or heat directly through combustion, or produce a combustible fuel commodity, such as methane, methanol, ethanol or synthetic fuels (Wikipedia). The WtE process is illustrated in Exhibit 13.

[8] NOTE: AEA stated that the ORC should be considered only after every heat use for building heat has been exhausted, AEA review comments on August 2013 Northwest Arctic Regional Energy Plan draft.

Exhibit 13: WtE Process



Source: wastetoenergycanada.com

A high-voltage, direct current (HVDC) electric power transmission system uses direct current for the bulk transmission of electrical power, in contrast with the more common alternating current (AC) systems, This technology was developed in the 1930's and has been modernized. The new HVDC system is considered by many as the transmission method of the future because of its ability to transmit current over very long distances with fewer losses than AC. For long-distance transmission, HVDC systems may be less expensive and suffer lower electrical losses (Patrick J. Kiger, National Geographic News, December 2012). The smallest HVDC system in operation is tens of megawatts, which is impractical in this region because of the great distances between communities.

Other emerging technology includes the Capstone MicroTurbine and Turbogen technology. These technologies have not been sufficiently developed nor tested in remote Arctic conditions and are impractical for development in this region at this time.

SUBREGIONAL SUMMARIES, COMMUNITY & ENERGY PROFILES

SUBREGIONAL SUMMARIES, COMMUNITY & ENERGY PROFILES

This chapter provides a closer look at the five subregions, their communities, resources and potential energy-related projects

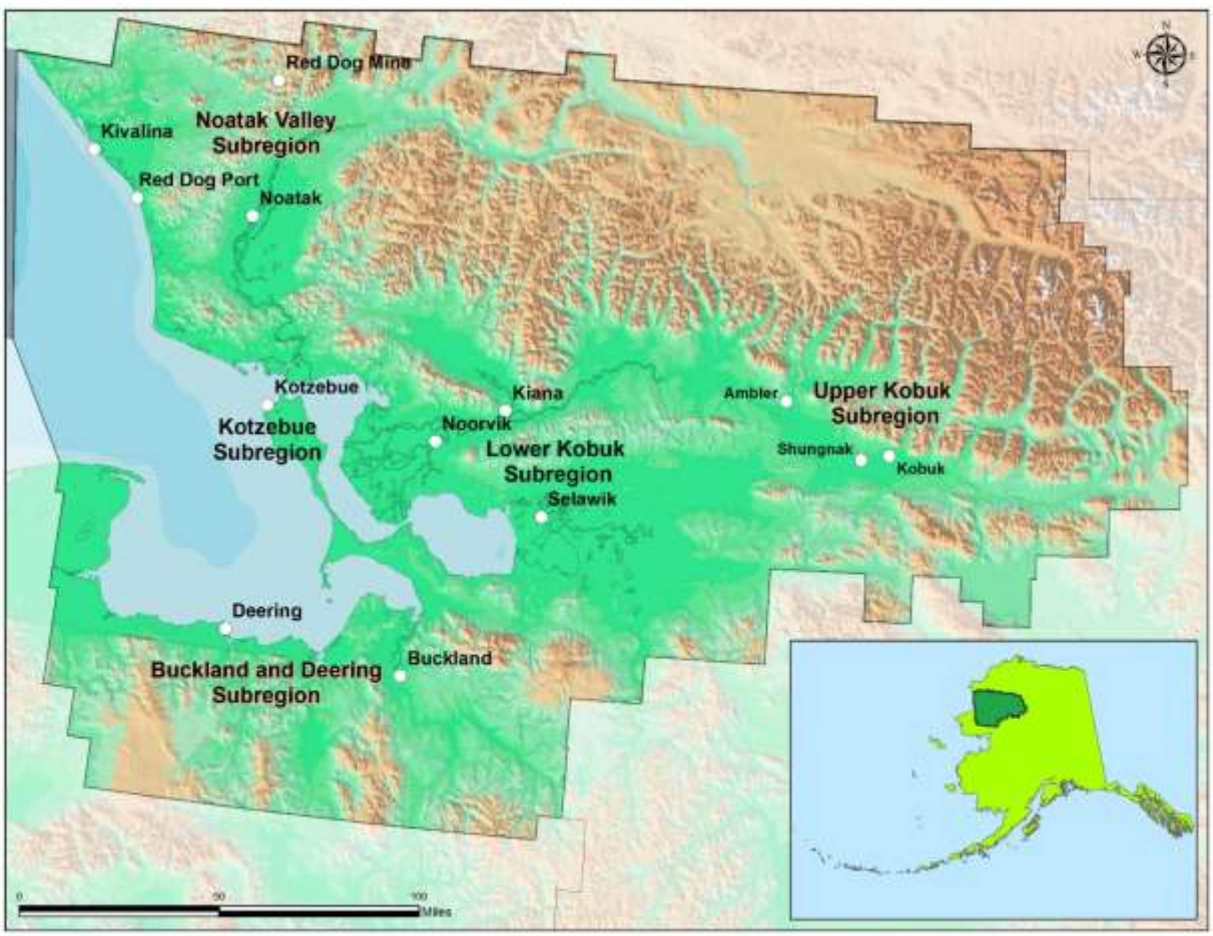
4. Subregional Summaries, Community and Energy Profiles

The Northwest Arctic Region is divided into five subregions:

- Upper Kobuk: Ambler, Kobuk, Shungnak
- Lower Kobuk: Kiana, Noorvik, Selawik
- Noatak Valley: Noatak, Kivalina
- Buckland/Deering
- Kotzebue

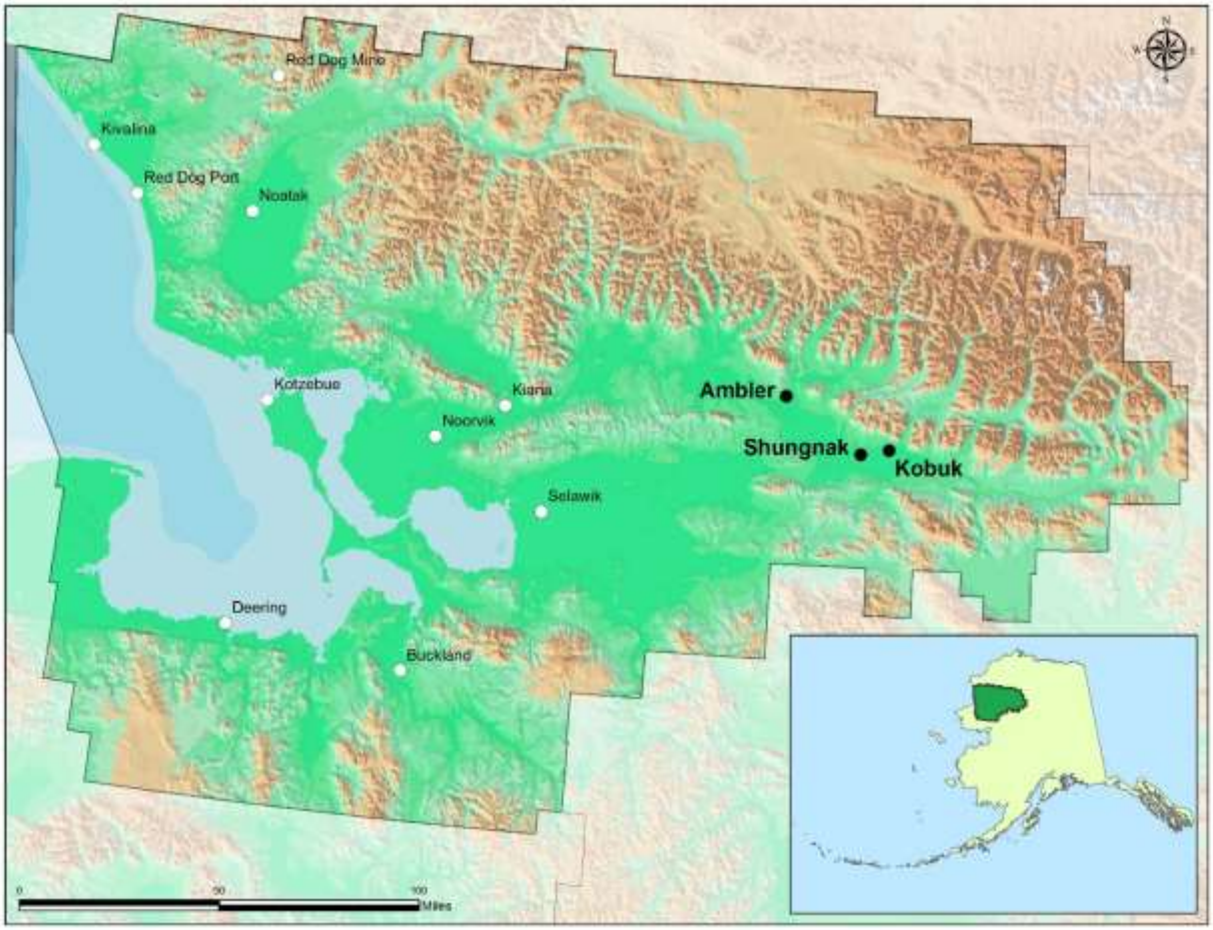
Some of the communities in the subregions can be considered energy clusters because of potential or existing interties and similar energy resources. The communities within each subregion are described throughout this chapter and shown in the overview map in Figure 4.

Figure 4: Northwest Arctic Region and Subregions



4.1 Upper Kobuk Subregion: Ambler, Kobuk, Shungnak

Figure 5: Upper Kobuk Community Subregion



4.1.Upper Kobuk Subregion: Ambler, Kobuk, Shungnak

Photo source: NANA website - http://nana.com/regional/about-us/overview-of-region/shungnak/

The Upper Kobuk subregion includes Ambler, Kobuk and Shungnak. The 2010 U.S. Census reports a total population of 671. Ambler is located 129 air miles east of Kotzebue and 24 miles from Shungnak. Kobuk is located about 10 miles upriver from Shungnak.

Table 20 provides contact information for the governmental entities serving the Upper Kobuk area.

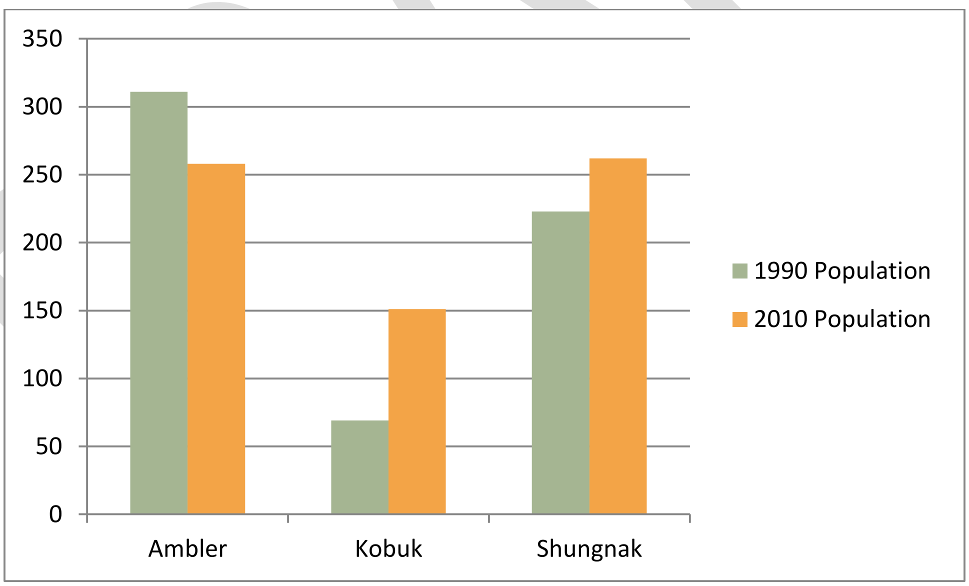
Table 20: Upper Kobuk Local and Regional Contacts

Community	Ambler	Kobuk	Shungnak
City Government	City of Ambler PO Box 9 Ambler, AK 99786 Phone: 907-445-2122 Fax: 907-445-2174 cityofambler@yahoo.com	City of Kobuk PO Box 51020 Kobuk, AK 99751 Phone: 907-948-2217 Fax: 907-948-2228 kobukcity@yahoo.com	City of Shungnak PO Box 59 Shungnak, AK 99773 Phone: 907-437-2161 Fax: 907-437-2176 Beverelygriest25@hotmail.com
Tribal Government	Native Village of Ambler P.O. Box 47 Ambler, AK 99786 Phone: 907-445-2238 Fax: 907-475-2257	Native Village of Kobuk P.O. Box 51039 Noorvik, AK 99751 Phone: 907-948-2203 Fax: 907-948-2123 tribeadmin@haugvii.org	Native Village of Shungnak PO Box 64 Shungnak, AK 99773 Phone: 907-437-2163 Fax: 907-437-2183 roy_sun1@hotmail.com

4.1.1. Demographics

Ambler (population 258), Kobuk (population 151) and Shungnak (population 262) experienced an average population growth of about .5% over the past 20 years. Given this rate of growth over the next 20 years, the population of the area would be 771 by 2030.

Exhibit 14: Upper Kobuk Subregion 20-Year Population Change



Source: US Census

4.1.2. Economy

The economy in this area is primarily based on a traditional subsistence lifestyle supplemented with some full time and part time work with the school, city, tribe, health clinic (Maniilaq Association) and local stores. Major food sources include caribou, moose and whitefish. Construction and Bureau of Land Management (BLM) firefighting provide seasonal income for some residents. Some residents also make and sell hand-crafted baskets, masks, mukluks, parkas, hats, and mittens. Recently, there are also jobs associated with nearby mining at Bornite and Ambler mining districts.

The unemployment rate averages 31% and about 43% of the residents live below the poverty level.

4.1.3. Community Plans

The communities in this area are included in the NAB's hazard mitigation plan that expires in June 2014. They also each have transportation plans that were done for the Bureau of Indian Affairs and all of the communities were included in the state's Northwest Regional Transportation Plan. The Borough also coordinates with each of the villages on a regular basis and expects to update community plans in 2014.

4.1.4. Infrastructure

There are 173 occupied homes in the Upper Kobuk subregion according to the 2010 Census numbers. NANA reports that there is an average of 4.5 persons in each family household. All three communities have a circulating, buried water system and a gravity buried sewer system. AVEC operates the electric utility in all three communities. There are Class 3 landfills in each community, however while Kobuk's landfill has a current permit, Ambler and Shungnak's landfills have never been permitted (DCED, 2014, based on 10/3/13 DEC update).

Each community has a school operated by the Northwest Arctic Borough School District, a post office, health clinic, city and tribal offices, power plants, and water plants. All communities have state-owned and operated airports. There is also an airport about ten miles northeast of Kobuk at Dahl Creek. Table 21 summarizes the Upper Kobuk subregion's energy facts.

Although relatively new, the backup generator in Kobuk is housed in an un-insulated shed with a dirt floor and there is no piped fuel system to fill the day tank (AVEC email: 6/4/2013).

Table 21: Upper Kobuk Subregion Quick Facts

Upper Kobuk Quick Facts Ambler, Kobuk, Shungnak	
Population (U.S. Census, 2010)	671
Utility	AVEC
Total Electricity Production, mWh (AEA, 2012)	2,805
Diesel Fuel Consumed to Produce Electricity, per year (AEA, 2012)	(Shungnak only) 107,611
Annual Heating Oil Consumption, gallons (AEA, 2010)	202,939
Average Subregional Residential Electric Rate, pre-PCE (NAB, 2013)	$0.74
Average Commercial Electricity Rate, per kWh, (AVEC, 2012)	$0.6489
Annual Transportation Fuel Use, gallons (AEA, 2010)	74,821
2013 Average Diesel Fuel Price – for power generation, per gallon (NAB, 2013)	$5.93

4.1.5. Energy Issues

Ambler, Shungnak, and Kobuk have some of the highest energy costs in the region. Most years, fuel is flown into Shungnak because the water level in the Kobuk River is too low for the barge delivery. A recent report on the existing, State-owned intertie between Shungnak and Kobuk found that power delivery to Kobuk is unreliable and the intertie is in need of maintenance (AVEC email: 6/4/2013).

Measuring water flow on Upper Dahl Creek
Photo by Michael Lilly, Geo-Watersheds Scientific

A reconnaissance study indicated that a small hydroelectric plant on the Kogoluktuk River could be constructed and would supplement diesel fuel used for power generation. The proposed 'run-of-river' hydroelectric plant uses a more modest structure than a large dam, and relies on the natural flow volume of the stream or river. This type of facility would have fewer environmental impacts compared to conventional dam-storage hydroelectric plants because of the lack of a large artificial reservoir. With proper siting, construction techniques, and operation and maintenance, a hydropower in the region could have minimal impacts on fisheries and other subsistence resources. The study determined that hydro sites in this area could provide electricity from about mid-April until early November, although the Kogoluktuk River may be able to provide power later into the winter, and earlier in the spring. However, AEA remains cautious and has concluded that "the process to successfully operate and maintain seasonal hydroelectric projects north of the Arctic Circle remains unknown and unproven."[9]

AVEC applied to AEA in last year's funding cycle for funding to study the wind at Cosmos Hills in the Upper Kobuk. The project was recommended for funding, but only scored in the second $25 million tier of funding and thus was not part of the governor's/legislature's budget.

AVEC has expressed an interested in constructing an intertie between Shungnak and Ambler and constructing a new Ambler joint power plant and bulk fuel facility able to serve Ambler, Shungnak and Kobuk. This could improve efficiencies, thereby helping to stabilize rising energy costs in the area. AVEC has two alternative locations for the new power plant, including the existing AVEC-owned power plant site, and a NANA-owned location near the old sewage lagoon. AVEC is requesting site control from the City of Ambler to expand onto the old Armory property adjacent to the existing facility and from NANA for the property near the old sewage lagoon. AVEC is also in the process of acquiring permits for zone easements and site control through the NANA Title VIII committee for the intertie and a number of

[9] Northwest Arctic Draft Energy Plan – AEA Review, September, 2013.

other projects including the Kogoluktuk River Hydroelectric Project, and a new location for a new Ambler Power plant.

4.1.6. Energy Improvement Opportunities/Alternatives

Table 22 shows the energy opportunities that exist in the Upper Kobuk Subregion.

Table 22: Upper Kobuk Subregion Energy Improvement Opportunities

Energy Opportunity	Potential
Existing systems	High potential. AVEC plans to repair the standby generator in Kobuk and develop a new joint power plant in Ambler to serve Ambler, Kobuk and Shungnak. AVEC also plans to construct a consolidated tank farm for the new power plant. Tank Farm upgrades/certifications/rehabilitation.
Interties	High potential. There is an existing electric intertie between Shungnak and Kobuk. AVEC is proposing an intertie between Ambler and Shungnak/Kobuk.
Wind	Low to medium potential. Within each community the wind potential is a Class 1, or poor. Much stronger wind resources (Class 5 to 7) are located about 5 miles from Kobuk and are being investigated with a Met Tower in Shungnak 2014.
Energy efficiency program	High potential. Currently additional TED (The Energy Detective) meters are being sent out to the communities for households that missed out on initial installation. Additional TED Meters may be installed in the schools in 2014/2015. Better instruction on the use of TED meters will be implemented in 2014/2015.
Heat recovery	High potential. AVEC is working with the ANTHC to renovate the recovered heat systems in Shungnak.
Hydroelectric	High potential. Several possible small scale hydroelectric sites have good potential including Dahl Creek and Cosmos Hills (Kogoluktuk River) Hills. AVEC is moving into the conceptual design and permitting stage for the Cosmos Hills Hydroelectric project.
Solar	High potential. Solar PVs have been proven as a power source at the Ambler water treatment plant. This technology has been installed in Shungnak, Kobuk, Deering, and Noorvik and is scheduled for installation in Kiana, Selawik, Buckland, Noatak and Kivalina.
Biomass	High potential. In 2010, the boreal forest in the Upper Kobuk area was investigated and considered a viable energy option. Currently, the NAB is conducting an Upper Kobuk Biomass study to determine how to develop that resource.
Hydrokinetic	High potential. These inland communities have potential for in-river hydrokinetic. The technology is evolving.
Geothermal	Low potential. The only known geothermal resource is at Division Hot Springs, located too far from the communities to be economically feasible.
Gas	Low potential. Gas opportunities undiscovered.
Coal	Low potential. Coal resources are not known in this area.

4.1.7. Priority Energy Actions

Representatives from the Energy Steering Committee provided the following information.

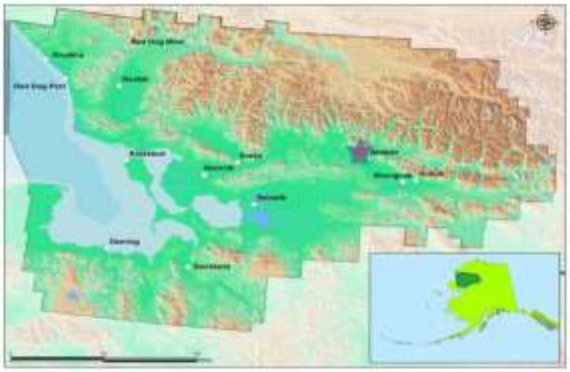
Table 23: Upper Kobuk Subregion Priority Energy Actions

Timeframe	Community	Project	Estimated Costs
Short Term Actions 1-5 years	Ambler	Residential solar thermal and electric	Unknown
		Energy-efficiency education and upgrades	Unknown
		Wind/solar kits for fish camps	Unknown
		Biomass boiler system in washeteria 2014/2015	Unknown
		LED street lights	Complete ($350/lt)
	Kobuk	Biomass system at WTP 2014	$401,873
		Water & sewer energy-efficiency upgrades (ARUC)	Unknown
		Energy-efficiency education and upgrades	Unknown
		Wind/solar kits for fish camps	Unknown
		Cosmos Hills hydroelectric feasibility study (completed 2014)	$1,500,000
		Cosmos Hills wind resource and intertie assessment	Unknown
		LED street lights	Complete ($350/lt)
	Shungnak	Biomass study in community building 2014	Unknown
		Wind/solar kits for fish camps	Unknown
		Wind diesel feasibility study – Met tower 2014	$150,000
		Shungnak/Ambler intertie	Unknown
		LED street lights	Complete ($350/lt)
Mid Term Actions 5-10 years	Ambler	Residential solar thermal and electric	Unknown
		Ambler/Shungnak wind diesel feasibility study	Unknown
		Fuel tank farm inventory and certification	Unknown
	Kobuk	Residential solar thermal and electric	Unknown
		Cosmos Hills hydroelectric construction	Unknown
		Fuel tank farm inventory and certification	Unknown
	Shungnak	Residential solar thermal and electric	Unknown
		Fuel tank farm inventory and certification	Unknown
Long Term Actions 10 < years	Ambler	New consolidated horizontal fuel tank farm	Unknown
	Shungnak	New consolidated horizontal fuel tank farm	Unknown
	Kobuk	New consolidated horizontal fuel tank farm	Unknown

Ambler

Community and Energy Profile

Community Profile: Ambler (Upper Kobuk)



Alaska Native Name (definition)

Ivisaappaat "The mouth of red stone"

Historical Setting / Cultural Resources

The residents of Ambler are Kowagniut Inupiat Eskimos. Ambler is named after Dr. James M. Ambler, a U.S. Navy surgeon on the U.S.S. Jeannette, who perished in 1881 in the Lena River Delta while with the Arctic expedition under the command of Lt. Comdr. G.W. DeLong (1879-1880). Ambler was permanently settled in 1958 when people from Shungnak and Kobuk moved upstream because of the variety of fish, wild game, and spruce trees in the area. An archaeological site is located nearby at Onion Portage. A post office was established in 1963.

Incorporation	2nd Class City, 1971

Location

Ambler is located on the north bank of the Kobuk River, near the confluence of the Ambler and the Kobuk Rivers. It lies 45 miles north of the Arctic Circle. It is 138 miles northeast of Kotzebue, 30 miles northwest of Kobuk, and 30 miles downriver from Shungnak.

Longitude	**Latitude**
ANCSA Region	NANA Regional Corporation
Borough/CA	Northwest Arctic Borough
School District	Northwest Arctic Borough School District
AEA Region	Northwest Arctic

Taxes Type (rate)	Per-Capita Revenue
N/A	N/A

Economy

Residents practice a traditional subsistence lifestyle. 69% residents employed: 49% private sector, 47% local government, and 4% in state governement.

Climate	Avg. Temp.	Climate Zone	Heating Deg. Days
	-10/65	Continental	N/A

Natural Hazard Plan	
All-Hazards Mitigation Plan (borough-wide)	2009

Community Plans	Year
NWAB Comprehensive Plan (borough-wide)	1993

Local Contacts	Email	Phone	Fax
NANA Regional Corporation, Incorpor	communications@nana.com	907-485-2173	907-485-2137
Northwest Arctic Borough	info@nwabor.org	907-442-2500	907-442-2930
Native Village of Ambler	tribemanager@ivisaappaat.org	907-445-2238	907-445-2257
City of Ambler	cityofamblerak@starband.net	907-445-2122	907-445-2174

Demographics	2000	2010		2013
Population	309	258	Percent of Residents Employed	69.00%
Median Age	22	29	Denali Commission Distressed Community	No
Avg. Household Size	4	4	Percent Alaska Native/American Indian (2010)	84.50%
Median Household Income	N/A	$38,750	Low and Moderate Income (LMI) Percent (201x)	60%

Electric Utility	Generation Sources	Interties	PCE?
Alaska Village Electric Cooperative (AVEC)	Diesel	No	Yes

Landfill	Class	III	Permitted?	No	Location	2 miles west of the community

Water/Wastewater System		Homes Served		System Volume
Water	Circ	75		
Sewer	Gravity	Water/Wastewater Energy Audit?	Yes	
Notes				

Access

Road	No				
Air Access	Amber Airport, gravel, fair condition	Runway 1	2,400 ft. x 60 ft.	Runway 2	3,000 ft. x 60 ft.
		Runway 3	N/A	Runway 4	N/A
Dock/Port	Yes	Barge Access?	Yes, Seasonal	Ferry Service?	No

Energy Profile: Ambler

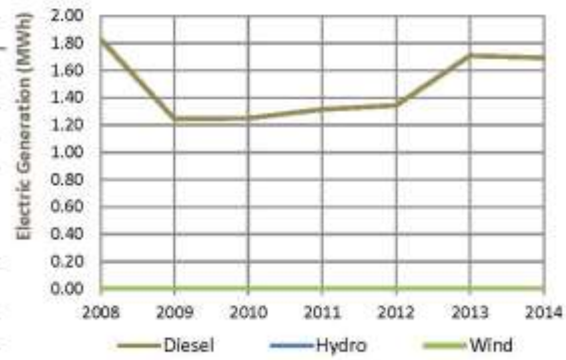
Power House

Utility	AVEC		
Generators	Make/Model	Rated Capacity	Condition/Hrs
Unit 1	Kato/4P3-1475	363	
Unit 2	Kato/6P4-2000	271	
Unit 3	Newage/HCI504C	397	
Unit 4			
Unit 5			
Line Loss		3.40%	
Heat Recovery?		Yes	
Upgrades?			
Outage History/Known Issues			

Operators	No. of Operators	Training/Certifications

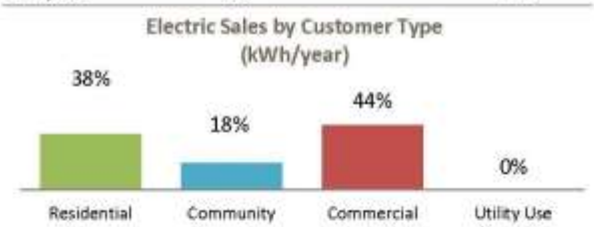
Power Production

Diesel (kWh/yr)	1,249,892	Avg. Load (kW)	147
Wind (kWh/yr)	0	Peak Load (kW)	319
Hydro (kWh/yr)	0	Efficiency (kWh/ga	13.81
Total (kWh/yr)	1,249,892	Diesel Used (gals/y	90,507



Maintenance Planning (RPSU)

Electric Sales	No. of Customers	kWh/year	kWh/Customer
Residential	81	447,304	5522.271605
Community	13	214,356	16488.92308
Commercial	18	519,310	28850.55556
Utility Use	N/A		N/A



Electric Rates ($/kWh)		Cost per kWh Sold ($/kWh)	
Rate with PCE	0.21	Fuel Cost	0.53
Residential Rate	0.77	Non-fuel Cost	0.23
Commercial Rat	0.62	Total Cost	0.76

Fuel Prices ($)	Utility/Wholesale	Retail	Senior
Diesel (1 gal)	11.33		
Other Fuel? (1 gal)			
Gasoline (1 gal)	11.07		
Propane (100#)	250.00		
Wood (1 cord)			
Pellets			
Discounts?			

Alternative Energy	Potential	Projects/Notes	Status
Hydroelectric	High	AVEC Cosmos Hills Hydroelectric project, conceptual design/permitting stage	
Wind Diesel	Low/Medium	Class 1-2, wind study completed 2011-12	
Biomass	High	Upper Kobuk Biomass study	
Solar	High	Water treatment plant solar PVs	
Geothermal	Low		
Oil and Gas	Low		
Coal	Low		
Emerging Tech	Unknown		
Heat Recovery	High		
Energy Efficiency	High	Homes & schools provided w/ extra TED meters 2014/2015; 2014 TED training	

Bulk Fuel

Tank Owner	Fuel Type(s)	Capacity	Age/Condition
AVEC	Diesel	98,550	

Purchasing	Deliveries/Year	Gallons/Delivery	Vendor(s)
By Barge	5	18,000	AVEC
By Air			

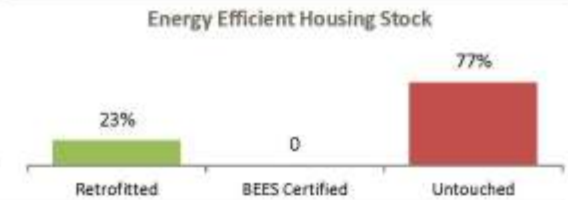
Cooperative Purchasing Agreements

Notes

Energy Profile: Ambler

Housing Units	Occupied	Vacant	% Owner-Occup.
	63	37	83%
Housing Need		Overcrowded	1-star
		39.7%	N/A
Data Quality			

Regional Housing Authority		Weatherization Service Provider	
NIHA		NIHA	
Energy Use	Average Home Energy Rating	Average Square Feet	Avg. EUI (kBTU/sf)
	N/A	N/A	N/A



Lighting	Upgraded?	Owner	Notes

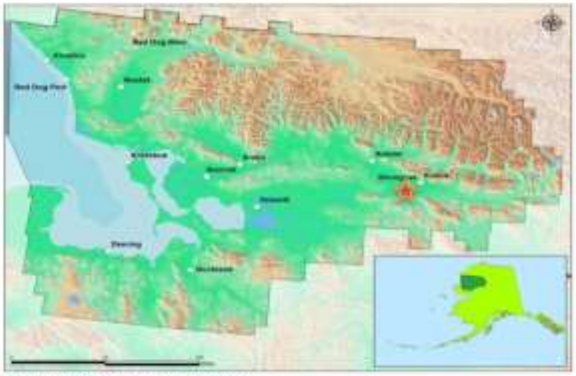
Non-residential Building Inventory

Building Name or Location	Year Built	Square Feet	Audited?	Retrofits Done?	In ARIS?
Water Plant/Lift Station		1,728	ANTHC		No
Community Shop		150	EECBG		No
Washeteria		300	EECBG		No
AIRPORT ELECTRICAL	2000	336			No
Ambler Baptist Church					No
Ambler Clinic	2004	5000			No
Ambler Friends Church					No
Ambler Native Store					No
Ambler Post Office	1985	480			No
Boiler module	2004	1275			No
City Office Building					No
EQUIPMENT STORAGE	1992	1260			No
Ivisaapaat Tribal Council Office					No
Kobuk River Lodge	1981	2000			No
Maintenance shop		576			No
New School	2004	23444			No
Old high school	1977	13100			No
Storage building		240			No

Shungnak

Community and Energy Profile

Community Profile: Shungnak (Upper Kobuk)



Incorporation	2nd Class City,

Location

Shungnak is located on the west bank of the Kobuk River, about 150 miles east of Kotzebue. The original settlement was 10 miles further upstream at Kobuk.

Longitude		Latitude
ANCSA Region	NANA Regional Corporation	
Borough/CA	Northwest Arctic Borough	
School District	Northwest Arctic Borough School District	
AEA Region	Northwest Arctic	

Taxes Type (rate)	Per-Capita Revenue
N/A	$140

Alaska Native Name (definition)

Issingnak "Jade"

Historical Setting / Cultural Resources

It is a traditional Inupiat Eskimo village with a subsistence lifestyle. Founded in 1899 as a supply point for mining activities in the Cosmos Hills, this Inupiat Eskimo village was forced to move in the 1920s because of river erosion and flooding. The old site, 10 miles upstream, was renamed Kobuk by those who remained there. The new village was named "Kochuk" but later reverted to Shungnak. This name is derived from the Eskimo word "Issingnak," which means jade, a stone found extensively throughout the surrounding hills. The city government was incorporated in 1967.

Economy

Shungnak subsists mainly on fishing, seasonal employment, hunting and trapping. Food sources include sheefish, whitefish, caribou, moose, ducks and berries. Most full-time employment is with the school district, City, Maniilaq Association, two stores and a lodge. 65% residents employed: 62% private sector, 38% local government.

Climate	Avg. Temp.	Climate Zone	Heating Deg. Days
	-10/65	Transitional	N/A

Natural Hazard Plan	
All-Hazards Mitigation Plan (borough-wide)	2009

Community Plans	Year
NWAB Comprehensive Plan (borough-wide)	1993

Local Contacts	Email	Phone	Fax
NANA Regional Corporation, Incorpor	communications@nana.com	907-485-2173	907-485-2137
Northwest Arctic Borough	info@nwabor.org	907-442-2500	907-442-2930
Native Village of Shungnak	tribeclerk@issingnak.org	907-437-2163	907-437-2183
City of Shungnak		907-437-2161	907-437-2176

Demographics	2000	2010		2013
Population			Percent of Residents Employed	
Median Age			Denali Commission Distressed Community	No
Avg. Household Size			Percent Alaska Native/American Indian (2010)	
Median Household Income			Low and Moderate Income (LMI) Percent (201x)	66%

Electric Utility	Generation Sources	Interties	PCE?
Alaska Village Electric Cooperative (AVEC)	Diesel	No	Yes

Landfill	Class	III	Permitted?	No	Location	1 mile southwest of the community

Water/Wastewater System		Homes Served		System Volume
Water	Circ	61		10,000 - 50,000
Sewer	Gravity	Water/Wastewater Energy Audit?	No	
Notes	Honey Buckets			

Access					
Road	No				
Air Access	Shungnak Airport, gravel, fair condition	Runway 1	4,001 ft. x 60 ft.	Runway 2	N/A
		Runway 3	N/A	Runway 4	N/A
Dock/Port	Yes	Barge Access?	Yes	Ferry Service?	No

Energy Profile: Shungnak

Power House

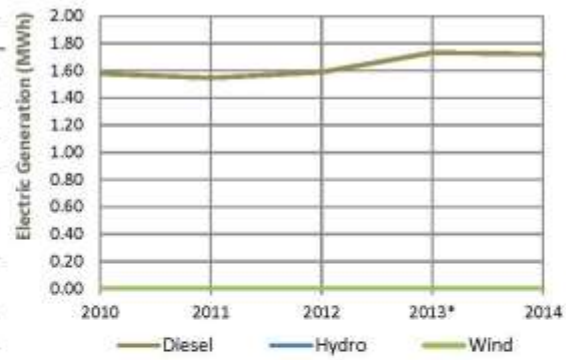
Utility	AVEC		
Generators	Make/Model	Rated Capacity	Condition/Hrs
Unit 1	Kato/4P3-1475	202	
Unit 2	Kato/4P3-1475	335	
Unit 3	Kato/4P3-1475	363	
Unit 4	Newage/HCI504C1	397	
Unit 5			
Line Loss		40.70%	
Heat Recovery?		Yes	
Upgrades?	Yes, City Office, 2012, Heating System		
Outage History/Known Issues			

Operators	No. of Operators	Training/Certifications

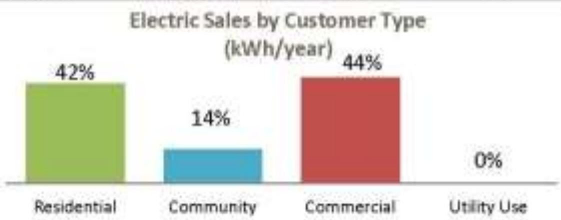
Maintenance Planning (RPSU)

Power Production

Diesel (kWh/yr)	1,721,352	Avg. Load (kW)	204
Wind (kWh/yr)	0	Peak Load (kW)	360
Hydro (kWh/yr)	0	Efficiency (kWh/ga	13.91
Total (kWh/yr)	1,721,352	Diesel Used (gals/y	123,751



Electric Sales	No. of Customers	kWh/year	kWh/Customer
Residential	63	404,221	6416.206349
Community	11	137,886	12535.09091
Commercial	17	429,647	25273.35294
Utility Use	N/A	N/A	N/A



Electric Rates ($/kWh)		Cost per kWh Sold ($/kWh)	
Rate with PCE	0.21	Fuel Cost	0.87
Residential Rate	0.83	Non-fuel Cost	0.23
Commercial Rat	0.68	Total Cost	$1.10

Fuel Prices ($)	Utility/Wholesale	Retail	Senior
Diesel (1 gal)	9	6.13	
Other Fuel? (1 gal)			
Gasoline (1 gal)	9		
Propane (100#)	303.9		
Wood (1 cord)			
Pellets			
Discounts?			

Alternative Energy	Potential	Projects/Notes	Status
Hydroelectric	High	AVEC Cosmos Hills Hydroelectric project	
Wind Diesel	Low/Medium	Met Tower installed 2013, feasibility study and report completed 2014	
Biomass	High	Upper Kobuk Biomass study	
Solar	High	Solar PVs installed	
Geothermal	Low		
Oil and Gas	Low		
Coal	Low		
Emerging Tech	Unknown		
Heat Recovery	High	AVEC working with ANTHC to renovate recovered heat systems	
Energy Efficiency	High	Homes & schools provided w/ extra TED meters 2014/2015; 2014 TED training	

Bulk Fuel

Tank Owner	Fuel Type(s)	Capacity	Age/Condition
AVEC	Diesel	110,789	

Purchasing	Deliveries/Year	Gallons/Delivery	Vendor(s)
By Barge	12	50,308	AVEC
By Air			

Cooperative Purchasing Agreements

Notes

Energy Profile: Shungnak

Housing Units	Occupied	Vacant	% Owner-Occup.	Regional Housing Authority		Weatherization Service Provider	
	77	0	57%	NIHA		NIHA	
Housing Need		Overcrowded	1-star	Energy Use	Average Home Energy Rating	Average Square Feet	Avg. EUI (kBTU/sf)
		55.8%	N/A		2-star plus	827	180
Data Quality							

Lighting	Upgraded?	Owner	Notes

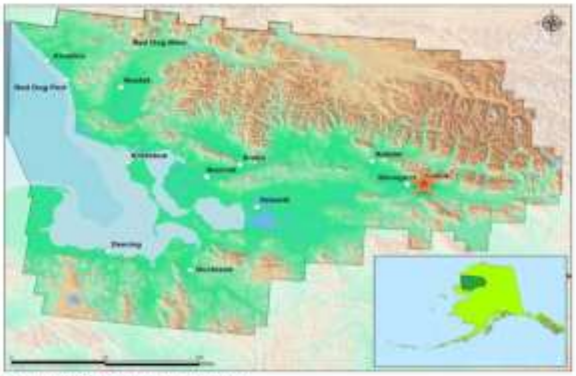
Non-residential Building Inventory

Building Name or Location	Year Built	Square Feet	Audited?	Retrofits Done?	In ARIS?
City Office		1989	EECBG	Yes	No
AIRPORT ELECTRICAL	2000	96			No
City Office Building	1981				No
Coffee House					No
Maintenance shop		576			No
Old Clinic					No
School	1977	22228			No
Shungnak Clinic	2004	5000			No
Shungnak Friends Church	1984				No
Shungnak Native Store	1985	3220			No
Sprinkler van		160			No
SREB	1999	2000			No
Water Treatment Plant					

Kobuk

Community and Energy Profile

Community Profile: Kobuk (Upper Kobuk)



Alaska Native Name (definition)

Laugviik "Where they cut big logs"

Historical Setting / Cultural Resources

Kobuk was founded in 1899 as a supply point for mining activities in the Cosmos Hills to the north and was then called Shungnak. A trading post, school, and Friends mission drew area residents to the settlement. Due to river erosion and flooding, the village was relocated in the 1920s to a new site 10 miles downstream, which was called "Kochuk," now Shungnak. The few who remained at the village renamed it Kobuk. Ice jams on the river cause high water each year. In May 1973, a flood covered the entire village. In October 1973, the city was incorporated.

Incorporation	2nd Class City, 1973

Location

Kobuk is located on the right bank of the Kobuk River, about 7 miles northeast of Shungnak and 128 air miles northeast of Kotzebue. It is the smallest village in the Northwest Arctic Borough.

Longitude		**Latitude**
ANCSA Region	NANA Regional Corporation	
Borough/CA	Northwest Arctic Borough	
School District	Northwest Arctic Borough School District	
AEA Region	Northwest Arctic	

Taxes Type (rate)	Per-Capita Revenue
N/A	N/A

Economy

It is an Inupiat Eskimo village practicing a traditional subsistence lifestyle. 83% residents employed: 50%private sector and 50% local government.

Climate	Avg. Temp.	Climate Zone	Heating Deg. Days
	-10/65	Continental	N/A

Natural Hazard Plan	
All-Hazards Mitigation Plan (borough-wide)	2009

Community Plans	Year
NWAB Comprehensive Plan (borough-wide)	1993

Local Contacts	Email	Phone	Fax
NANA Regional Corporation, Incorpor	communications@nana.com	907-485-2173	907-485-2137
Northwest Arctic Borough	info@nwabor.org	907-442-2500	907-442-2930
Native Village of Kobuk	tribeadmin@laugvik.org	907-948-2203	907-948-2123
City of Kobuk	kobukcity@yahoo.com	907-948-2217	907-948-2228

Demographics	2000	2010		2013
Population	109	151	**Percent of Residents Employed**	83.00%
Median Age	18	21	**Denali Commission Distressed Community**	No
Avg. Household Size	5	5	**Percent Alaska Native/American Indian (2010)**	90.07%
Median Household Income	N/A	$48,750	**Low and Moderate Income (LMI) Percent (201x)**	77%

Electric Utility	Generation Sources	Interties	PCE?
Alaska Village Electric Cooperative (AVEC)	Diesel	No	Yes

Landfill	Class	III	Permitted?	Yes	Location	2 road miles north of Kobuk

Water/Wastewater System		Homes Served		System Volume
Water	Circ	42		10,000 - 50,000
Sewer	Gravity	**Water/Wastewater Energy Audit?**	No	
Notes				

Access

Road	No				
Air Access	Kobuk Airport, gravel, fair condition	**Runway 1**	4,020 ft. x 75 ft.	**Runway 2**	N/A
		Runway 3	N/A	**Runway 4**	N/A
Dock/Port	Yes	**Barge Access?**	Yes	**Ferry Service?**	No

Energy Profile: Kobuk

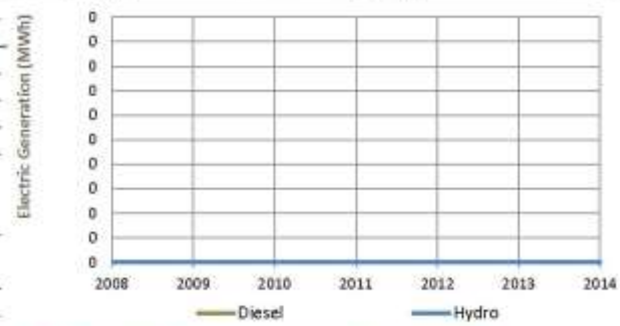
Power House

Utility	AVEC		
Generators	**Make/Model**	**Rated Capacity**	**Condition/Hrs**
Unit 1	Marathon/432 RSL 40	257	
Unit 2			
Unit 3			
Unit 4			
Unit 5			
Line Loss		See Shungnak	
Heat Recovery?		See Shungnak	
Upgrades?			
Outage History/Known Issues			

Operators	**No. of Operators**	**Training/Certifications**

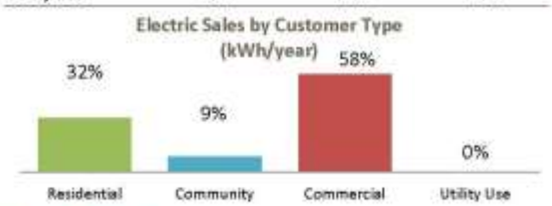
Power Production

Diesel (kWh/yr)	See Shungnak	**Avg. Load (kW)**	See Shungnak
Wind (kWh/yr)	0	**Peak Load (kW)**	136
Hydro (kWh/yr)	0	**Efficiency (kWh/gal)**	See Shungnak
Total (kWh/yr)	See Shungnak	**Diesel Used (gals/yr)**	See Shungnak



Maintenance Planning (RPSU)

Electric Sales	**No. of Customers**	**kWh/year**	**kWh/Customer**
Residential	35	194,167	5547.628571
Community	0	55,951	
Commercial	16	352,309	22019.3125
Utility Use	N/A	N/A	N/A



Electric Rates ($/kWh)		**Cost per kWh Sold ($/kWh)**
Rate with PCE	0.21	**Fuel Cost**
Residential Rate	0.83	**Non-fuel Cost**
Commercial Rate		**Total Cost**

Fuel Prices ($)	**Utility/Wholesale**	**Retail**	**Senior**
Diesel (1 gal)	9.53		
Other Fuel? (1 gal)			
Gasoline (1 gal)	10.03		
Propane (100#)			
Wood (1 cord)			
Pellets			
Discounts?			

Alternative Energy	**Potential**	**Projects/Notes**	**Status**
Hydroelectric	High	AVEC Cosmos Hills Hydroelectric project	
Wind Diesel	Low/Medium	Met Tower in Shungnak installed 2013, feasibility study and report completed 2014	
Biomass	High	Upper Kobuk Biomass project	
Solar	High	Solar PVs installed	
Geothermal	Low		
Oil and Gas	Low		
Coal	Low		
Emerging Tech	Unknown		
Heat Recovery	High		
Energy Efficiency	High	Homes & schools provided w/ extra TED meters 2014/2015; 2014 TED training	

Bulk Fuel

Tank Owner	**Fuel Type(s)**	**Capacity**	**Age/Condition**
See Shungnak			

Purchasing	**Deliveries/Year**	**Gallons/Delivery**	**Vendor(s)**
By Barge			
By Air			

Cooperative Purchasing Agreements

Notes

Intertie between Kobuk and Shungnak

Energy Profile: Kobuk

Housing Units	Occupied	Vacant	% Owner-Occup.	Regional Housing Authority	Weatherization Service Provider
	24	21	75%	NIHA	NIHA

Housing Need	Overcrowded	1-star
	50.0%	N/A

Energy Use	Average Home Energy Rating	Average Square Feet	Avg. EUI (kBTU/sf)
	3-star plus	984	197

Data Quality

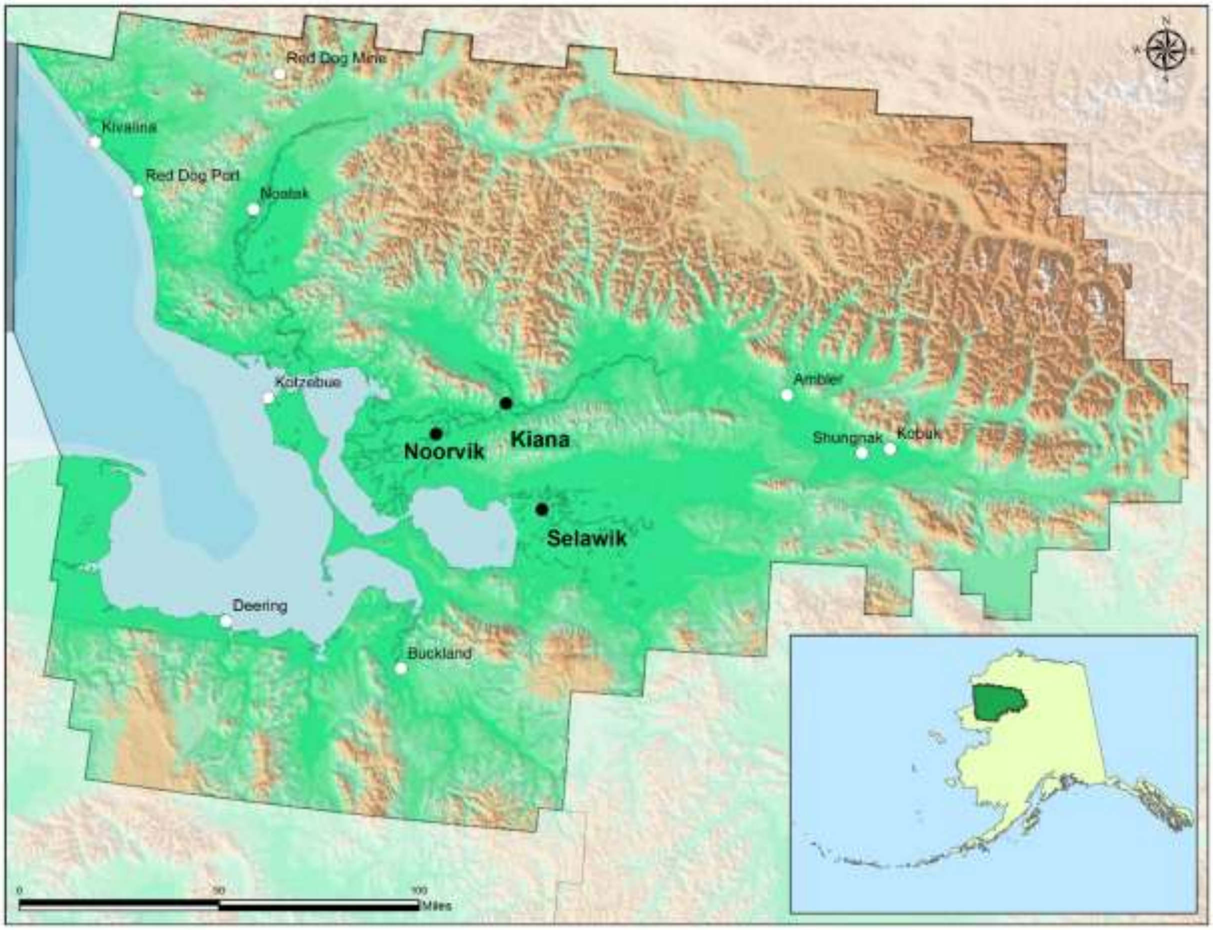
Lighting	Upgraded?	Owner	Notes

Non-residential Building Inventory

Building Name or Location	Year Built	Square Feet	Audited?	Retrofits Done?	In ARIS?
City Office		2025	EECBG	Yes	No
AIRPORT ELECTRICAL	2000	96			No
Boiler module		256			No
City Office Building					No
Generator bldg.		240			No
Harry O Brown Trading Post	1968	600			No
Kobuk Clinic	2004	5000			No
Kobuk Hotel					No
Kobuk Store	1960	900			No
Kobuk Traditional Council Office	1970	920			No
Maintenance shop		576			No
Modular classroom		864			No
Modular classroom		1260			No
School	1991	5459			No
SREB	1999	2000			No
Water Treatment Plant					No

4.2 Lower Kobuk Subregion: Kiana, Noorvik, Selawik

Figure 6: Lower Kobuk Subregion



4.2.Lower Kobuk Subregion: Kiana, Noorvik, Selawik

The Lower Kobuk subregion includes Kiana, Noorvik and Selawik. Table 24 provides contact information for the governmental entities serving the Lower Kobuk area.

Table 24: Lower Kobuk Local and Regional Contacts

Community	Kiana	Noorvik	Selawik
City Government	City of Kiana PO Box 150 Kiana, AK 99749 Phone: 907-475-2136 Fax: 907-475-2174 cityclerk@cityofkiana.org	City of Noorvik PO Box 146 Noorvik, AK 99763 Phone: 907-636-2100 Fax: 907-636-2135 cityofnoorvik@gmail.com	City of Selawik PO Box 99 Selawik, AK 99770 Phone: 907-484-2132 Fax: 907-484-2209 city_of_selawik@hotmail.com
Tribal Government	Native Village of Kiana P.O. Box 69 Kiana, AK 99749 Phone: 907-475-2109 Fax: 907-475-2180 tribedirector@katyaaq.org	Noorvik Native Community P.O. Box 209 Noorvik, AK 99763 Phone: 907-636-2144 Fax: 907-636-2284	Native Village of Selawik 59 North Tundra St Selawik, AK 99770 Phone: 907-484-2165 Fax: 907-484-2226 tribeadmin@akuligaq.org

Kiana is situated on a bluff overlooking the confluence of the Kobuk and Squirrel Rivers in northwestern Alaska, about 30 miles north of the Arctic Circle. Kiana is 57 air miles east of Kotzebue.

Kiana homes

Noorvik is located on the south bank of the Nazuruk Channel of the Kobuk River, about 30 miles downriver from the southern border of 1.7 million acre Kobuk Valley National Park. Noorvik is 33 miles northwest of Selawik and 42 air miles southeast of Kotzebue on the opposite side of Hotham Inlet, also known as Kobuk Lake.

The current village of Selawik is located at the mouth of the Selawik River where it flows into Selawik Lake, about 90 air miles east of Kotzebue. Selawik is spread across three land areas separated by the multi-channeled river mouth and linked by structural bridges. Meandering rivers, flood plains, numerous lakes and tundra with scattered low bushes and no trees characterize Selawik topography. Selawik is within the 2.15 million acre Selawik National Wildlife Refuge, a crucial breeding and resting spot for migratory waterfowl.

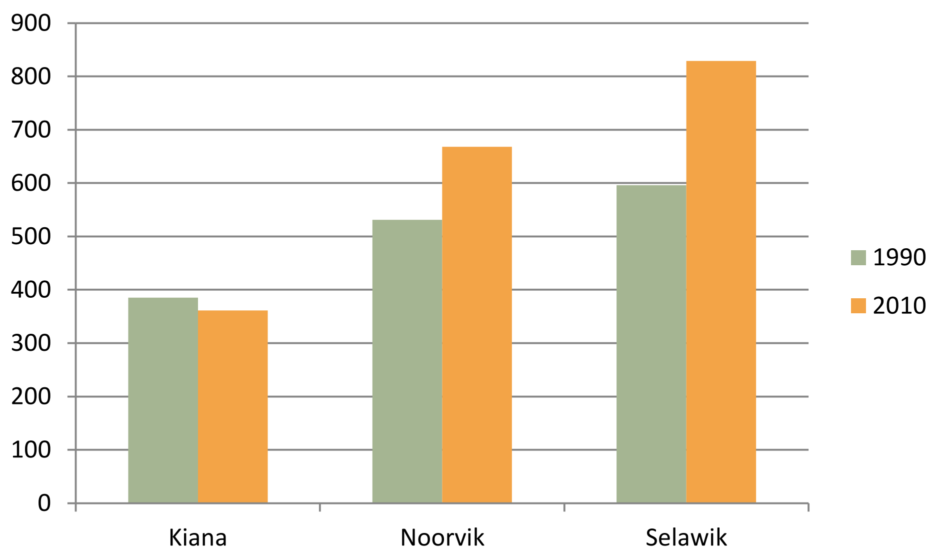
There are no connecting roads between the communities, though frozen rivers and winter trails allow for snow machine access in winter.

Selawik wind farm (Source: Ingemar Mathiasson)

4.2.1. Demographics

Kiana (population 361), Noorvik (population 668) and Selawik (population 829) experienced an average annual growth rate over the past 20 years of over one percent. The unemployment rate was nearly 36 percent and about 26 percent of the residents were below the poverty rate. Exhibit 15 illustrates the change in population of the Lower Kobuk communities over the past 20 years.

Exhibit 15: Lower Kobuk Subregion 20-year Population Change



Source: US Census

4.2.2. Economy

The economy in Kiana, Noorvik and Selawik is a mix of cash and subsistence activities. Chum salmon, freshwater fish, moose, caribou, waterfowl and berries are harvested. Occasionally, bartered seal and beluga whale supplement the diet. The school, City, Maniilaq Association, IRA councils and general stores provide the majority of year-round jobs. The Red Dog Mine also provides some jobs, and seasonal employment also includes work on river barges, BLM fire-fighting and jade mining. There is local interest in constructing a whitefish and turbot value-added processing plant. Handicrafts are made and sold locally and at gift shops in larger cities. Seasonal work is found at the Red Dog Mine, BLM firefighting or on river barges. Kiana is also interested in developing eco-tourism, primarily guided river trips to the Great Kobuk Sand Dunes.

4.2.3. Community Plans

Noorvik winter landscape

The communities in this area are included in the NAB's hazard mitigation plan that expires in June 2014. They also each have transportation plans that were done for the Bureau of Indian Affairs and all of the communities were included in the state's Northwest Alaska Regional Transportation Plan. The Borough coordinates with each of the villages on a regular basis and is currently updating their community plans.

4.2.4. Infrastructure

There are 440 occupied homes in the Lower Kobuk subregion according to the 2010 Census numbers reported by the DCRA, with an average of about 4.5 persons in each family household.

All three communities have a circulating water system to which most residences are connected; Noorvik and Selawik's are above ground, while Kiana's is buried. The sewer systems also vary, with above-ground vacuum systems in Noorvik and Selawik and a gravity buried system in Kiana. Some residents still haul water and rely on honeybuckets. AVEC operates the electric utility in all three communities.

The landfills in Noorvik and Selawik are Class 3 permitted by the Alaska Department of Environmental Conservation. Kiana has a Class 3 landfill; however, no permit has been obtained (DCED, 2014, based on 10/3/13 DEC update).

Each community has a school operated by the Northwest Arctic Borough School District, a post office, a health clinic, city and tribal offices, power plants, and water plants. Noorvik has a public safety building.

All communities have state-owned and operated airports. In addition, Selawik operates a city-owned, 3,000-foot-long by 70-foot-wide gravel airstrip located at the Siilivitchaq or "Spud Farm," about 15 miles from town.

Table 25 provides an overview of energy facts for the Lower Kobuk subregion.

Table 25: Lower Kobuk Subregion Quick Facts

Lower Kobuk Subregion Quick Facts Kiana, Noorvik and Selawik	
Population (U.S. Census, 2010)	1,858
Utility	AVEC
Total Electricity Production, mWh (AEA, 2010)	6,367
Diesel Fuel Consumed to Produce Electricity, per year (AEA, 2012)	492,391
Annual Heating Oil Consumption, gallons (AEA, 2010)	548,991
Average Subregional Residential Electric Rate, pre-PCE (NAB, 2013)	$0.62
Average Commercial Electricity Rate (AVEC, 2012)	$0.6358
Annual Transportation Fuel Use, gallons (AEA, 2010)	202,405
2013 Average Diesel Fuel Price – for power generation, per gallon (NAB, 2013)	$3.56

4.2.5. Energy Issues

As is the case across the Northwest Arctic Region, the cost of fuel is the driving energy issue in the Lower Kobuk subregion. Energy is produced in each village at a local power plant, creating a redundancy of facilities and staffing, which could be reduced through consolidation of power generation. The wind resources at Hotham Peak are being assessed as a first step in this direction. Subsequently, interties would be needed to distribute power to the three communities. No interties currently exist.

Kiana has benefited from an experienced utility operator, who has done much to keep the water and sewer systems running in an energy efficient manner. Upgrades and improvements to the sewage pumping facilities are needed to improve that efficiency. Water treatment and distribution facilities in Noorvik are not in good condition, with many components of the system not functioning. The water system in Noorvik is estimated to be using more than double the power on which it should be operating. As a vacuum system, the sewer system uses more energy than a gravity flow system. Additional monitoring equipment is needed for that system. Selawik is working with ARUC to improve its water and sewer systems. Heat loss from the above-ground utilidors makes the system extremely costly, as these utilidors are very long and minimally insulated. The soil is quite saturated in Selawik and utilidors are partially submerged in places.

4.2.6. Energy Improvement Opportunities/Alternatives

Table 26 shows the energy opportunities that exist in the Lower Kobuk Subregion.

Table 26: Lower Kobuk Energy Improvement Opportunities

Energy Opportunity	Potential
Existing Systems	High potential. Improvements to heat recovery systems and water/wastewater energy efficiency. Tank Farm upgrades/certifications/rehabilitation.
Interties	Medium potential. Intercommunity distances within the subregion range from 19 to 32 miles, creating difficulties; however, AVEC has expressed an interest in a transmission line study for connecting Noorvik, Kiana, and Selawik.
Wind	High potential. Selawik has four AOC 15/50 wind turbines currently integrated into its power system. These could be replaced with higher capacity models or augmented with additional turbines. In-town wind resources in Kiana and Noorvik are rated as Class 2 to 3 (marginal to fair); however, much stronger winds (Class 6-7) are reported to exist about 6 miles east of Kiana.
Energy Efficiency program	High potential. Currently additional TED meters are being sent out to the communities for households that missed out on initial installation. Additional TED Meters may be installed in the schools in 2014/2015. Provide TED Meter training for all communities 2014/2015.
Heat Recovery	High potential. AVEC is working with ANTHC to renovate the recovered heat systems at Kiana and Selawik, and design will start soon on recovered heat at Noorvik, with potential fall 2014 construction.
Hydroelectric	Low potential. A small hydroelectric plant on Canyon Creek 8 miles NE of Kiana proved uneconomic in 1981; however, new technology could change that. There are no known appropriate sites for hydroelectric power near Noorvik or Selawik.
Solar	Medium to high potential. Solar PVs have been proven as a power source at the Ambler water treatment plant. This technology is planned for Kiana and Selawik. Installed in Noorvik 2013. Noorvik has potential for a solar farm.
Biomass	Medium potential. Biomass resources near Kiana are being investigated and there are potential biomass resources near Noorvik, as well. There are no known biomass resources of significance near Selawik. Use Alaska Wood Energy Development Task Group (AWEDTG) for pre-feasibility studies.
Hydrokinetic	Low potential. In-stream turbines may prove feasible near Kiana.
Geothermal	Low potential. Geothermal resources are not known in the area.
Gas	Low potential. Gas opportunities undiscovered.
Coal	Medium potential. Coal resources have been identified in the Hockley Hills between Kiana and Selawik. Further study is needed.

4.2.7. Priority Energy Actions

Representatives from the energy steering committee provided the prioritization of energy actions for the Lower Kobuk subregion shown in Table 27.

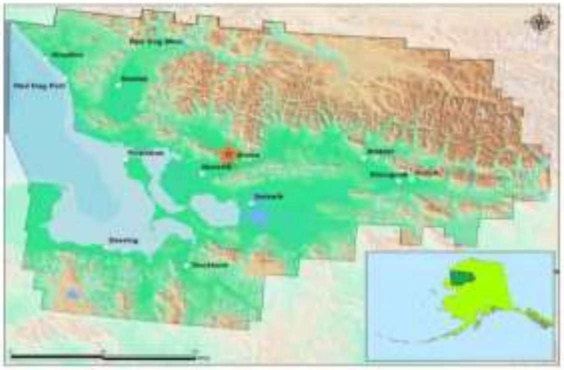
Table 27: Lower Kobuk Subregion Priority Energy Actions

Timeframe	Community	Project	Estimated Costs
Short Term Actions 1-5 years	Kiana	Wind feasibility study	$150,000
		Solar farm feasibility study	$10,000/kW
		Biomass feasibility study	Unknown
		Wind/solar combo kits for fish camps	Unknown
		Solar PV at WTP – 2014	$75,000
		TED meters – 2014 install and education	$250/house
		Energy efficiency education and upgrades	Unknown
		LED street lights	Complete
	Noorvik	Heat recovery feasibility study – 2014	$96,700
		Heat recovery system at WTP	$985,508
		Wind/solar combo kits for fish camps	Unknown
		Solar farm feasibility study – 2014	$10,00/kW
		TED meters 2014 install and education	$250/house
		Power plant upgrade to incorporate alternative energy resources	$800,000
		Energy efficient design of native store	Unknown
		Biomass feasibility study	Unknown
		LED street lights	Complete
	Selawik	Heat recovery system upgrade	Unknown
		Energy efficiency improvements to water/sewer	Unknown
		Energy efficiency education and upgrades	Unknown
		Repower wind diesel – 2014	$2,500,000
		Solar PV at WTP – 2014	$75,000
		LED street lights	Complete
Mid Term Actions 5-10 years	Kiana	Kiana-Noorvik intertie	$23,000,000
		Residential solar thermal and electrical	Unknown
		Fuel tank farm inventory and certification	Unknown
		Construct Kiana wind diesel	Unknown
		Hydroelectric feasibility study at Canyon Creek	Unknown
	Noorvik	Residential solar thermal and electrical	Unknown
		Kiana-Noorvik intertie	See above
		Fuel tank farm inventory and certification	Unknown
	Selawik	Residential solar thermal and electrical	Unknown
		Fuel tank farm inventory and certification	Unknown
Long Term Actions >10 years	Selawik	Selawik-Kiana-Noorvik intertie	Unknown
		New consolidated horizontal fuel tank farm	Unknown
	Kiana	New consolidated horizontal fuel tank farm	Unknown
	Noorvik	New consolidated horizontal fuel tank farm	Unknown

Kiana

Community and Energy Profile

Community Profile: Kiana (Lower Kobuk)



Incorporation	2nd Class City, 1964		

Location

Kiana is located on the north bank of the Kobuk River, 57 air miles east of Kotzebue.

Longitude	-160.4228	**Latitude**	66.975
ANCSA Region	NANA Regional Corporation		
Borough/CA	Northwest Arctic Borough		
School District	Northwest Arctic Borough School District		
AEA Region	Northwest Arctic		

Alaska Native Name (definition)

Katyaaq, "a place where the rivers meet"

Historical Setting / Cultural Resources

It was established long ago as the central village of the Kobuk River Kowagmiut Inupiat Eskimos. In 1909, it became a supply center for the Squirrel River placer mines. A post office was established 1915. The city government was incorporated in 1964. Prior to the formation of the Northwest Arctic Borough in 1976, the BIA high school taught students from Noatak, Shugnak, Kobuk, and Ambler, who boarded with local residents.

Taxes Type (rate)	Per-Capita Revenue
N/A	$120

Economy

Residents depend on traditional subsistence activities, augmented by a cash economy. Chum salmon, freshwater fish, moose, caribou, waterfowl and berries are harvested. The school, City, and Manillaq Association provide the majority of year-round jobs. Red Dog Mine also offers area employment. 65% residents employed; 46% private sector, 52% local government, and 2% state government.

Climate	Avg. Temp.	Climate Zone	Heating Deg. Days
	-10/60	Transitional	15,404

Natural Hazard Plan	
All-Hazards Mitigation Plan (borough-wide)	2009

Community Plans	Year
NWAB Comprehensive Plan (borough-wide)	1993

Local Contacts	Email	Phone	Fax
NANA Regional Corporation, Incorpor	communications@nana.com	907-485-2173	907-485-2137
Northwest Arctic Borough	info@nwabor.org	907-442-2500	907-442-2930
Native Village of Kiana	tribedirector@katyaaq.org	907-475-2109	907-475-2180
City of Kiana	cityclerk@cityofkiana.org		

Demographics	2000	2010		2013
Population	388	361	**Percent of Residents Employed**	65.00%
Median Age	23	27	**Denali Commission Distressed Community**	No
Avg. Household Size	4	4	**Percent Alaska Native/American Indian (2010)**	90.30%
Median Household Income	N/A		**Low and Moderate Income (LMI) Percent (201x)**	N/A

Electric Utility	Generation Sources	Interties	PCE?
Alaska Village Electric Cooperative (AVEC)	Diesel	No	Yes

Landfill	Class		Permitted?		Location
		III		No	

Water/Wastewater System		Homes Served		System Volume
Water	Circ	85		10,000 - 50,000
Sewer	Gravity	**Water/Wastewater Energy Audit?**	Yes	
Notes				

Access					
Road	No				
Air Access	Bob Baker Memorial Airport, gravel, good condition	**Runway 1**	3,400 ft. x 100 ft.	**Runway 2**	N/A
		Runway 3	N/A	**Runway 4**	N/A
Dock/Port	Yes	**Barge Access?**	Yes	**Ferry Service?**	No

Energy Profile: Kiana

Power House

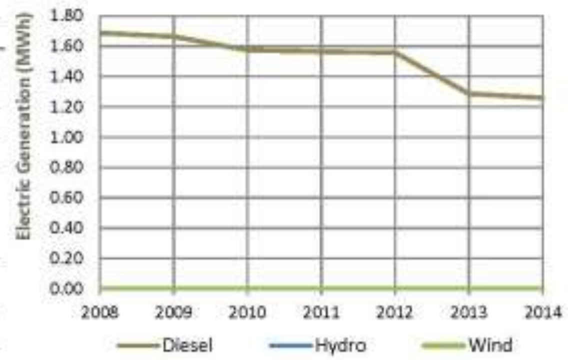
Utility	AVEC		
Generators	Make/Model	Rated Capacity	Condition/Hrs
Unit 1	Newage/HC1504	324	
Unit 2	Kato/6P4-1363	350	
Unit 3	Newage/HC1544E	499	
Unit 4			
Unit 5			
Line Loss		5.10%	
Heat Recovery?			
Upgrades?			
Outage History/Known Issues			

Operators	No. of Operators	Training/Certifications

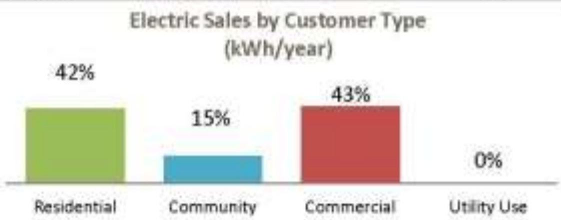
Maintenance Planning (RPSU)

Power Production

Diesel (kWh/yr)	1,562,863	Avg. Load (kW)	178
Wind (kWh/yr)	0	Peak Load (kW)	408
Hydro (kWh/yr)	0	Efficiency (kWh/ga	13.68
Total (kWh/yr)	1,562,863	Diesel Used (gals/y	114,269



Electric Sales	No. of Customers	kWh/year	kWh/Customer
Residential	121	603,525	4987.809917
Community	13	218,384	16798.76923
Commercial	21	624,396	29733.14286
Utility Use			N/A



Electric Rates ($/kWh)		Cost per kWh Sold ($/kWh)	
Rate with PCE	0.20	Fuel Cost	0.34
Residential Rate	0.66	Non-fuel Cost	0.23
Commercial Rat	0.64	Total Cost	$0.57

Fuel Prices ($)	Utility/Wholesale	Retail	Senior
Diesel (1 gal)	6.00	3.59	
Other Fuel? (1 gal)			
Gasoline (1 gal)	6.50		
Propane (100#)	350.00		
Wood (1 cord)			
Pellets			
Discounts?			

Alternative Energy	Potential	Projects/Notes	Status
Hydroelectric	Low	Unsuccessful small hydroelectric plant established in 1981	
Wind Diesel	High	Class 6-7 winds reported to exist 6 miles east of Kiana	
Biomass	Medium	Resources being investigated	
Solar	Medium to High	Solar PVs planned for Kiana	
Geothermal	Low		
Oil and Gas	Low		
Coal	Medium	Coal resources identified in the Hockley Hills between Kiana and Selawik	
Emerging Tech	Unknown		
Heat Recovery	High	AVEC working with ANTHC to renovate system	
Energy Efficiency	High	Homes & schools provided w/ extra TED meters 2014/2015; 2014 TED training	

Bulk Fuel

Tank Owner	Fuel Type(s)	Capacity	Age/Condition
AVEC	Diesel	136,621	

Purchasing	Deliveries/Year	Gallons/Delivery	Vendor(s)
By Barge	2	114,178	AVEC
By Air			

Cooperative Purchasing Agreements

Notes

Energy Profile: Kiana

Housing Units	Occupied	Vacant	% Owner-Occup.
	96	52	61%

Regional Housing Authority	Weatherization Service Provider
NIHA	NIHA

Housing Need	Overcrowded	1-star
	39.2%	N/A

Energy Use	Average Home Energy Rating	Average Square Feet	Avg. EUI (kBTU/sf)
	2-star	872	178

Data Quality

Lighting	Upgraded?	Owner	Notes

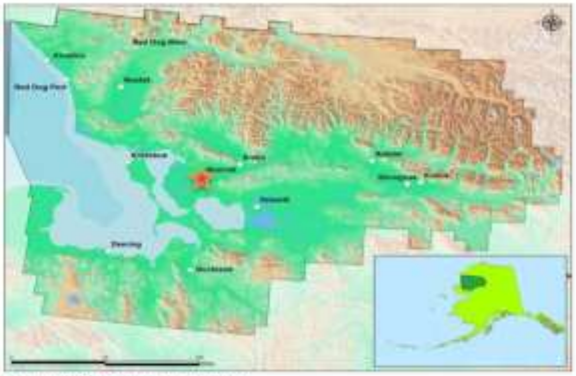
Non-residential Building Inventory

Building Name or Location	Year Built	Square Feet	Audited?	Retrofits Done?	In ARIS?
Water Treatment Plant			ANTHC		No
AVEC Power Plant			ANTHC		No
City Office		2443	EECBG, VEEP	Yes	No
Community Building		1763	EECBG, VEEP	Yes	No
Fire Hall		1372	EECBG, VEEP	Yes	No
Friends Church			VEEP	Yes	No
Native Village Office		1840	VEEP	Yes	No
Public Safety Building		1190	VEEP	Yes	No
VPSO House		718	VEEP	Yes	No
AIRPORT ELECTRICAL	2000	96			No
City Office Building	1970	2688			No
EQUIPMENT STORAGE	1992	1260			No
Industrial arts classroom		2829			No
Kiana Baptist Church					No
Kiana Clinic	2004	5000			No
Kiana Friends Church		4000			No
Kiana Post Office	1989	480			No
Kiana Trading Post					No
New boiler module		1920			No
New school	2003	36311			No
Old boiler module		2108			No

Noorvik

Community and Energy Profile

Community Profile: Noorvik (Lower Kobuk)



Incorporation	2nd Class City, 1964

Location

Noorvik is located on the right bank of the Nazuruk Channel of the Kobuk River, 33 miles northwest of Selawik and 45 miles east of Kotzebue. The village is downriver from the 1.7-million acre Kobuk Valley National Park.

Longitude	-161.0328	**Latitude**	66.8383
ANCSA Region	NANA Regional Corporation		
Borough/CA	Northwest Arctic Borough		
School District	Northwest Arctic Borough School District		
AEA Region	Northwest Arctic		

Taxes Type (rate)	Per-Capita Revenue
N/A	$70

Alaska Native Name (definition)

Noorvik, "a place that is moved to"

Historical Setting / Cultural Resources

The village was established by Kowagmuit Inupiat Eskimo fishermen and hunters from Deering in the early 1900s. The village was also settled by people from Oksik, a few miles upriver. A post office was established in 1937.

Economy

The primary local employers are the school district, the City, the Maniilaq health clinic, and two stores. Seasonal employment found at the Red Dog Mine, BLM fire fighting, or work in Kotzebue supplements incomes. 60% residents employed: 47% private sector, 51% local government, and 2% state government.

Climate	Avg. Temp.	Climate Zone	Heating Deg. Days
	-10/65	Transitional	15,812

Natural Hazard Plan	
All-Hazards Mitigation Plan (borough-wide)	2009

Community Plans	Year
NWAB Comprehensive Plan (borough-wide)	1993

Local Contacts	Email	Phone	Fax
NANA Regional Corporation, Incorpor	communications@nana.com	907-485-2173	907-485-2137
Northwest Arctic Borough	info@nwabor.org	907-442-2500	907-442-2930
Noorvik Native Community	tribemanager@nuurvik.org	907-636-2144	907-636-2284

Demographics	2000	2010		2013
Population	634	668	**Percent of Residents Employed**	60.00%
Median Age	22	22	**Denali Commission Distressed Community**	No
Avg. Household Size	5	5	**Percent Alaska Native/American Indian (2010)**	88.32%
Median Household Income	N/A	$54,375	**Low and Moderate Income (LMI) Percent (201x)**	55%

Electric Utility	Generation Sources	Interties	PCE?
Alaska Village Electric Cooperative (AVEC)	Diesel	No	Yes

Landfill	Class	III	Permitted?	Yes	Location	2.6 mile east

Water/Wastewater System		Homes Served		System Volume
Water	Pressure, Circ			50,001 - 100,000
Sewer	Vacuum	**Water/Wastewater Energy Audit?**	No	
Notes				

Access					
Road	No				
Air Access	Robert Curtis Memorial Airport, gravel, fair condition	**Runway 1**	4,000 ft. x 100 ft.	**Runway 2**	N/A
		Runway 3	N/A	**Runway 4**	N/A
Dock/Port	Yes	**Barge Access?**	Avg. Temp.	**Ferry Service?**	No

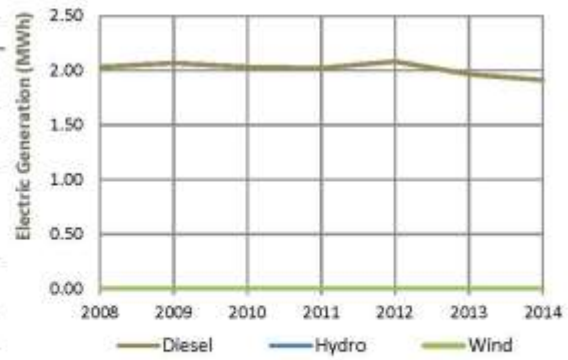
Energy Profile: Noorvik

Power House

Utility	AVEC		
Generators	Make/Model	Rated Capacity	Condition/Hrs
Unit 1	Newage/HCI504C1	363	
Unit 2	Newage/HCI504F1	499	
Unit 3	Marathon/750ROZD	710	
Unit 4			
Unit 5			
Line Loss		2.70%	
Heat Recovery?	*Was project implemented?		
Upgrades?			
Outage History/Known Issues			

Power Production

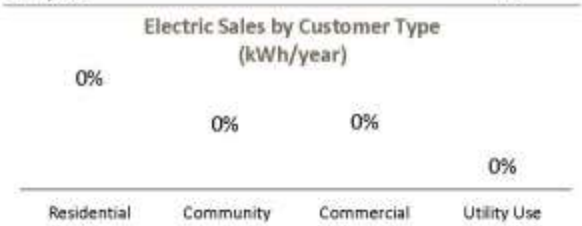
Diesel (kWh/yr)	1,911,548	Avg. Load (kW)	224
Wind (kWh/yr)	N/A	Peak Load (kW)	474
Hydro (kWh/yr)	N/A	Efficiency (kWh/ga	12.78
Total (kWh/yr)	1,911,548	Diesel Used (gals/y	149,548



Operators	No. of Operators	Training/Certifications

Maintenance Planning (RPSU)

Electric Sales	No. of Customers	kWh/year	kWh/Customer
Residential			#DIV/0!
Community			#DIV/0!
Commercial			#DIV/0!
Utility Use			N/A



Electric Rates ($/kWh)		Cost per kWh Sold ($/kWh)	
Rate with PCE	0.20	Fuel Cost	0.35
Residential Rate	0.65	Non-fuel Cost	0.23
Commercial Rat	0.65	Total Cost	0.58

Fuel Prices ($)	Utility/Wholesale	Retail	Senior
Diesel (1 gal)	7.60	3.69	
Other Fuel? (1 gal)			
Gasoline (1 gal)	8.03		
Propane (100#)	307.00		
Wood (1 cord)			
Pellets			
Discounts?			

Alternative Energy	Potential	Projects/Notes	Status
Hydroelectric	Low		
Wind Diesel	Low/Medium	Class 3, feasibility study, construction 2014	
Biomass	Medium	Resources investigated in Noorvik	
Solar	Medium to High	Solar PVs planned for Noorvik	
Geothermal	Low		
Oil and Gas	Low		
Coal	Medium	Further study on resource potential needed	
Emerging Tech	Unknown		
Heat Recovery	High	Design for system was scheduled for 2014 fall construction	
Energy Efficiency	High	Homes & schools provided w/ extra TED meters 2014/2015; 2014 TED training	

Bulk Fuel

Tank Owner	Fuel Type(s)	Capacity	Age/Condition
AVEC	Diesel	202,944	

Purchasing	Deliveries/Year	Gallons/Delivery	Vendor(s)
By Barge	1	96,946	AVEC
By Air			

Cooperative Purchasing Agreements

Notes

Energy Profile: Noorvik

Housing Units	Occupied	Vacant	% Owner-Occup.	Regional Housing Authority		Weatherization Service Provider	
	153	18	65%	NIHA		NIHA	
Housing Need		Overcrowded	1-star	Energy Use	Average Home Energy Rating	Average Square Feet	Avg. EUI (kBTU/sf)
		52.0%	N/A		N/A	N/A	N/A
Data Quality							

Lighting	Upgraded?	Owner	Notes

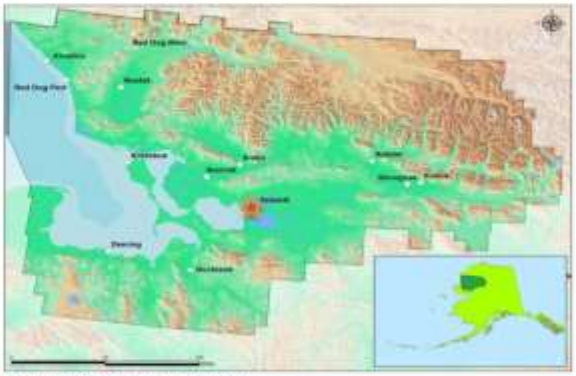
Non-residential Building Inventory

Building Name or Location	Year Built	Square Feet	Audited?	Retrofits Done?	In ARIS?
City Office		3200	EECBG	Yes	No
AIRPORT ELECTRICAL	2001	96			No
Boiler/generator/fire pump module		1488			No
Lift station bldg.		1728			No
Maintenance shop		720			No
Morris Trading Post	1970				No
New garage	1977	5600			No
Noorvik City Building	1973	4800			No
Noorvik Friends Church					No
Noorvik Native Store					No
Noorvik Native Village Office		1404			No
Noorvik Post Office	1970				No
Old garage	1970	875			No
Sally Harvey Memorial Health Clinic	2004	7500			No
School	2002	61300			No
Snow machine building	1970	625			No
SREB	2001	2000			No
Water storage bldg.		2520			No
Water Treatment Plant	1973	12000			No

Selawik

Community and Energy Profile

Community Profile: Selawik (Lower Kobuk)



Incorporation	2nd Class City, 1974	

Location

Selawik is located at the mouth of the Selawik River, where it empties into Selawik Lake, about 90 miles east of Kotzebue. It lies 670 miles northwest of Anchorage. The city is near the Selawik National Wildlife Refuge, a key breeding and resting spot for migratory waterfowl.

Longitude		Latitude
ANCSA Region	NANA Regional Corporation	
Borough/CA	Northwest Arctic Borough	
School District	Northwest Arctic Borough School District	
AEA Region	Northwest Arctic	

Taxes Type (rate)	Per-Capita Revenue
N/A	$270

Alaska Native Name (definition)

Akuli gaq "Where the river meets together"

Historical Setting / Cultural Resources

Lt. L.A. Zagoskin of the Imperial Russian Navy first reported the village in the 1840s as "Chilivik." Ivan Petroff counted 100 "Selawigamute" people in his 1880 census. Selawik is an Eskimo name for a species of fish. Around 1908, the site had a small wooden schoolhouse and church. The village has continued to grow and has expanded across the Selawik River onto three banks, linked by bridges. Selawik incorporated as a first-class city in 1974 but in 1977 changed to a second-class city government.

Economy

59% residents employed: 42% private sector and 58% local government.

Climate	Avg. Temp.	Climate Zone	Heating Deg. Days
	-10/65	Transitional	15,950

Natural Hazard Plan	
All-Hazards Mitigation Plan (borough-wide)	2009

Community Plans	Year
NWAB Comprehensive Plan (borough-wide)	1993

Local Contacts	Email	Phone	Fax
NANA Regional Corporation, Incorpor	communications@nana.com	907-485-2173	907-485-2137
Northwest Arctic Borough	info@nwabor.org	907-442-2500	907-442-2930
Native Village of Selawik	tribeadmin@akuligaq.org	907-484-2165	907-484-2226
City of Selawik	city_of_selawik@hotmail.com	907-484-2132	907-484-2209

Demographics	2000	2010		2013
Population	772	829	Percent of Residents Employed	59.00%
Median Age	19	22	Denali Commission Distressed Community	Yes
Avg. Household Size	5	5	Percent Alaska Native/American Indian (2010)	85.40%
Median Household Income	N/A	$35,625	Low and Moderate Income (LMI) Percent (201x)	77%

Electric Utility	Generation Sources	Interties	PCE?
Alaska Village Electric Cooperative (AVEC)	Diesel, wind	No	Yes

Landfill	Class	Permitted?	Location

Water/Wastewater System		Homes Served		System Volume
Water	Circ			10,000 - 50,000
Sewer	Vacuum	Water/Wastewater Energy Audit?	Yes	
Notes				

Access					
Road	No				
Air Access	Roland Norton Memorial Airstrip, gravel	Runway 1	3,000 ft. x 70 ft.	Runway 2	N/A
		Runway 3	N/A	Runway 4	N/A
Dock/Port	Yes	Barge Access?	Yes	Ferry Service?	No

Energy Profile: Selawik

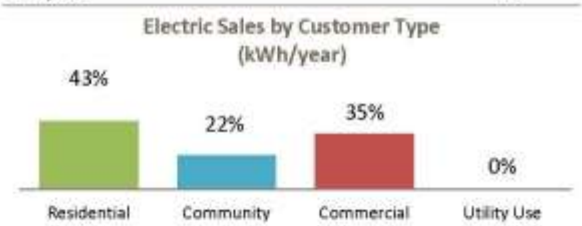
Power House

Utility	AVEC		
Generators	Make/Model	Rated Capacity	Condition/Hrs
Unit 1	arathon/572RSL40	363	
Unit 2	Newage/HCI544F	499	
Unit 3	Newage/HCI604J1	824	
Unit 4			
Unit 5			
Line Loss		2.80%	
Heat Recovery?		Yes	
Upgrades?			
Outage History/Known Issues			

Operators	No. of Operators	Training/Certifications

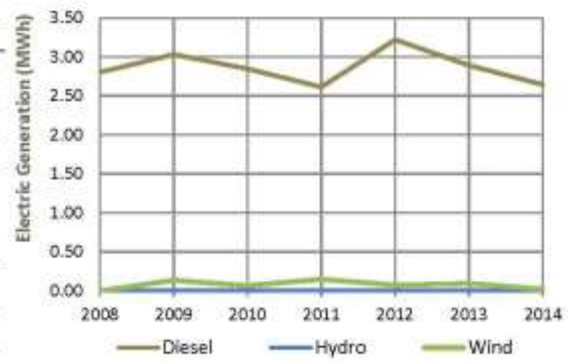
Maintenance Planning (RPSU)

Electric Sales	No. of Customers	kWh/year	kWh/Customer
Residential	179	1,098,976	6139.530726
Community	17	550,009	32353.47059
Commercial	50	894,373	17887.46
Utility Use			N/A



Power Production

Diesel (kWh/yr)	1,098,976	Avg. Load (kW)	332
Wind (kWh/yr)	21,408	Peak Load (kW)	725
Hydro (kWh/yr)	0	Efficiency (kWh/ga	13.85
Total (kWh/yr)	2,665,515	Diesel Used (gals/y	190,956



Electric Rates ($/kWh)		Cost per kWh Sold ($/kWh)	
Rate with PCE	0.20	Fuel Cost	0.32
Residential Rate	0.61	Non-fuel Cost	0.23
Commercial Rat	0.62	Total Cost	0.55

Fuel Prices ($)	Utility/Wholesale	Retail	Senior
Diesel (1 gal)	7.99	3.41	
Other Fuel? (1 gal)			
Gasoline (1 gal)	8.25		
Propane (100#)	320.19		
Wood (1 cord)			
Pellets			
Discounts?			

Alternative Energy	Potential	Projects/Notes	Status
Hydroelectric	Low		
Wind Diesel	Low/Medium	Class 2-3, Four AOC 15/50 wind turbines integrated into power system	
Biomass	Low		
Solar	Medium to High	Solar PVs planned for Selawik	
Geothermal	Low		
Oil and Gas	Low		
Coal	Medium	Coal resources identified in the Hockley Hills between Kiana and Selawik	
Emerging Tech	Unknown		
Heat Recovery	High	AVEC working with ANTHC to renovate system	
Energy Efficiency	High	Homes & schools provided w/ extra TED meters 2014/2015; 2014 TED training	

Bulk Fuel

Tank Owner	Fuel Type(s)	Capacity	Age/Condition
AVEC	Diesel	273,878	

Purchasing	Deliveries/Year	Gallons/Delivery	Vendor(s)
By Barge	3	230,572	AVEC
By Air			

Cooperative Purchasing Agreements

Notes

Energy Profile: Selawik

Housing Units	Occupied	Vacant	% Owner-Occup.	Regional Housing Authority		Weatherization Service Provider	
	166	27	54%	NIHA		NIHA	
Housing Need		Overcrowded	1-star	Energy Use	Average Home Energy Rating	Average Square Feet	Avg. EUI (kBTU/sf)
		43.4%	N/A		2-star	560	224
Data Quality							

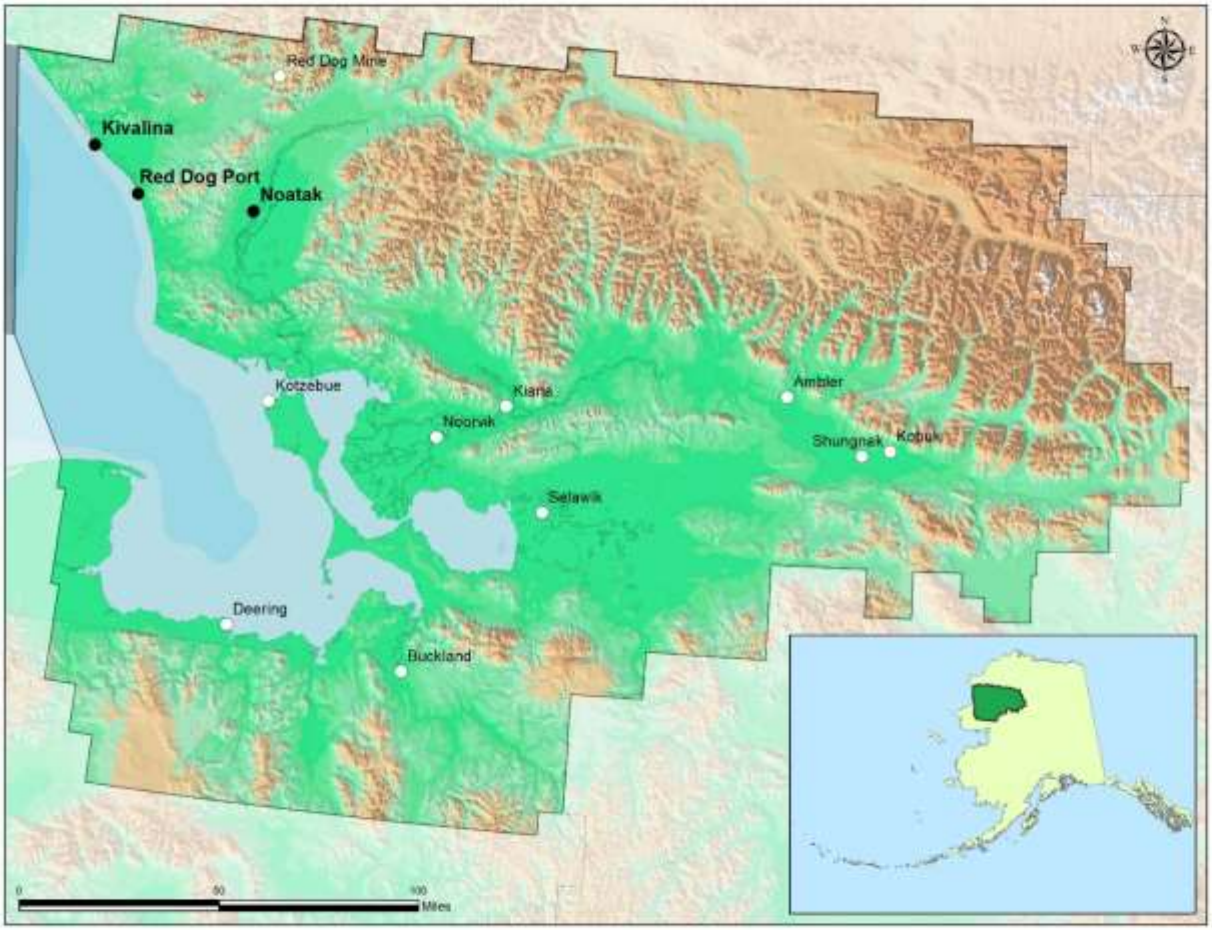
Lighting	Upgraded?	Owner	Notes

Non-residential Building Inventory

Building Name or Location	Year Built	Square Feet	Audited?	Retrofits Done?	In ARIS?
Sewer Vacuum Plant		1,120	EECBG	Yes	No
Water Treatment Plant		5,700	EECBG	Yes	No
AIRPORT ELECTRICAL	2000	96			No
EQUIPMENT STORAGE	1992	1260			No
Generator van		160			No
Industrial arts shop		600			No
Maintenance shop		320			No
Modular classroom		864			No
School	1998	52975			No
Selawik Clinic	2011	7500			No

4.3 Noatak Valley Subregion: Kivalina & Noatak

Figure 7: Noatak Valley Subregion



4.3. Noatak Valley Subregion: Kivalina & Noatak

The Noatak Valley Subregion includes the communities of Kivalina and Noatak. The 2010 U.S. Census reports a total population of 888. Kivalina is located 80 air miles northwest of Kotzebue. Noatak is located on the west bank of the Noatak River, 55 miles north of Kotzebue and 70 miles north of the Arctic Circle.

Village of Noatak

Table 28 provides contact information for the governmental entities serving the Noatak Valley area.

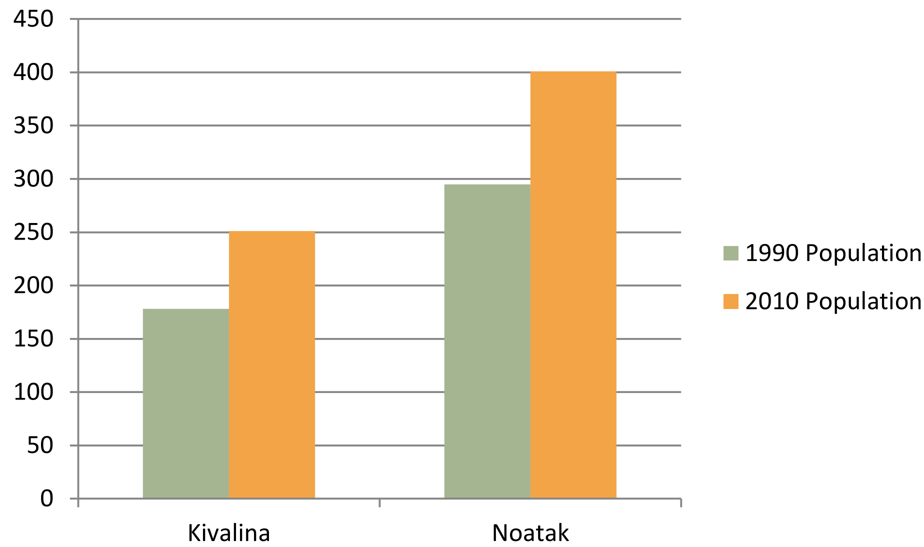
Table 28: Noatak Valley Local and Regional Contacts

Community	Kivalina	Noatak
City Government	City of Kivalina PO Box 50079 Kivalina, AK 99750 Phone: 907-645-2137 Fax: 907-645-2175 kivalinacity@aol.com	None
Tribal Government	Native Village of Kivalina P.O. Box 50051 Kivalina, AK 99750 Phone: 907-645-2201 Fax: 907-645-2193 tribeadmin@kivaliniq.org	Native Village of Noatak P.O. Box 89 Noatak, AK 99761 Phone: 907-485-2173 Fax: 907-485-2137 tribeadmin@nautaaq.org

4.3.1. Demographics

Kivalina (population 374) and Noatak (population 514) experienced an average annual growth rate over the past 20 years of just over 1.6 percent. The unemployment rate is approximately 19 percent and about 17 percent of the residents were below the poverty rate. Exhibit 16 illustrates the change in population of the Noatak Valley communities over the past 20 years.

Exhibit 16: Noatak Valley Subregion 20-year Population Change



Source: US Census

4.3.2. Economy

The economy in Kivalina and Noatak is a mix of cash and subsistence activities. Bearded seal, walrus, bowhead whale, Dolly Varden, trout, tomcods, blue cods, salmon, whitefish, waterfowl, moose and caribou are harvested. Occasionally, bartered seal and beluga whale supplement the diet. The school, City, Maniilaq Association, NRC, tribal councils and general stores provide the majority of year-round jobs. Nine residents hold commercial fishing permits, while many families travel to summer fish camps for subsistence harvesting. The Red Dog Mine provides some jobs, and seasonal employment also includes BLM fire-fighting.

4.3.3. Community Plans

The Borough coordinates with each of the villages on a regular basis and is currently updating community plans. Kivalina's hazard mitigation plan expired in December 2012 and needs to be updated. As an unincorporated community, Noatak is included in the NAB's hazard mitigation plan that expires in June 2014. They also each have transportation plans that were done for the Bureau of Indian Affairs and all of the communities were included in the state's Northwest Alaska Regional Transportation Plan.

4.3.4. Infrastructure

There are 199 occupied homes in the Noatak Valley Subregion according to the 2010 Census numbers reported by the DCRA, with an average of about five persons in each family household.

Noatak has a circulating water system to which most residences are connected and a gravity buried sewer system. Kivalina residents still haul water from the washeteria and rely on honey buckets. AVEC operates the electric utility in both communities. Kivalina and Noatak operate Class 3 landfills, however neither facility has ever been permitted (DCED, 2014, based on 10/3/13 DEC update).

Each community has a school operated by the Northwest Arctic Borough School District, a post office, a health clinic, city and tribal offices, water treatment facilities and power plants. Both communities have state-owned and operated airports.

Table 29 provides an overview of energy facts for the Noatak Valley subregion.

Table 29: Noatak Valley Subregion Quick Facts

Noatak Valley Subregion Quick Facts Kivalina and Noatak	
Population (U.S. Census, 2010)	888
Utility	AVEC
Total Electricity Production, mWh (AEA, 2010)	3,013
Diesel Fuel Consumed to Produce Electricity, per year (AEA, 2010)	229,885
Annual Heating Oil Consumption, gallons (AEA, 2010)	229,919
Average subregional Residential Electric Rate, pre-PCE (NAB, 2013)	$0.69
Average Commercial Electricity Rate (AVEC, 2012)	$0.7633
Annual Transportation Fuel Use, gallons (AEA, 2010)	84,768
2013 Average Diesel Fuel Price – for power generation, per gallon (NAB, 2013)	$5.02

4.3.5. Energy Issues

As is the case across the Northwest Arctic Region, the cost of fuel is the driving energy issue in Noatak Valley subregion. Energy is produced in each village at a local power plant, creating a redundancy of facilities and staffing which could be reduced through consolidation of power generation. The proximity of the Red Dog port site allows for the potential to consolidate energy production. No interties currently exist, so if energy is to be shared across the subregion, Noatak will need to be connected to the Port site and subsequently Kivalina will need to be tied in.

Kivalina has been considering relocation for some time as the barrier island on which it is situated is eroding. Because of this, further investment in the community by funding agencies has been stalled and many improvements have been deferred.

Roads are also needed to facilitate fuel sharing. The river near Noatak has been too low for fuel to be barged to the community. Fuel flown in is much more costly than barged fuel. To alleviate the expense, some residents travel overland via snowmachine in winter to purchase fuel from Red Dog. A road connecting Noatak to the road between the Port site and the mine (DeLong Mountain Transportation Service) would greatly facilitate fuel transport and reduce fuel costs. The Federal Highway Administration explored this option but concluded that a road was too expensive. Recently, talks have concluded that a winter fuel haul vehicle could be used to transport fuel for this purpose.

Noatak's water and sewer facilities – particularly the wastewater facilities – need extensive work, and improvements would be expected to reduce the energy needed to keep them operational.

AVEC has actively pursued funding for a new power plant and tank farm in Noatak. In early 2009, with the help of community leaders, a feasible power plant and consolidated tank farm site near the new school was identified. The new power plant would be more efficient than the current plant. The consolidated tank farm would serve AVEC and Native Village of Noatak. AVEC has previously looked at the feasibility of installing solar panels in Noatak to help reduce power plant service station fees. The proposed power plant and tank farm site is currently leased from NANA to the Borough for a length of 55 years. NAB determined that they do not want to sublease the site to AVEC and instead would like AVEC to obtain the land directly from NANA. AVEC has initiated this process, but it has proven to be difficult and expensive, so they are looking at alternatives.

AVEC approached the Alaska State Legislature in January 2012 requesting an appropriation of $11,500,000 for a new power plant and consolidated bulk fuel facility that would be constructed away from the currently eroding site on the Noatak River. The project was not awarded. To move forward, AVEC needs NANA's assistance in gaining site control for an area near the new school.

According to findings in a 2001 Concept Design Report,[10] Noatak's fuel storage capacity included the following:

AVEC: 99,800 gallons
IRA: 91,800 gallons
School: 89,500 gallons

From AVEC's operations numbers, the maximum fill capacity is 95,000 gallons and the usable capacity is 92,000 gallons.

The Noatak IRA operates three separate tank farms: at the store, the pump house and the airport. Total capacity is 91,800 gallons. The store has 46,000 gallons. The pump house tank farm is in two separate locations, with a combined capacity of 26,500 gallons. The remaining tanks are located at the airport with a combined capacity of about 19,300.

AEA granted funding to AVEC to produce a conceptual design report and feasibility study for a transmission line and wind development at both Kivalina and the Red Dog Mine, however, economic feasibility remains the primary obstacle to ascertaining feasibility. The Kivalina power plant site is vulnerable as it is located near the beach which is subject to erosion; the tank farm is located far from power plant. Future funding might be hard to secure at the 'old' site and the new site is undefined.

[10] Cited by AVEC in email May 23, 2013.

4.3.6. Energy Improvement Opportunities/Alternatives

Table 30 shows the energy opportunities that exist in the Noatak Valley subregion.

Table 30: Noatak Valley Energy Improvement Opportunities

Energy Opportunity	Potential
Existing systems	High potential. Improvements to monitoring and structures at water plant will reduce energy usage. Tank Farm upgrades/certifications/rehabilitation.
Interties	Medium potential. Kivalina is about 16 miles from Red Dog Port (Figure 7) and may benefit from an electrical intertie. Noatak lies 30 miles from the port, so an intertie is unlikely to be economically feasible. HVDC technology may change this.
Wind	Medium potential. Kivalina wind resources are rated as Class 4 (marginal to fair) both at the current and proposed town sites. Noatak's wind resources are poor. Better wind resources may be available along the new road connecting to the Red Dog Mine Road.
Energy efficiency program	High potential. Currently additional TED meters are being sent out to the communities for households that missed out on initial installation. Provide TED meter training 2014. Additional TED meters may be installed in the schools in 2014/2015.
Heat recovery	High potential. AVEC and ANTHC are investigating the feasibility of a heat recovery system in Kivalina. High potential in Noatak for recovered heat.
Hydroelectric	Low potential. There are no known appropriate sites for hydroelectric power near Noatak or Kivalina.
Solar	High potential. Solar PVs have been proven as a power source at the Ambler water treatment plant. This technology is planned for Noatak and Kivalina. High potential for a solar farm in Noatak. Solar for residential fish camps.
Biomass	Medium potential. There are potential biomass resources near Noatak and AWEDG could do pre-feasibility study at no cost. There are no known biomass resources of significance near Kivalina.
Hydrokinetic	Low potential. No known feasible hydrokinetic sites in the area.
Geothermal	Low potential. Geothermal resources are not known in the area.
Gas	Low potential. Gas opportunities undiscovered.
Coal	Low potential. No known coal resources are located in the Noatak Valley subregion.

4.3.7. Priority Energy Actions

Representatives from the energy steering committee provided the prioritization of energy actions for the Noatak Valley subregion shown in Table 31.

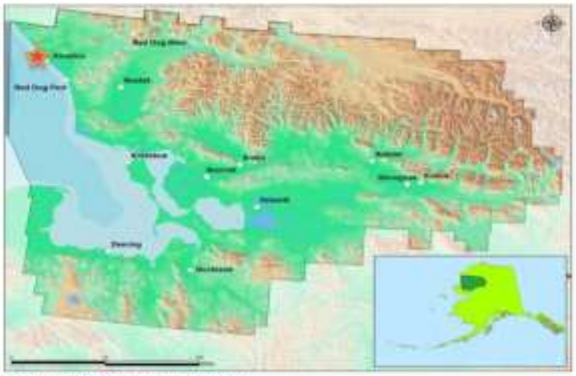
Table 31: Noatak Valley Subregion Priority Energy Actions

Timeframe	Community	Project	Estimated Costs
Short Term Actions 1-5 years	Noatak	Red Dog Port fuel haul project	$425,000
		LED street lights	Unknown
		TED meters install and education 2014	$250/household
		Solar farm feasibility study	Unknown
		Biomass feasibility study	Unknown
	Kivalina	Solar PV at WTP - 2014	$75,000
		Red Dog port site - Kivalina wind transmission feasibility study (May 2014)	$173,000
		Biomass feasibility study	$85,000
		TED meters install and education 2014	$250/household
		Residential energy efficiency upgrades and education	Unknown
		Heat recovery at water treatment plant	Unknown
		Wind study at new school site	$150,000
Mid Term Actions 5-10 years	Noatak	Solar farm construction	Unknown
		Residential solar thermal and electrical	Unknown
		Bulk fuel buying program	Unknown
		Fuel tank farm inventory and certification	Unknown
	Kivalina	Kivalina-Red Dog port intertie	Unknown
		Wind diesel construction	Unknown
		Residential solar thermal and electrical	Unknown
		Fuel tank farm inventory and certification	Unknown
Long Term Actions >10 years	Kivalina	Intertie to Red Dog	Unknown
		New consolidated horizontal fuel tank farm	Unknown
	Noatak	Wind diesel construction	Unknown
		Road to Red Dog port	Unknown
		New consolidated horizontal fuel tank farm	Unknown

Kivalina

Community and Energy Profile

Community Profile: Kivalina (Noatak Valley)



Incorporation	2nd Class City, 1969		

Location

Kivalina is at the tip of an 8-mile barrier reef located between the Chukchi Sea and Kivalina River. It lies 80 air miles northwest of Kotzebue.

Longitude	-164.5333	**Latitude**	67.7269
ANCSA Region	NANA Regional Corporation		
Borough/CA	Northwest Arctic Borough		
School District	Northwest Arctic Borough School District		
AEA Region	Northwest Arctic		

Taxes Type (rate)	Per-Capita Revenue
N/A	$90

Alaska Native Name (definition)

Kivaliniq

Historical Setting / Cultural Resources

Kivalina has long been a stopping-off place for seasonal travelers between Arctic coastal areas and Kotzebue Sound communities. It is the only village in the Northwest Arctic Borough region where people hunt the bowhead whale. At one time, the village was located at the north end of the Kivalina Lagoon. It was reported as "Kivualinagmut" in 1847 by Lt. Zagoskin of the Russian Navy. Lt. G.M. Stoney of the U.S. Navy reported the village as "Kuveleek" in 1885. A post office was established in 1940. An airstrip was built in 1960. During the 1970s, new houses, a new school, and an electric system were constructed. Due to severe erosion and wind-driven ice damage, the city intends to relocate to a new site 2.5 miles away. Relocation alternatives have been studied, and a new site has been designed and engineered.

Economy

Kivalina's economy depends on subsistence practices. Bearded seal, walrus, bowhead whale, Dolly Varden trout, tomcods, blue cods, salmon, whitefish, and caribou are utilized. The school, city, Maniilaq Association, NANA Regional Corporation, tribal council, airlines, and local stores provide year-round jobs. The Red Dog Mine also offers some employment.

Climate	Avg. Temp.	Climate Zone	Heating Deg. Days
	-15/57	Transitional	19,579

Natural Hazard Plan	
All-Hazards Mitigation Plan (borough-wide)	2009

Community Plans	Year
NWAB Comprehensive Plan (borough-wide)	1993

Local Contacts	Email	Phone	Fax
NANA Regional Corporation, Incorpor	communications@nana.com	907-485-2173	907-485-2137
Northwest Arctic Borough	info@nwabor.org	907-442-2500	907-442-2930
Native Village of Kivalina	tribeadmin@kivaliniq.org	907-645-2153	907-645-2193
City of Kivalina	kivalinacity@aol.com	907-645-2137	907-645-2175

Demographics	2000	2010		2013
Population	377	374	Percent of Residents Employed	65.00%
Median Age	21	22	Denali Commission Distressed Community	Yes
Avg. Household Size	5	5	Percent Alaska Native/American Indian (2010)	96.26%
Median Household Income	N/A	$59,167	Low and Moderate Income (LMI) Percent (201x)	70%

Electric Utility	Generation Sources	Interties	PCE?
Alaska Village Electric Cooperative (AVEC)	Diesel	No	Yes

Landfill	Class	Permitted?	Location
	III	No	1/3 mi. north of runway

Water/Wastewater System		Homes Served	System Volume
Water	Haul, Washeteria	100%	
Sewer	Honeybucket	Water/Wastewater Energy Audit? No	
Notes	School and clinic have individual water and sewer system		

Access					
Road	No				
Air Access	Kivalina Airport, gravel, fair condition	Runway 1	3,000 ft. x 60 ft.	Runway 2	N/A
		Runway 3	N/A	Runway 4	N/A
Dock/Port	Yes	Barge Access?	Yes	Ferry Service?	No

Energy Profile: Kivalina

Power House

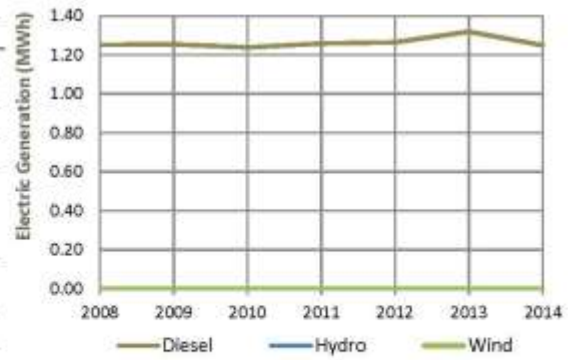
Utility	AVEC		
Generators	Make/Model	Rated Capacity	Condition/Hrs
Unit 1	Kato/6P4-1025	229kW	
Unit 2	Kato/6P4-1700	337kW	
Unit 3	Kato/4P3-1475	250kW	
Unit 4	arathon/572RSL40	363kW	
Unit 5			
Line Loss		2.30%	
Heat Recovery?			
Upgrades?			
Outage History/Known Issues			

Operators	No. of Operators	Training/Certifications

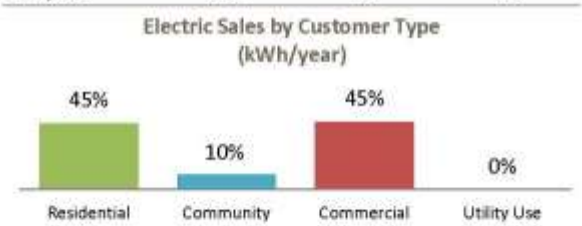
Maintenance Planning (RPSU)

Power Production

Diesel (kWh/yr)	1,259,478	Avg. Load (kW)	3.81
Wind (kWh/yr)	0	Peak Load (kW)	297
Hydro (kWh/yr)	0	Efficiency (kWh/ga	13.78
Total (kWh/yr)	1,259,478	Diesel Used (gals/y	91,418



Electric Sales	No. of Customers	kWh/year	kWh/Customer
Residential	85	533,861	6280.717647
Community	10	118,477	11847.7
Commercial	15	543,942	36262.8
Utility Use	N/A	N/A	N/A



Electric Rates ($/kWh)		Cost per kWh Sold ($/kWh)	
Rate with PCE	0.20	Fuel Cost	0.33
Residential Rate	0.65	Non-fuel Cost	0.23
Commercial Rat	0.65	Total Cost	0.56

Fuel Prices ($)	Utility/Wholesale	Retail	Senior
Diesel (1 gal)	6.45	3.36	
Other Fuel? (1 gal)			
Gasoline (1 gal)	6.72		
Propane (100#)	404.00		
Wood (1 cord)			
Pellets			
Discounts?			

Alternative Energy	Potential	Projects/Notes	Status
Hydroelectric	Low		
Wind Diesel	Medium	Class 5; Met tower, feasibility study	
Biomass	Low		
Solar	High	Solar PVs planned for Kivalina	
Geothermal	Low		
Oil and Gas	Low		
Coal	Low		
Emerging Tech	Unknown		
Heat Recovery	High	AVEC and ANTHC are investigating the feasibility of a heat recovery system	
Energy Efficiency	High	Homes & schools provided w/ extra TED meters 2014/2015; 2014 TED training	

Bulk Fuel

Tank Owner	Fuel Type(s)	Capacity	Age/Condition
AVEC	Diesel	108,522	

Purchasing	Deliveries/Year	Gallons/Delivery	Vendor(s)
By Barge	1	102,061	AVEC
By Air			

Cooperative Purchasing Agreements

Notes

Energy Profile: Kivalina

Housing Units	Occupied	Vacant	% Owner-Occup.	Regional Housing Authority		Weatherization Service Provider	
	79	6	65%	NIHA		NIHA	
Housing Need		Overcrowded	1-star	Energy Use	Average Home Energy Rating	Average Square Feet	Avg. EUI (kBTU/sf)
		39.2%	N/A		3-star plus	770	129
Data Quality							

Lighting	Upgraded?	Owner	Notes

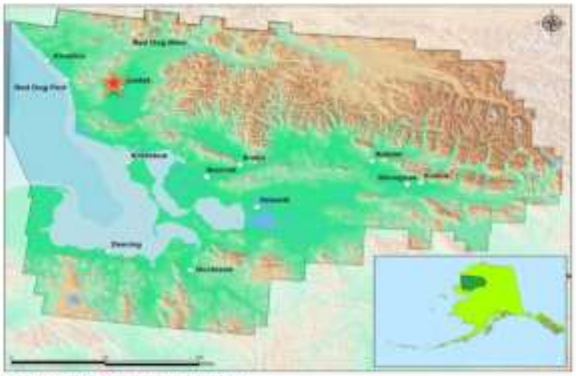
Non-residential Building Inventory

Building Name or Location	Year Built	Square Feet	Audited?	Retrofits Done?	In ARIS?
AIRPORT ELECTRICAL	2000	96			No
Bingo Hall					No
City Office Building	1980	1120			No
Community Building					No
Garage					No
Generator van		160			No
Heavy Equipment Building					No
Jail House					No
Kivalina Clinic	2011	14500			No
Kivalina Native Store					No
Kivalina Post Office					No
Maintenance shop		800			No
School	1976	14400			No
SNOW REMOVAL EQUIP BLDG	1996	2000			No
Storage bldg.		1200			No
Water Treatment Plant					No

Noatak

Community and Energy Profile

Community Profile: Noatak (Noatak Valley)



Incorporation	Unincorporated in Norhtwest Arctic Borough

Location

Noatak is located on the west bank of the Noatak River, 55 miles north of Kotzebue and 70 miles north of the Arctic Circle. This is the only settlement on the 396 mile-long Noatak River, just west of the 66-million acre Noatak National Preserve.

Longitude	-162.9653	Latitude	67.5711
ANCSA Region	NANA Regional Corporation		
Borough/CA	Northwest Arctic Borough		
School District	Northwest Arctic Borough School District		
AEA Region	Northwest Arctic		

Taxes Type (rate)	Per-Capita Revenue
N/A	N/A

Alaska Native Name (definition)

Noatagamut, "Inland River People"

Historical Setting / Cultural Resources

The village is Inupiat Eskimo. It was established as a fishing and hunting camp in the 19th century. The rich resources of this region enabled the camp to develop into a permanent settlement. The 1880 census listed the site as Noatagamut, which means "inland river people." A post office was established in 1940.

Economy

Subsistence activities are the central focus of the culture, and families travel to fish camps during the summer. 68% residents employed: 71% private sector, 28% local government, and 1% state government.

Climate	Avg. Temp.	Climate Zone	Heating Deg. Days
	-21/60	Arctic	15,229

Natural Hazard Plan	
All-Hazards Mitigation Plan (borough-wide)	2009

Community Plans	Year
NWAB Comprehensive Plan (borough-wide)	1993

Local Contacts	Email	Phone	Fax
NANA Regional Corporation, Incorpor	communications@nana.com	907-485-2173	907-485-2137
Native Village of Noatak	tribeadmin@nautaaq.org	907-485-2173	907-485-2137
Northwest Arctic Borough	info@nwabor.org	907-442-2500	907-442-2930

Demographics	2000	2010		2013
Population	428	514	Percent of Residents Employed	68.00%
Median Age	23	23	Denali Commission Distressed Community	No
Avg. Household Size	5	5	Percent Alaska Native/American Indian (2010)	94.75%
Median Household Income	N/A	$58,250	Low and Moderate Income (LMI) Percent (201x)	N/A

Electric Utility	Generation Sources	Interties	PCE?
Alaska Village Electric Cooperative (AVEC)	Diesel	No	Yes

Landfill	Class	Permitted?	Location
	III	No	Gravel road north of runway

Water/Wastewater System		Homes Served	77	System Volume
Water	Circ/heated system			50,001 - 100,000
Sewer	Gravity	Water/Wastewater Energy Audit?	No	
Notes	1/2 homes not served by water/wastewater system			

Access					
Road	No				
Air Access	Noatak Airport, gravel, good condition	Runway 1	3,992 ft. x 60 ft.	Runway 2	N/A
		Runway 3	N/A	Runway 4	N/A
Dock/Port	No	Barge Access?	No	Ferry Service?	No

Energy Profile: Noatak

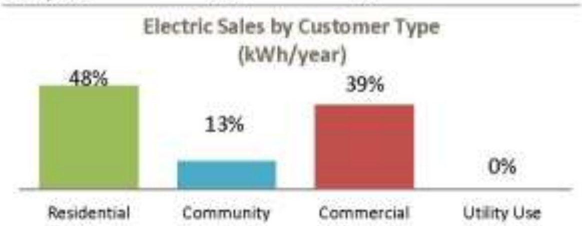
Power House

Utility	AVEC		
Generators	Make/Model	Rated Capacity	Condition/Hrs
Unit 1	Kato/4P3-1475	314 kW	
Unit 2	Newage/HCI534F1	499 kW	
Unit 3	Newage/HCI534CI	397 kW	
Unit 4			
Unit 5			
Line Loss		4.50%	
Heat Recovery?		No	
Upgrades?			
Outage History/Known Issues			

Operators	No. of Operators	Training/Certifications

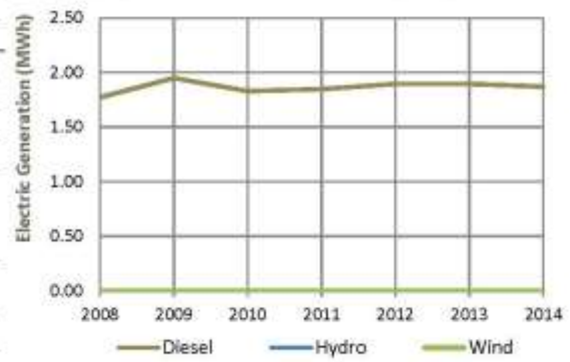
Maintenance Planning (RPSU)

Electric Sales	No. of Customers	kWh/year	kWh/Customer
Residential	117	837601	7158.982906
Community	9	223474	24830.44444
Commercial	26	679652	26140.46154
Utility Use	N/A	N/A	



Power Production

Diesel (kWh/yr)	1,869,341	Avg. Load (kW)	219
Wind (kWh/yr)	0	Peak Load (kW)	443
Hydro (kWh/yr)	0	Efficiency (kWh/ga	14.57
Total (kWh/yr)	1,869,341	Diesel Used (gals/y	128,286



Electric Rates ($/kWh)		Cost per kWh Sold ($/kWh)	
Rate with PCE	0.22	Fuel Cost	0.55
Residential Rate	0.88	Non-fuel Cost	0.23
Commercial Rat	0.87	Total Cost	0.78

Fuel Prices ($)	Utility/Wholesale	Retail	Senior
Diesel (1 gal)	9.99	6.76	
Other Fuel? (1 gal)			
Gasoline (1 gal)	9.99		
Propane (100#)			
Wood (1 cord)			
Pellets			
Discounts?			

Alternative Energy	Potential	Projects/Notes	Status
Hydroelectric	Low		
Wind Diesel	Low	Class 4, Met Tower, feasibility study complete	
Biomass	Medium	Pre-feasibility study recommended; AWEDG would provide study at no cost	
Solar	High	Solar PVs planned for Noatak, high potential for solar farm	
Geothermal	Low		
Oil and Gas	Low		
Coal	Low		
Emerging Tech	Unknown		
Heat Recovery	High		
Energy Efficiency	High	Homes & schools provided w/ extra TED meters 2014/2015; 2014 TED training	

Bulk Fuel

Tank Owner	Fuel Type(s)	Capacity	Age/Condition
AVEC	Diesel	99,800	
IRA	Diesel	91,800	
School	Diesel	89,500	

Purchasing	Deliveries/Year	Gallons/Delivery	Vendor(s)
By Barge	28	125,770	AVEC
By Air			
Cooperative Purchasing Agreements			

Notes

Energy Profile: Noatak

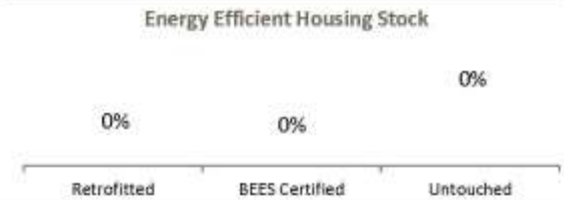
Housing Units	Occupied	Vacant	% Owner-Occup.
	106	16	70%

Regional Housing Authority	Weatherization Service Provider
NIHA	NIHA

Housing Need	Overcrowded	1-star
	56.6%	N/A

Energy Use	Average Home Energy Rating	Average Square Feet	Avg. EUI (kBTU/sf)
	3-star plus	875	125

Data Quality



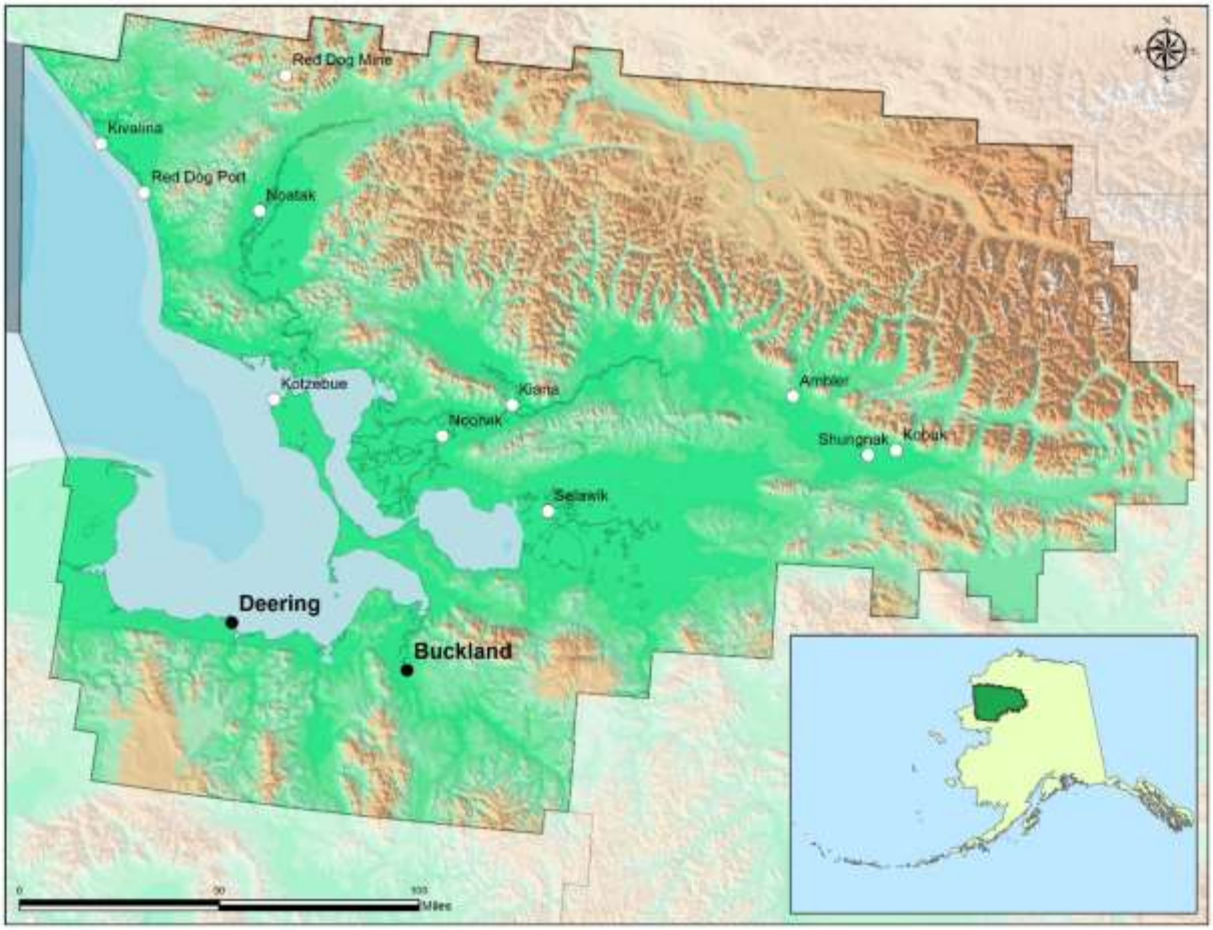
Lighting	Upgraded?	Owner	Notes

Non-residential Building Inventory

Building Name or Location	Year Built	Square Feet	Audited?	Retrofits Done?	In ARIS?
AIRPORT ELECTRICAL	2000	96			No
Elem. & High School	1980	11461			No
EQUIPMENT STG BLDG	1993	2000			No
Esther Barger Memorial Health Center	2004	5000			No
IRA Building	1983	2592			No
Jail House	1987				No
Maintenance/generator shop		1240			No
Middle School		3120			No
Noatak Friends Church	1980	4000			No
Noatak Native Store	1968	4864			No
Noatak Post Office	1970	1512			No
Storage bldg.		336			No
Water Treatment Plant					No

4.4 Buckland & Deering Subregion

Figure 8: Buckland/Deering Subregion



4.4. Buckland & Deering Subregion

The Buckland/Deering subregion includes the communities of Buckland and Deering. The 2010 U.S. Census reports a total population of 538. Buckland is located on the west bank of the Buckland River, 75 air miles southeast of Kotzebue. Deering is located on the Kotzebue Sound at the mouth of the Inmachuk River, 57 miles southwest of Kotzebue.

Village of Buckland (NRC, 2010)

Table 32 provides contact information for the governmental entities serving the Buckland/Deering area.

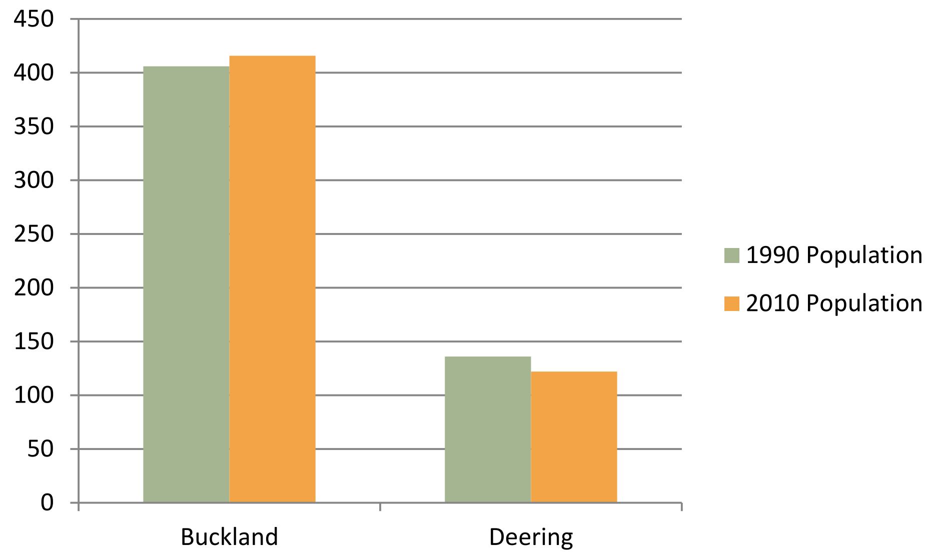
Table 32: Buckland/Deering Local and Regional Contacts

Community	Buckland	Deering
City Government	City of Buckland P.O. Box 49 Buckland, AK 99727 Phone: 907-494-2121 Fax: 907-494-2138 city_of_buckland@yahoo.com	City of Deering PO Box 49 Deering, AK 99736 Phone: 907-363-2136 Fax: 907-363-2156 cityofdeering@yahoo.com
Tribal Government	Native Village of Buckland P.O. Box 67 Buckland, AK 99727 Phone: 907-494-2121 Fax: 907-494-2217 tribeclerk@nunachiak.org	Native Village of Deering P.O. Box 36089 Deering, AK 99736 Phone: 907-363-2138 Fax: 907-363-2195 tribeadmin@ipnatchiaq.org

4.4.1. Demographics

Buckland (population 416) and Deering (population 122) experienced a slight negative average annual growth rate over the past 20 years of less than 0.04 percent—in other words, the population has remained relatively stable. The unemployment rate is approximately 36.5 percent and about 20 percent of the residents were below the poverty rate. Exhibit 17 illustrates the change in population of the Buckland/Deering communities over the past 20 years.

Exhibit 17: Buckland/Deering Subregion 20-year Population Change



Source: US Census

4.4.2. Economy

Buckland residents depend on a subsistence lifestyle for most food sources. Employment is primarily with the school, city, health clinic, and stores. Some mining also occurs. Deering's economy is a mix of cash and subsistence activities. Moose, seal and beluga whale provide most meat sources; pink salmon, tom cod, herring, ptarmigan, rabbit and waterfowl are also utilized. A number of residents earn income from handicrafts and trapping. The village is interested in developing a craft production facility and cultural center to train youth in Native crafts. The school, City, Maniilaq Association, stores, and an airline provide the only year-round jobs. Some mining occurs in the Seward Peninsula's interior. Two residents hold commercial fishing permits. The village wants to develop eco-tourism, including a 38-mile road to Inmachuk Springs for tourists (NAB, 2013).

4.4.3. Community Plans

Buckland and Deering were both included in the NAB's hazard mitigation plan that expires in June 2014. They also each have transportation plans that were completed for the Bureau of Indian Affairs and both of the communities were included in the state's Northwest Alaska Regional Transportation Plan. The Borough coordinates with each of the villages on a regular basis and expects to update community plans in 2014.

4.4.4. Infrastructure

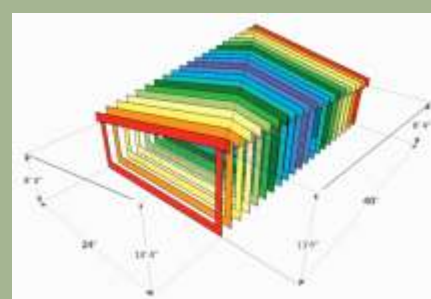
There are 142 occupied homes in the Buckland/Deering subregion according to the 2010 Census numbers reported by the DCRA, with an average of about 4.6 persons in each family household. A partnership between the UAF Chukchi Campus, NIHA, and the Native Village of Buckland, funded through a HUD grant, designed and constructed a prototype "affordable, energy efficient, healthy home" in Buckland. Using a whole-house or integrated truss method, "the Buckland prototype has floor, walls and roof all combined into a single structural piece. This prefabricated technology allows for rapid construction schedules; the home can be out of the elements and enclosed within in a matter of days.

Buckland prototype house under construction.

"Unlike most foundations in the region – houses elevated on piles anywhere from 3-8 feet above the tundra- the Buckland prototype rests directly on a gravel pad. Structural beams made of treated wood are placed upon the pad and the floor portion of the integrated truss runs across them. Soy-based polyurethane foam is sprayed through the joists directly on a geo-textile mat. This raft-like foundation provides an insulation value of R-60 and an effective thermal break, which prevents heat from inside the home from conducting through the floor joists into the ground (CCHRC, 2010)."

Buckland has a circulating buried water system to which most residences are connected and a gravity buried sewer system. Deering residents still haul water from the washeteria and but have a vacuum buried sewer system. The Kotzebue Electric Association (KEA) operates the electric utility in Buckland and Ipnatchiaq Electric Company (IEC), a city and private partnership, provides electrical power to Deering (NRC, 2010). Buckland and Deering operate Class 3 landfills. Buckland's landfill has never been permitted and Deering's permit has expired (DCED, 2014, based on 10/3/13 DEC update).

Buckland Affordable, Energy Efficient, Healthy Home Prototype



The house is rectilinear, and designed to address two important factors: orientation with respect to the site plot and to the prevailing winds. The form has a roof ridge, which runs from corner to corner; the low east-west corners present small wedges into prevailing winds, while the high north-south corners contain storage space and tall windows for solar gain.

(CCHRC, 2010)

Each community has a school operated by the Northwest Arctic Borough School District; a Post Office; and health clinic, City and Tribal Offices, water treatment facilities and power plants. Both communities have state-owned and operated airports.

Table 33 provides an overview of energy facts for the Buckland/Deering subregion.

Table 33: Buckland/Deering Subregion Quick Facts

Buckland/Deering Subregion Quick Facts Buckland and Deering	
Population (U.S. Census, 2010)	538
Utility	KEA – Buckland IEC – Deering
Total Electricity Production, mWh (AEA, 2010)	(Buckland only) 1,592
Diesel Fuel Consumed to Produce Electricity, per year (AEA, 2010)	250,561
Annual Heating Oil Consumption, gallons (AEA, 2010)	147,805
Average Subregional Residential Electric Rate, pre-PCE (NAB, 2013)	$0.59
Average Commercial Electricity Rate (AVEC, 2012)	$0.5894*
Annual Transportation Fuel Use, gallons (AEA, 2010)	54,494
2013 Average Diesel Fuel Price (NAB, 2013)	$7.00

* Buckland $0.4741 and Deering $0.7047

4.4.5. Energy Issues

Staff training in the maintenance and operation of current equipment is needed for utility operators.

As with other subregions, the cost of transport of fuel is high in the Buckland/Deering subregion.

4.4.6. Energy Improvement Opportunities/Alternatives

Table 34 shows the energy opportunities that exist in the Buckland/Deering subregion.

Table 34: Buckland/Deering Energy Improvement Opportunities

Energy Opportunity	Potential
Existing systems	High potential. Additional training for operators would help to make utilities run more efficiently. Tank Farm upgrades/certifications/rehabilitation. Energy Efficiency Upgrades.
Interties	Low potential. Buckland and Deering are located about 50 miles apart, so an intertie is unlikely to be economically feasible.
Wind	High potential. Buckland wind resources are rated as Class 4 (marginal to fair) along the ridges west of the community. Excellent wind resources (Class 5-6) are reported to exist near Cape Deceit, 1.5 miles northwest of Deering, but there are cemetery and avian issues that may prevent development. Studies in final design stage 2014.
Energy efficiency program	High potential. Currently, additional meters are being sent out to the communities for households that missed out on initial installation. Additional TED meters may be installed in the Schools in 2013/2014.
Heat recovery	High potential. Ongoing project in Deering through ARUC.
Hydroelectric	Low potential. A small hydroelectric plant on Hunter Creek 23 miles SW of Buckland proved uneconomic; however, new technology could change that. There are no known appropriate sites for hydroelectric power near Deering.
Solar	High potential. Solar PVs have been proven as a power source at the Ambler water treatment plant. This technology is planned for Buckland and is installed in Deering.
Biomass	Low potential. There are no significant biomass resources near Buckland or Deering.
Hydrokinetic	Low to medium potential. No known feasible hydrokinetic sites in the area.
Geothermal	Medium potential. Geothermal resources are known to exist at Granite Mountain Hot Springs, 40 miles south of Buckland and at Lava Creek, 50 miles south of Deering. Exploration for possible sub-surface geothermal resources closer to the communities is needed.
Gas	Low potential. Gas opportunities undiscovered.
Coal	Medium potential. Coal resources of a low grade are located in the Chicago Creek Region between Buckland and Deering and may be suitable for small scale village use.

4.4.7. Priority Energy Actions

Representatives from the energy steering committee provided the prioritization of energy actions for the Buckland/Deering subregion shown in Table 35.

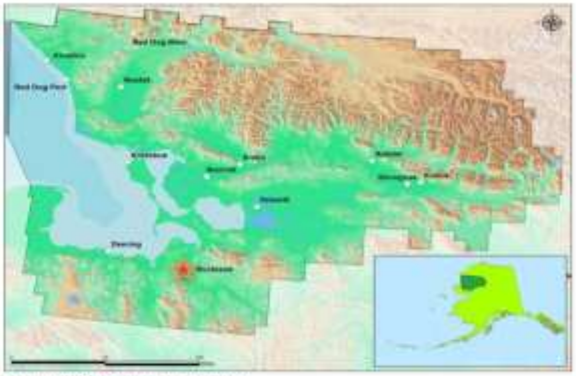
Table 35: Buckland/Deering Subregion Priority Energy Actions

Timeframe	Community	Project	Estimated Costs
Short Term Actions 1-5 years	Buckland	Solar PV, solar thermal at water treatment plant	$75,000
		Energy efficiency upgrades for secondary load for hybrid system (integrated system for alternative energy resources)	$250,000
		TED meters installation and education 2014	$250/household
		Community electrical assessment	Unknown
		Wind diesel final design 2014	$20,000
	Deering	ARUC startup: heat recovery	Unknown
		Deering community photovoltaic	$250,000
		TED meters installation and education 2014	$250/household
		Water and sewer energy efficiency upgrades	Unknown
Mid Term Actions 5-10 years	Buckland	Residential solar thermal and electrical	Unknown
		Fuel tank farm inventory and certification	Unknown
	Deering	Residential solar thermal and electrical	Unknown
		Fuel tank farm inventory and certification	Unknown
Long Term Actions >10 years	Buckland	New consolidated horizontal fuel tank farm	Unknown
	Deering	New consolidated horizontal fuel tank farm	Unknown
		Hydrogen cell feasibility study with new wind energy	Unknown
		New energy efficient water and sewer system	Unknown

Buckland

Community and Energy Profile

Community Profile: Buckland (Buckland and Deering)



Incorporation	2nd Class City, 1966		

Location

Buckland is located on the west bank of the Buckland River, about 75 miles southeast of Kotzebue.

Longitude	-161.1231	**Latitude**	65.9797
ANCSA Region	NANA Regional Corporation		
Borough/CA	Northwest Arctic Borough		
School District	Northwest Arctic Borough School District		
AEA Region	Northwest Arctic		

Taxes Type (rate)	**Per-Capita Revenue**
N/A	$250

Alaska Native Name (definition)

Nunachiaq "New Land"

Historical Setting / Cultural Resources

The residents have moved from one site to another along the river at least five times in recent memory, to places known as Elephant Point, Old Buckland, and New Site. The presence of many fossil finds at Elephant Point indicate prehistoric occupation of the area. The Inupiaq Eskimos depend on reindeer, beluga whale, and seal for survival. The city government was incorporated in 1966.

Economy

Buckland is an Inupiat Eskimo village, and subsistence activities are an important focus of the economy. 66% residents employed: 54% private sector and 46% local government.

Climate	**Avg. Temp.**	**Climate Zone**	**Heating Deg. Days**
	-14/60	Transitional	N/A

Natural Hazard Plan	
All-Hazards Mitigation Plan (borough-wide)	2009

Community Plans	**Year**
NWAB Comprehensive Plan (borough-wide)	1993

Local Contacts	**Email**	**Phone**	**Fax**
NANA Regional Corporation, Incorpor	communications@nana.com	907-485-2173	907-485-2137
Northwest Arctic Borough	info@nwabor.org	907-442-2500	907-442-2930
Native Village of Buckland	tribeclerk@nunachiak.org	907-494-2171	907-494-2217
City of Buckland	city_of_buckland@yahoo.com	907-494-2121	907-494-2138

Demographics	**2000**	**2010**		**2013**
Population	406	416	**Percent of Residents Employed**	66.00%
Median Age	18	20	**Denali Commission Distressed Community**	No
Avg. Household Size	5	5	**Percent Alaska Native/American Indian (2010)**	95.43%
Median Household Income	N/A	$48,281	**Low and Moderate Income (LMI) Percent (201x)**	66%

Electric Utility	**Generation Sources**	**Interties**	**PCE?**
City of Buckland	Diesel, wind	No	Yes

Landfill	**Class**	III	**Permitted?**	No	**Location**	1/2 mile west of the community

Water/Wastewater System		**Homes Served**		**System Volume**
Water	Washeterial, Haul			100,000
Sewer	Haul	**Water/Wastewater Energy Audit?**	Yes	
Notes				

Access

Road	No				
Air Access	Buckland Airport, gravel, fair condition	**Runway 1**	3,200 ft. x 75 ft.	**Runway 2**	N/A
		Runway 3	N/A	**Runway 4**	N/A
Dock/Port	Yes	**Barge Access?**	Yes	**Ferry Service?**	No

Energy Profile: Buckland

Power House

Utility	City of Buckland		
Generators	Make/Model	Rated Capacity	Condition/Hrs
Unit 1	CAT 3456	475	Good
Unit 2	CAT 3456	475	Good
Unit 3	CAT C9	175	Good
Unit 4			
Unit 5			
Line Loss		4.80%	
Heat Recovery?		Yes	
Upgrades?			

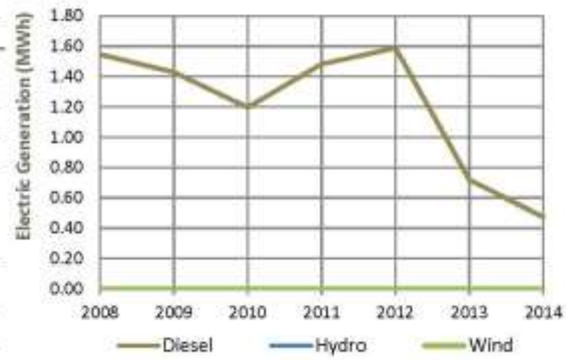
Outage History/Known Issues

One generator has ghost has issues shutting down - controls

Operators	No. of Operators	Training/Certifications
	2	

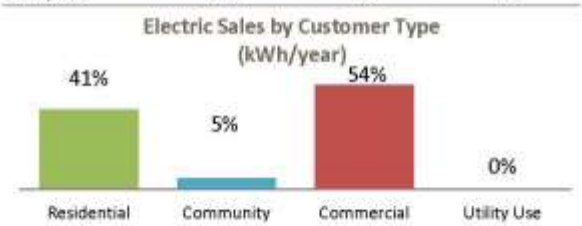
Power Production

Diesel (kWh/yr)	1,693,004	Avg. Load (kW)	
Wind (kWh/yr)	0	Peak Load (kW)	650
Hydro (kWh/yr)	0	Efficiency (kWh/ga	14.16
Total (kWh/yr)	1,693,004	Diesel Used (gals/y	119,524



Maintenance Planning (RPSU)

Electric Sales	No. of Customers	kWh/year	kWh/Customer
Residential	98	646,071	6592.561224
Community	10	85,552	8555.2
Commercial	19	841,835	44307.10526
Utility Use	N/A	N/A	N/A



Electric Rates ($/kWh)		Cost per kWh Sold ($/kWh)	
Rate with PCE	0.47	Fuel Cost	0.33
Residential Rate	0.22	Non-fuel Cost	0.10
Commercial Rate		Total Cost	0.43

Fuel Prices ($)	Utility/Wholesale	Retail	Senior
Diesel (1 gal)	7.00		
Other Fuel? (1 gal)			
Gasoline (1 gal)	7.00		
Propane (100#)	295.00		
Wood (1 cord)			
Pellets			
Discounts?			

Alternative Energy	Potential	Projects/Notes	Status
Hydroelectric			
Wind Diesel	High	Class 4, construction 2014, two turbines installed by the City	
Biomass	Low		
Solar	High	Solar PVs planned for Buckland	
Geothermal	Medium	Resources exist 40 mi. south of Buckland at Granite Mountain Hot Springs	
Oil and Gas	Low		
Coal	Medium	Low grade resources located in the Chicago Creek Region	
Emerging Tech	Unknown		
Heat Recovery		Ongoing project in Deering through ARUC.	
Energy Efficiency	High	Additional homes & schools provided w/ TED meters	

Bulk Fuel

Tank Owner	Fuel Type(s)	Capacity	Age/Condition
City of Buckland	Wind	200	

Purchasing	Deliveries/Year	Gallons/Delivery	Vendor(s)
By Barge			
By Air			

Cooperative Purchasing Agreements

Notes

Energy Profile: Buckland

Housing Units	Occupied	Vacant	% Owner-Occup.
	95	1	57%

Regional Housing Authority	Weatherization Service Provider
NIHA	NIHA

Housing Need	Overcrowded	1-star
	72.6%	N/A

Energy Use	Average Home Energy Rating	Average Square Feet	Avg. EUI (kBTU/sf)
	4-star	1,029	135

Data Quality

Lighting	Upgraded?	Owner	Notes

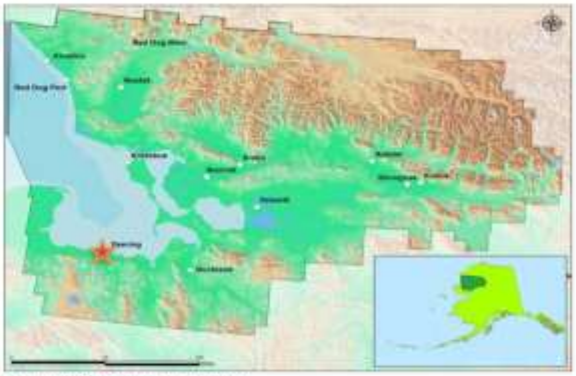
Non-residential Building Inventory

Building Name or Location	Year Built	Square Feet	Audited?	Retrofits Done?	In ARIS?
Buckland School	1977		AHFC	No	No
AIRPORT ELECTRICAL	2000	96			No
Buckland Friends Church	1980	6000			No
Buckland Native Store					No
Buckland Post Office	1987	480			No
City Office Building	1991				No
Community Building	1960				No
Native Village of Buckland Office	1980	1480			No
School	2000	44922			No
School-Boiler Module #1		160			No
School-Boiler Module #2		160			No
School-Boiler Module #3		160			No
School-Fire Pump Van		320			No
School-Generator Van		160			No
School-Lift Station Building		120			No
School-Maintenance Shop		384			No
Shop 1	2007	4200			No
Shop 2	1992	3250			No
SREB	1999	2000			No
Tigautchiaq Amagiaq Health Clinic	2004	5000			No
Washeteria	1985				No

Deering

Community and Energy Profile

Community Profile: Deering (Buckland and Deering)



Incorporation	2nd Class City, 1970

Location

Deering is located on Kotzebue Sound at the mouth of the Inmachuk River, 57 miles southwest of Kotzebue. It is built on a flat sand and gravel spit 300 feet wide and a half-mile long.

Longitude	Latitude
ANCSA Region	NANA Regional Corporation
Borough/CA	Northwest Arctic Borough
School District	Northwest Arctic Borough School District
AEA Region	Northwest Arctic

Taxes Type (rate)	Per-Capita Revenue
N/A	$140

Alaska Native Name (definition)

Inmachukmiut

Historical Setting / Cultural Resources

The village was established in 1901 as a supply station for Interior gold mining near the historic Malemiut Eskimo village of "Inmachukmiut." The name Deering was probably taken from the 90-ton schooner "Abbey Deering," which was in nearby waters around 1900. The city was incorporated in 1970.

Economy

The population of the village is primarily Inupiat Eskimo. The people are active in subsistence. 72% residents employed: 41% private sector and 59% in local government.

Climate	Avg. Temp.	Climate Zone	Heating Deg. Days
	-18/63	Transitional	15,751

Natural Hazard Plan	
All-Hazards Mitigation Plan (borough-wide)	2009

Community Plans	Year
NWAB Comprehensive Plan (borough-wide)	1993

Local Contacts	Email	Phone	Fax
NANA Regional Corporation, Incorpor	communications@nana.com	907-485-2173	907-485-2137
Northwest Arctic Borough	info@nwabor.org	907-442-2500	907-442-2930
Native Village of Deering	tribeadmin@ipnatchiaq.org	907-363-2138	907-363-2195
City of Deering	cityofdeering@yahoo.com	907-363-2136	907-363-2156

Demographics	2000	2010	
Population	136	122	
Median Age	27	30	
Avg. Household Size	4	3	
Median Household Income	N/A	$47,000	

	2013
Percent of Residents Employed	72.00%
Denali Commission Distressed Community	No
Percent Alaska Native/American Indian (2010)	86.89%
Low and Moderate Income (LMI) Percent (201x)	62%

Electric Utility	Generation Sources	Interties	PCE?
Ipnatchiaq Electric Company	Diesel, wind	No	Yes

Landfill	Class	Permitted?	Location

Water/Wastewater System		Homes Served		System Volume
Water	Washeteria, water delivery			
Sewer	Vacuum, honey bucket haul	**Water/Wastewater Energy Audit?**	No	
Notes				

Access					
Road	No				
Air Access	Deering Airport, gravel, fair condition	**Runway 1**	3,320 ft. x 75 ft.	**Runway 2**	2,660 ft. x 75 ft.
		Runway 3	N/A	**Runway 4**	N/A
Dock/Port	Yes	**Barge Access?**	Yes	**Ferry Service?**	No

Energy Profile: Deering

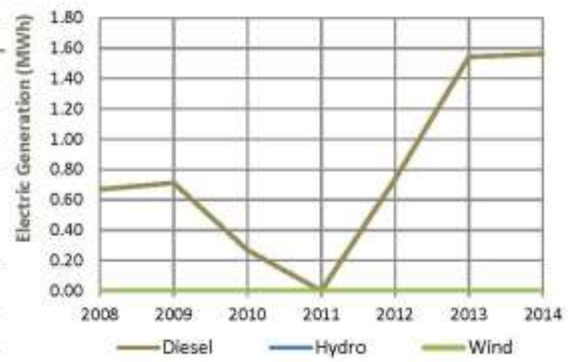
Power House

Utility	Ipnatchiaq Electric Company		
Generators	Make/Model	Rated Capacity	Condition/Hrs
Unit 1	John Deere	100	Poor
Unit 2	John Deere	137	Poor
Unit 3	Cummins	170	Poor
Unit 4	Cummins	170	Poor
Unit 5			
Line Loss			
Heat Recovery?		Yes	
Upgrades?			
Outage History/Known Issues			

Operators	No. of Operators	Training/Certifications
	2	1 certified, 1 in training

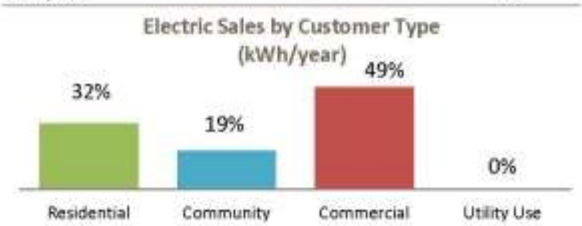
Power Production

Diesel (kWh/yr)	473,140	Avg. Load (kW)	
Wind (kWh/yr)		Peak Load (kW)	
Hydro (kWh/yr)	0	Efficiency (kWh/ga	8.29
Total (kWh/yr)	473,140	Diesel Used (gals/y	57,053



Maintenance Planning (RPSU)

Electric Sales	No. of Customers	kWh/year	kWh/Customer
Residential	47	213,599	4544.659574
Community	7	123,982	17711.71429
Commercial	15	330,588	22039.2
Utility Use			N/A



Electric Rates ($/kWh)	
Rate with PCE	0.26
Residential Rate	0.70
Commercial Rate	

Cost per kWh Sold ($/kWh)	
Fuel Cost	0.39
Non-fuel Cost	0.29
Total Cost	0.69

Fuel Prices ($)	Utility/Wholesale	Retail	Senior
Diesel (1 gal)	6.75		
Other Fuel? (1 gal)			
Gasoline (1 gal)	6.75		
Propane (100#)	285.00		
Wood (1 cord)			
Pellets			
Discounts?			

Alternative Energy	Potential	Projects/Notes	Status
Hydroelectric	Low		
Wind Diesel	High	Class 3 (Airport), Class 5-6 (1.5 mi. NW of Deering), 1 turbine	
Biomass	Low		
Solar	High	Solar PVs planned for Buckland	
Geothermal	Medium	Resources exist 50 mi. south at Lava Creek, resource exploration needed	
Oil and Gas	Low		
Coal	Medium	Low grade resources located in the Chicago Creek Region	
Emerging Tech	Unknown		
Heat Recovery	High	Ongoing project in Deering through ARUC.	
Energy Efficiency	High	Additional homes & schools provided w/ TED meters	

Bulk Fuel

Tank Owner	Fuel Type(s)	Capacity	Age/Condition
Ipnatchiaq	Diesel	92,000	
Native Village	Heating Oil	73,000	
Native Village	Gasoline	27,000	

Purchasing	Deliveries/Year	Gallons/Delivery	Vendor(s)
By Barge			
By Air			
Cooperative Purchasing Agreements			

Notes

Energy Profile: Deering

Housing Units	Occupied	Vacant	% Owner-Occup.
	30	38	43%

Regional Housing Authority	Weatherization Service Provider
NIHA	NIHA

Housing Need		Overcrowded	1-star
		13.3%	N/A

Energy Use	Average Home Energy Rating	Average Square Feet	Avg. EUI (kBTU/sf)
	3-star plus	955	146

Data Quality

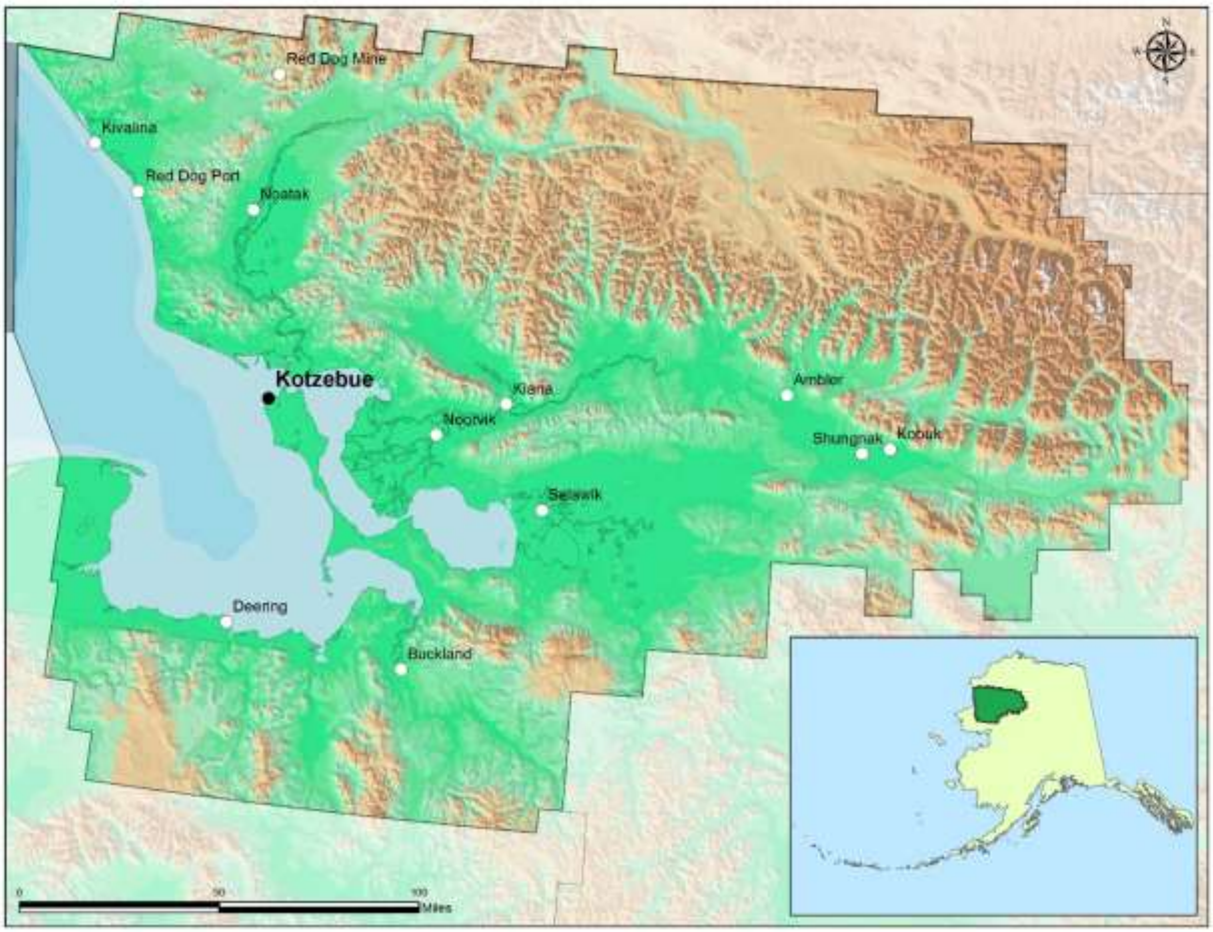
Lighting	Upgraded?	Owner	Notes

Non-residential Building Inventory

Building Name or Location	Year Built	Square Feet	Audited?	Retrofits Done?	In ARIS?
City Office		3,003	VEEP	Yes	No
City Shop		1,440	VEEP	Yes	No
Deering Native Store		2967	VEEP	Yes	No
Ipnatchiaq Electric Power Plant		840	VEEP	Yes	No
Vacuum Sewer Building		1000	VEEP	Yes	No
Washeteria		3105	VEEP	Yes	No
AIRPORT ELECTRICAL	2000	96			No
Boiler module		160			No
City Office Building	1980	1800			No
Craft/maintenance shop		320			No
Deering Friends Church					No
Deering Native Store	1900				No
Deering Post Office	2001				No
EQUIPMENT STORAGE	1992	1760			No
Generator bldg.		288			No
Pauline Alitchaq Barr Health Clinic	2004	5000			No
Photo lab		496			No
Pump house		98			No
School	1978	11431			No
Sprinkler van		160			No
Teacher housing duplex (teen center)		1632			No
Vacuum Sewer Building	1997	400			No
Washeteria and Water Treatment Plant	1997	1250			No

4.5 Kotzebue Subregion

Figure 9: Kotzebue Subregion



4.5. Kotzebue Subregion

The Kotzebue subregion includes only the community of Kotzebue. The 2010 U.S. Census reports a total population of 3,201. Kotzebue is located along three miles of a 1,100- to 3,600-foot-wide gravel spit on the Baldwin Peninsula, which extends into the Kotzebue Sound near the mouths of the Kobuk, Noatak and Selawik Rivers. Kotzebue is 26 miles north of the Arctic Circle and 549 air miles northwest of Anchorage. Kotzebue is a gateway to the region's other communities.

Kotzebue sunset

Table 36 provides contact information for the governmental entities serving the Kotzebue area.

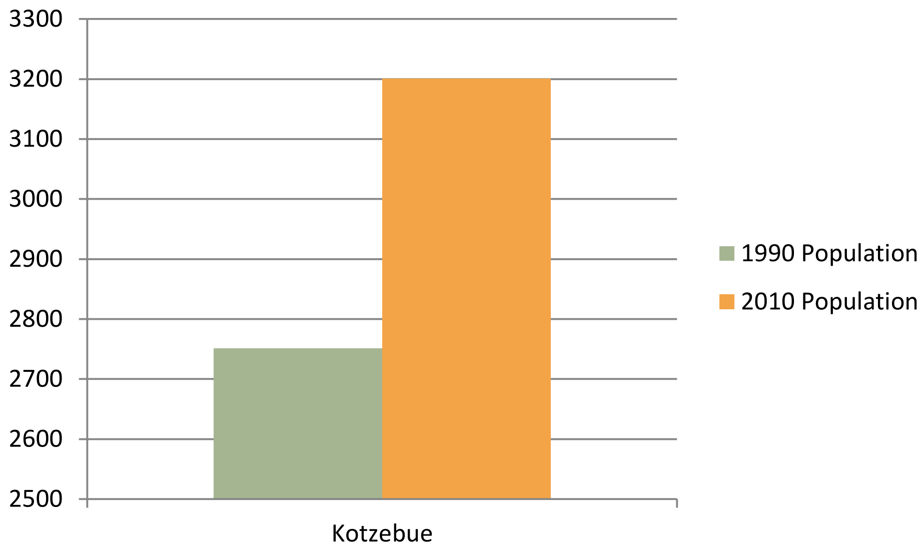
Table 36: Kotzebue Local and Regional Contacts

Community	Kotzebue
City Government	City of Kotzebue PO Box 46 Kotzebue, AK 99752 Phone: 907-442-3401 Fax 907-442-3742 lgreene@kotzebue.org
Tribal Government	Native Village of Kotzebue P.O. Box 296 Kotzebue, AK 997520296 Phone: 907-442-3467 Fax: 907-442-2162 info@kotzebueira.org
Village Corporation	Kikiktagruk Inupiat Corporation P.O. Box 1050 Kotzebue, AK 99752 Phone: 907-442-3165 Fax: 907-442-2165 Website: http://www.kikiktagruk.com/

4.5.1. Demographics

Kotzebue (population 3,201) experienced an average annual growth rate over the past 20 years of more than 0.7 percent. The unemployment rate is approximately 19.9 percent and about 16 percent of the residents were below the poverty rate. Exhibit 18 illustrates the change in population of the Kotzebue communities over the past 20 years.

Exhibit 18: Kotzebue Subregion 20-year Population Change



Source: US Census

4.5.2. Economy

Kotzebue is the service and transportation center for all villages in the northwest region. It has a healthy cash economy, a growing private sector, and a stable public sector. Because of its location at the confluence of three river drainages, Kotzebue is the transfer point between ocean and inland shipping. It is also the air transport center for the region. Activities related to oil and minerals exploration and development have contributed to the economy. The majority of income is directly or indirectly related to government employment, such as the school district, Maniilaq Association, the city, and the borough. The Teck Alaska Red Dog Mine is a significant regional employer. Commercial fishing for chum salmon provides some seasonal employment. Currently, 112 residents hold commercial fishing permits. Most residents rely on subsistence to supplement income.

4.5.3. Community Plans

The City of Kotzebue updated and adopted a comprehensive plan in January 2013; their hazard mitigation plan expires in June 2013. The community has a transportation plan that was prepared for the Bureau of Indian Affairs and the community was included in the state's Northwest Alaska Regional Transportation Plan. The Borough coordinates with each of the villages on a regular basis and expects to update community plans in 2014.

4.5.4. Infrastructure

There are 954 occupied homes in Kotzebue according to the 2010 Census numbers reported by the DCRA, with an average of about 4.4 persons in each family household.

Kotzebue has a circulating buried water system and a gravity buried sewer system. The Kotzebue Electric Association (KEA) operates the electric utility. The City of Kotzebue operates a Class 2 permitted landfill (DCED, 2014, based on 10/3/13 DEC update).

The community has a school operated by the Northwest Arctic Borough School District, a Post Office, Maniilaq Health Center, City and Tribal Offices, fire department, water treatment facilities, power plants and regional jail facilities.

The Ralph Wien Memorial Airport supports daily commercial jet service to Anchorage and Nome as well as supporting regularly scheduled flights to the region's villages.

Table 37 provides an overview of energy facts for Kotzebue.

Table 37: Kotzebue Quick Facts

Kotzebue Subregion Quick Facts Kotzebue	
Population (U.S. Census, 2010)	3,201
Utility	KEA
Total Electricity Production, kWh (AEA, 2010)	22,383,324
Diesel Fuel Consumed to Produce Electricity, per year (AEA, 2010)	1,486,221
Annual Heating Oil Consumption, gallons (AEA, 2010)	1,143,731
Average Subregional Residential Electric Rate, pre-PCE (NAB, 2013)	$0.42
Average Commercial Electricity Rate (AVEC, 2012)	*
Annual Transportation Fuel Use, gallons (AEA, 2010)	421,678
2013 Diesel Fuel Price (NAB, 2013)	$3.19

* Small commercial rate is roughly $0.37/kWh, large commercial rate is roughly $.35/kWh.

4.5.5. Energy Issues

Shallow coastal waters cause high shipping costs. Kotzebue is not connected to the rest of the state by roads and air freight costs are prohibitive for many items. Barges bring fuel and goods; however, the shallow coastline requires that ships anchor 12 to 15 miles southwest of Kotzebue and lighter fuel and material to the dock by using barges with a draft of no more than five feet. The freight is distributed within Kotzebue or to shallow-draft vessels for delivery to outlying villages. This adds significantly to the time, labor and cost required to transport freight to Kotzebue and the region.

At certain times of the year, Kotzebue has excess wind capacity. KEA has looked at various alternatives for energy storage, but none has yet proven capable in arctic temperatures.

4.5.6. Energy Improvement Opportunities/Alternatives

Table 38 shows the energy opportunities that exist in Kotzebue.

Table 38: Kotzebue Energy Improvement Opportunities

Energy Opportunity	Potential
Existing systems	High potential. Improvements to heat recovery systems, diesel engine efficiencies and supervisory control and data acquisition (SCADA)/dispatch controls should be evaluated.
Interties	Low potential. It does not appear that electrical interties from Kotzebue to Noorvik, Kiana, Selawik or Buckland would be economically feasible.
Wind	High potential. Kotzebue wind resources are rated as Class 5 (excellent). KEA has 19 turbines integrated into the community's power system. As technology advances, improvements to the system may be made through augmentation or replacement.
Energy efficiency program	High potential. KEA is participating in the NRECA/US-DOE smart grid program to install customer in-home displays (ecometers) and smart relays and switching on the power system.
Heat recovery	High potential. As the cost of heating fuel rises, heat recovery projects in the vicinity of the KEA power plant will become economically feasible.
Hydroelectric	Low potential. There are no practical hydroelectric sites in the vicinity.
Solar	Medium potential. Solar thermal arrays have been proven as a thermal heat source at several elder's homes in Kotzebue. Solar PV has also proven a medium potential throughout the NANA region.
Biomass	Medium potential. There are no significant biomass resources near Kotzebue; however, there is significant opportunity to utilize the clean paper/wood waste stream in Kotzebue. Current funding request to AEA for waste to heat project construction.
Hydrokinetic	Medium potential. Hydrokinetic site in the area of the Crowley dock should be evaluated which can be used to determine if tidal kinetic energy near Kotzebue should be studied.
Geothermal	Low potential. There are no known geothermal resources in the vicinity of Kotzebue. Exploration for possible sub-surface geothermal resources could occur in conjunction with drilling for possible hydrocarbon resources.
Gas	Medium potential. Gas resources may be available in the local area. NANA is leading the effort to quantify the resource.
Coal	Low potential. No known easily accessible coal resources are located near Kotzebue, however the Deering resource is a close option for import.

4.5.7. Priority Energy Actions

Representatives from the energy steering committee provided the prioritization of energy actions for the Kotzebue subregion shown in Table 39.

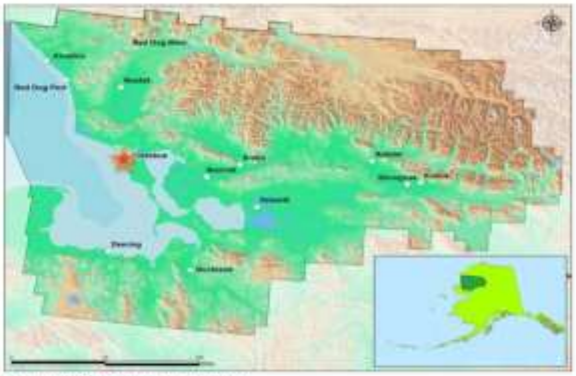
Table 39: Kotzebue Subregion Priority Energy Actions

Timeframe	Community	Project	Estimated Costs
Short Term Actions 1-5 years	Kotzebue	Smart grid	Unknown
		Solar PV at WTP – 2014	$75,000
		Waste to energy biofuel – 2014	Unknown
		Eocycle turbine testing 2014	$348,300
		Design Kotzebue-Cape Blossom Road and utility corridor	$2,500,000
		LED street lights	Unknown
Mid Term Actions 5-10 years		Hydrokinetic study (tidal device in trench)	$250,000
		Residential solar thermal and electrical	Unknown
		Kotzebue-Cape Blossom Road and utility corridor	Unknown
		Construct deep-water port at Cape Blossom	Unknown
Long Term Actions >10 years		Construct deep-water port at Cape Blossom	Unknown
		Construct hydrokinetic system	Unknown
		Intertie to Noorvik-Kiana-Selawik	Unknown
		Geothermal feasibility study at Cape Blossom	Unknown

Kotzebue

Community and Energy Profile

Community Profile: Kotzebue (Kotzebue Subregion)



Alaska Native Name (definition)

Kikiktagruk

Historical Setting / Cultural Resources

This site has been occupied by Inupiat Eskimos for at least 600 years. "Kikiktagruk" was the hub of ancient Arctic trading routes long before European contact, due to its coastal location near a number of rivers. The German Lt. Otto Von Kotzebue "discovered" Kotzebue Sound in 1818 for Russia. The community was named after the Kotzebue Sound in 1899 when a post office was established. Since the turn of the century, expansion of economic activities and services in the area have enabled Kotzebue to develop relatively rapidly. The city was formed in 1958. An air force base and White Alice Communications System were later constructed.

Incorporation 2nd Class City, 1958

Location

Kotzebue is on the Baldwin Peninsula in Kotzebue Sound, on a 3-mile long spit, which ranges in width from 1,100 to 3,600 feet. It is located near the discharges of the Kobuk, Noatak, and Selawick Rivers, 549 air miles northwest of Anchorage and 26 miles above the Arctic Circle.

Longitude	Latitude
ANCSA Region	NANA Regional Corporation
Borough/CA	Northwest Arctic Borough
School District	Northwest Arctic Borough School District
AEA Region	Northwest Arctic

Taxes Type (rate)	Per-Capita Revenue
N/A	$1,340

Economy

The residents of Kotzebue are primarily Inupiat Eskimos, and subsistence activities are an integral part of the lifestyle.

Climate	Avg. Temp.	Climate Zone	Heating Deg. Days
	-12/58	Transitional	16,531

Natural Hazard Plan	
All-Hazards Mitigation Plan (borough-wide)	2009

Community Plans	Year
NWAB Comprehensive Plan (borough-wide)	1993

Local Contacts	Email	Phone	Fax
NANA Regional Corporation, Incorpor	communications@nana.com	907-485-2173	907-485-2137
Northwest Arctic Borough	info@nwabor.org	907-442-2500	907-442-2930
Native Village of Kotzebue	executivedirecotry@qira.org	907-442-3467	907-442-2162
City of Kotzebue	lgreene@kotzebue.org	907-442-3401	907-442-3742

Demographics	2000	2010
Population	3,082	3,201
Median Age	26	28
Avg. Household Size	4	4
Median Household Income	N/A	$81,354

	2013
Percent of Residents Employed	68.00%
Denali Commission Distressed Community	No
Percent Alaska Native/American Indian (2010)	73.57%
Low and Moderate Income (LMI) Percent (201x)	49%

Electric Utility	Generation Sources	Interties	PCE?
Kotzebue Electric Association	Diesel, wind	No	Yes

Landfill	Class	Permitted?	Location

Water/Wastewater System		Homes Served	System Volume
Water	Piped		500,001 - 1,000,00
Sewer	Piped	**Water/Wastewater Energy Audit?**	
Notes			

Access					
Road	No				
Air Access	Ralph Wien Memorial Airport, gravel, good condition	**Runway 1**	5,900 ft. x 150 ft.	**Runway 2**	3,876 ft. x 90 ft.
		Runway 3	N/A	**Runway 4**	N/A
Dock/Port	Yes	**Barge Access?**	Yes	**Ferry Service?**	No

Energy Profile: Kotzebue

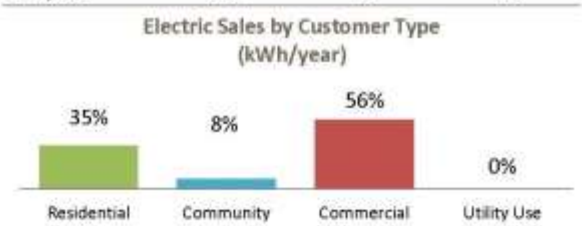
Power House

Utility	Kotzebue Electric Association		
Generators	Make/Model	Rated Capacity	Condition/Hrs
Unit 1			
Unit 2			
Unit 3			
Unit 4			
Unit 5			
Line Loss		5.80%	
Heat Recovery?			
Upgrades?			
Outage History/Known Issues			

Operators	No. of Operators	Training/Certifications

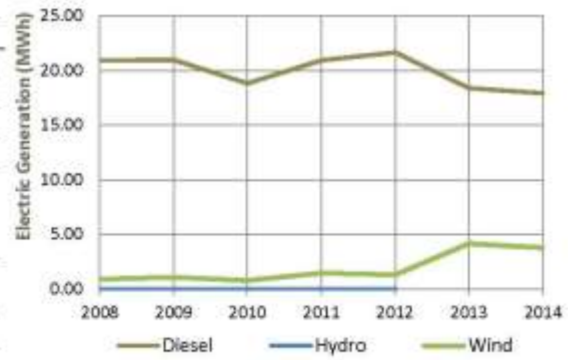
Maintenance Planning (RPSU)

Electric Sales	No. of Customers	kWh/year	kWh/Customer
Residential	1,046	7,060,641	6750.134799
Community	29	1,621,262	55905.58621
Commercial	171	11,267,237	65890.27485
Utility Use	N/A	N/A	N/A



Power Production

Diesel (kWh/yr)	17,900,120	Avg. Load (kW)	
Wind (kWh/yr)	3,768,108	Peak Load (kW)	
Hydro (kWh/yr)	0	Efficiency (kWh/ga	14.25
Total (kWh/yr)	21,668,228	Diesel Used (gals/y	1,255,854



Electric Rates ($/kWh)		Cost per kWh Sold ($/kWh)	
Rate with PCE	0.26	Fuel Cost	0.22
Residential Rate	0.44	Non-fuel Cost	0.07
Commercial Rat	N/A	Total Cost	0.29

Fuel Prices ($)	Utility/Wholesale	Retail	Senior
Diesel (1 gal)	6.16	3.19	
Other Fuel? (1 gal)			
Gasoline (1 gal)	6.80		
Propane (100#)	198.28		
Wood (1 cord)			
Pellets			
Discounts?			

Alternative Energy	Potential	Projects/Notes	Status
Hydroelectric	Low		
Wind Diesel	High	Class 5, KEA has 19 turbines, Ecycle testing 2013/2014	
Biomass	Medium	Current funding request to AEA for waste to heat project construction	
Solar	High	Thermal arrays at elder's homes and planned for power plant; Solar PV planne	
Geothermal	Low		
Oil and Gas	Medium	NANA leading effort to quantify local gas resources	
Coal	Low		
Emerging Tech	Unknown		
Heat Recovery	High	Rise of fuel heating costs make heat recovery feasible for KEA power plant	
Energy Efficiency	High	NRECA/US-DOE smart grid program to install ecometers and smart-relays	

Bulk Fuel

Tank Owner	Fuel Type(s)	Capacity	Age/Condition

Purchasing	Deliveries/Year	Gallons/Delivery	Vendor(s)
By Barge			
By Air			

Cooperative Purchasing Agreements

Notes

Energy Profile: Kotzebue

Housing Units	Occupied	Vacant	% Owner-Occup.
	911	170	46%

Regional Housing Authority	Weatherization Service Provider
NIHA	RurAL CAP, NIHA

Housing Need	Overcrowded	1-star
	30%	N/A

Energy Use	Average Home Energy Rating	Average Square Feet	Avg. EUI (kBTU/sf)
	3-star	1,258	147

Data Quality

Lighting	Upgraded?	Owner

Notes

Non-residential Building Inventory

Building Name or Location	Year Built	Square Feet	Audited?	Retrofits Done?	In ARIS?
Alaska Technical Center Dormitory	1986		AHFC	No	

IMPLEMENTATION PLAN

Implementation Plan

This chapter provides funding information and a strategy for completing the energy priorities.

5.1. Regional Priorities

Regional priority energy actions were identified from the AEA Community Deployment scenarios, stakeholder interviews, and input from the Energy Steering Committee and public meetings. The priorities were categorized into short term (1-5 years), medium term (5-10 years) and long term (over 10 years). Potential sources, opportunities, and constraints for energy project funding are presented in Appendix A.

Table 3: 2014 Regional Energy Priority Projects

Priority List	Projects	Specifics
Transportation	▪ Interties ▪ Air ▪ Barge	▪ Ambler-Shungnak, Noorvik, Kiana ▪ In-river operation Kobuk River
Bulk Fuel Buy-in	▪ Red Dog	▪ Tank Farm
Hydroelectric	▪ Cosmos Hills	▪ Kogoluktuk River
Natural Gas	▪ Kotzebue Basin	▪ Multiple test drillings
Wind	▪ Regional	▪ Kivalina, Kiana
Solar	▪ Utility scale solar array	▪ Noatak

The overarching energy vision for the Northwest Arctic Region is to achieve a 50 percent decrease in the use of imported diesel fuels by 2050. To achieve that end, potential projects were identified and prioritized. Each of the projects addresses issues or takes advantage of opportunities to improve the energy system and reduce energy costs. The projects have gone through initial screening recognizing that grant funding is becoming scarcer and there is a need to be creative and realistic about what can be accomplished in the 20 year planning horizon. It is important that analysis of existing wind, heat recovery, solar and other energy saving measures be done to provide lessons learned for future projects.

Table 40 lists short term projects planned for implementation in the next 1 to 5 years. The table includes a brief description or title of the project, if the project is ongoing or one recently identified by the energy steering committee or others, what the next step is in developing the project and the status of the funding.

Project analysis of a utility scale solar array is being done for Noatak, which will include the cost assessment, financing options, risks and issues, local support and steps to implementation. This cost analysis will be discussed and structured at the regional stakeholder advisory group (SAG) meeting in October 2015.

Table 40: Short Term Priority Energy Actions for the Northwest Arctic Region

PROJECTS	PROJECTS STATUS	NEXT STEPS	PARTNERS	FUNDING STATUS
Energy Efficiency				
Noorvik, Kiana, Selawik, Noatak, Kivalina - TED meters (2014)	Ongoing	Install meters	NANA, NAB	NAB/CIAP grant funded
Ambler, Deering, Selawik (2013), Noorvik (2014) - Heat recovery system upgrade and energy efficiency improvements	Ongoing	Construction	AVEC, ANTHC	Ambler, Deering, Selawik - AEA funded, Noorvik likely funded
Ambler - Shungnak intertie	Ongoing	Apply for AEA REF round 7 funding	AVEC, City, Tribes, NANA, NAB	Met tower funded
Kotzebue - Smart grid	Ongoing	Install grid	KEA, NAB	NRECA/DOE funded
Noorvik heat recovery	Ongoing	Complete project	ANTHC	Funded
Kivalina heat recovery at water treatment plant	Identified	Pursue funding		None
Retrofit current structures to improve energy efficiency.	Identified	Identify project champion, seek funding	NIHA, ANTHC, NANA, RurAL Cap	None
Fill data gaps: metering, fuel consumption, space heating, etc., at the building, local and regional levels	Identified	Identify project champion, seek funding	AEA, DOE	None

PROJECTS	PROJECTS STATUS	NEXT STEPS	PARTNERS	FUNDING STATUS
Add insulation to above ground water and wastewater system	Identified	Identify project champion, seek funding	ANTHC, DOE, AEA	None
Seek funding, design and construct additional cold climate houses	Identified	Identify project champion, coordinate with NW Inupiat Housing Authority and Cold Climate Research Center	NIHA, NAB, CCHRC	None
Replace approximately 750 street lights in region	Ongoing	Apply for VEEP funding	AVEC, NAB	Applied in 2013 for VEEP funds
Buckland – electrical assessment study	Identified	Seek funding	NAB, NANA, local officials	None
Solar				
NWABSD solar thermal - install commercial grade solar thermal units for school district buildings	Identified	Identify project champion	NWABSD	None
Solar PV at WTP - Kobuk, Noatak, Noorvik, Shungnak, Deering, Ambler (2013 - installed) Solar PV at WTP - Buckland, Kiana, Kivalina, Kotzebue, Selawik (2014)	Ongoing	Construction	NAB, ANTHC, Local government, KEA, City of Kotzebue	CIAP funded
Residential solar thermal and electrical	Identified	Identify champion, seek funding	NAB, local officials, NANA	None
Noatak, Kiana, Noorvik - complete solar farm feasibility study	Identified	Seek funding	NAB, NANA, local officials	None
Solar/Wind kits for fish camps	Identified	Identify champion, seek funding	NAB, local officials, NANA	None
Biomass				
Kivalina, Kiana, Noorvik biomass feasibility study	Identified	Seek funding	NAB, NANA, local officials	None
Upper Kobuk biomass project	Ongoing	Complete conceptual design	Local governments, ANTHC, NAB, NANA	AEA funded

PROJECTS	PROJECTS STATUS	NEXT STEPS	PARTNERS	FUNDING STATUS
Kobuk - Install and test biomass boiler at WTP (2014)	Ongoing	Construction	Local governments, ANTHC, NAB, NANA	ANTHC funded
Wind				
Shungnak/Kobuk – Wind diesel feasibility study and conceptual design ($150,000)	Ongoing	AEA Renewable Energy Fund Round 7 funded	AVEC, NAB, NANA, local governments	None (met tower installed)
Kiana - Wind study ($150,000)	Ongoing	Apply for round seven funding	AVEC, City of Kiana	None
Buckland/Deering/Noorvik wind diesel final design ($20,000)	Ongoing	Complete final design, construction and environmental documents	AVEC, NAB, NANA, local governments	AEA funded
Noorvik power plant upgrade to incorporate wind ($800,000)	Ongoing	USDA Rural Development request in process	AVEC	USDA RD request $800,000
Noorvik wind diesel design and construction	Ongoing			AEA $3.4 M
Cosmos Hills wind resource and intertie assessment	Ongoing	Complete study, apply for funding for construction	AVEC, NANA, NAB	AEA funded
Kotzebue - EWT turbine integration (wind) (2013-2014)	Ongoing	Completed project	KEA, KIC, NANA	Funded
Red Dog port site - Kivalina transmission feasibility study (May 2014)	Ongoing	Pursue funding for next steps	AVEC/Teck/NANA/NAB	AVEC funded
Kivalina Wind Feasibility at NEW school site	Identified	Seek funding	AVEC, NAB, NANA, local officials	None
Selawik - Repower wind diesel (2014)	Ongoing	Complete project	AVEC, NAB, NANA, local governments	Funded
Hydroelectric				
Upper Kobuk Cosmos Hills hydroelectric feasibility study (completed 2013), design and construction	Ongoing	Design and construction	AVEC, NANA, NAB	AEA funded feasibility study
Emerging Technology				
Kotzebue – Waste to energy biofuel (2014)	Ongoing	Identify project champion, seek funding	KEA, City of Kotzebue	None

PROJECTS	PROJECTS STATUS	NEXT STEPS	PARTNERS	FUNDING STATUS
Kotzebue - Eocycle turbine testing	Ongoing	Complete project	KEA, NAB	Funded
Noatak Red Dog port fuel haul project ($425,000)	Ongoing	Business development for village of Noatak	State of Alaska, NAB, NANA, Cruz Construction, Native Village of Noatak, Teck	State of Alaska funded
HVDC demonstration project	Ongoing	Identify project champion, seek funding	AVEC	None
Fuel Storage				
Implement a bulk fuel buying program to utilize economy of scale/may include regional tank farm	Ongoing	Identify project champion, coordinate with Teck	AIDEA, Teck, NOSI, NANA	None
Conduct feasibility study of local tank farms, including inspection, deficiencies, capacity and implement recommendations	Identified	Identify project champion, seek funding for study	NAB, NANA , EPA, ICDBG	None
Maintenance				
Buckland, Deering, Noatak Energy Audits/Repairs	Ongoing	Complete energy upgrades	ANTHC, Noatak IRA	DOE Funded
Buckland, Deering, Noatak - ARUC membership	Identified	Identify champion	ANTHC, local governments, local operator, NAB	None
Conduct utility operator training	Ongoing	Identify project champions, operators and communities that could benefit from training	ARUC, ANTHC, AVEC, NAB, DOL, NANA, Cities, KEA, BIA, Chukchi College Tech Center, Delta Career Advancement Center, local operators	None
Upgrade water/wastewater systems	Ongoing	Seek additional funding to monitor energy use, system operating pressures, flows, temperature, pump power loads, and feedback control loops.	ARUC, ANTHC, NAB, NANA, local operator	None
Employ full-time WTP operators in winter	Identified	Identify project champion	ARUC, ANTHC, NAB, NANA	None
Conduct water/wastewater operator training	Ongoing	Identify project champion	ARUC, ANTHC, NAB, NANA, local operator	None

PROJECTS	PROJECTS STATUS	NEXT STEPS	PARTNERS	FUNDING STATUS
Noatak - power plant relocation	Ongoing	Obtain land from NANA, apply for funding	AVEC, Noatak IRA, NANA NAB	None
Educate all residential users on the operation of their heating system and how to perform basic system maintenance	Identified	Identify champion, seek funding	RurAL CAP, NANA, AEA, utility providers, DOE	None
Develop and distribute a resource list of contacts for users in case of system problems	Identified	Identify champion, seek funding	RurAL CAP, NANA, AEA, utility providers, DOE	None
Develop and distribute a user's manual for home maintenance of household energy/heating system	Identified	Identify champion, seek funding	RurAL CAP, NANA, AEA, utility providers, DOE	None
Funding				
Make AHFC revolving loan program more accessible by lobbying for variances on Level 3 audit requirements	Ongoing	Identify project champion	AHFC, NIHA, NANA, NWALT, RurAL CAP	None
Continue to lobby for congressional changes to the HUD funding eligibility requirements	Ongoing	Identify project champion	All regional partners	None
Seek match funding and coordinate projects to reduce costs where feasible	Ongoing	Identify project champion	All regional partners	None
Consider forming a regional energy authority or independent power producer (IPP) to access bond funding	Identified	Identify project champion	All regional partners	None
Communication				
Continue the Energy Steering Committee efforts	Ongoing	Seek funding to continue meeting	All regional partners	None
Present the draft regional energy plan in local public meetings	Ongoing	Seek funding to continue meeting	All regional partners	Some money available through AEA
Review and update energy plan on a regular basis and present to communities	Ongoing	Seek funding to continue planning	All regional partners	None

PROJECTS	PROJECTS STATUS	NEXT STEPS	PARTNERS	FUNDING STATUS
Integrate energy planning with village comprehensive plans	Ongoing	Coordinate with NAB Economic Development office	NAB, NANA, local Governments	NAB is funding Comp. Plans. Due for completion 2014
Seek input from residents regarding their energy and heating needs and best solutions for their homes	Identified	Seek funding to continue meeting	All Regional Partners	None
Education				
Implement K-12 Alaska Smart Energy curriculum	Ongoing	Lobby school district personnel to provide energy education in the schools	NAB, NANA, Energy Steering Committee, NWABSD, NWALT, UAF, ACEP, AEA, DOE	None
Train educators in energy efficiency practices and promote energy efficiency through energy fairs in the schools	Identified	Identify project champion	NAB, NANA, Energy Steering Committee, NWABSD, NWALT, UAF, ACEP, AEA, DOE, RurAL CAP	None
Seek funding for and implement local energy education and continuation of the Energy Wise program	Identified	NAB/NANA to seek funding	RurAL CAP, NANA, AEA, DOE, Denali Commission	None
Transportation				
Connect Kotzebue to Cape Blossom via road with adequate right of way to accommodate all utilities	Identified	Complete design, City, tribe, KIC meetings with DOT&PF	DOT&PF, City of Kotzebue, Kotzebue IRA, FHWA, NAB, KEA, NANA, NWALT	Design funded
Identify roads or ice roads to connect villages to energy/fuel distribution points	Identified	Identify project champion, coordinate with NANA	NAB, NANA, DOT&PF, Maniilaq, village councils, cities	None
Potential Game Changers				

PROJECTS	PROJECTS STATUS	NEXT STEPS	PARTNERS	FUNDING STATUS
Remain informed and participate in meetings that have long term energy implications such as road or pipeline access into the region	Ongoing	Identify project champion	All regional partners	N/A
Identify and analyze future resource development projects that will require power	Ongoing	Identify project champion, coordinate with NANA	All regional partners	N/A
Reassess natural gas resources in the region	Ongoing	Identify project champion, coordinate with NANA	NANA, NOSI	N/A

Table 41 provides a list of medium term (5 to 10 years) and long term (10-20 years) energy actions. Medium and long term energy actions are generally not yet funded and lack specific details which will be determined in the intervening years.

Table 41: Medium and Long Term Priority Energy Actions for the Northwest Arctic Region

PROJECTS	*Timeframe*
Energy Efficiency	
Design and construct Ambler-Shungnak intertie	*Medium*
Design and construct Kivalina -Red Dog Port intertie	*Medium-Long*
Design and construct Kiana - Noorvik- Selawik intertie	*Medium-Long*
Add insulation to above ground water and wastewater system	*Medium-Long*
Seek funding, design and construct additional cold climate houses	*Medium-Long*
Solar	
Complete installation of residential solar thermal - design/install solar thermal units in villages (est. $1,000,000)	*Medium*
Complete installation of NWABSD solar thermal - commercial grade solar thermal units for school district buildings	*Medium*
Complete Installation of residential solar electric - design/install solar PV in villages	*Medium*
Design and construct Solar Farm	*Medium*
Biomass	
Implement biomass recommendations on a Regional level	*Medium*
Wind	
Construct Kiana and Kivalina wind diesel	*Medium-Long*
Complete Ambler/Shungnak wind diesel feasibility study	*Medium-Long*
Cosmos Hills - wind resource and intertie	*Medium-Long*
Hydroelectric	
Construct Cosmos Hills hydroelectric project	*Medium-Long*
Construct Ambler/Kobuk/Shungnak intertie	*Medium*
Construct Kivalina/Red Dog Port intertie	*Medium-Long*
Emerging Technology	
Kotzebue - Hydrokinetic study (tidal device in trench - est. $150,000)	*Medium*
HVDC design feasibility study	*Medium-Long*
Kotzebue – Geothermal Study at Cape Blossom Port	*Long*

PROJECTS	*Timeframe*
Fuel Storage	
Implement a bulk fuel buying program to utilize economy of scale	*Medium*
Construct a regional tank farm to accommodate bulk fuel program	*Medium*
Replace and/or repair bulk fuel tanks as needed – horizontal tanks	*Medium-Long*
Maintenance	
Continue to conduct utility operator training	*Medium-Long*
Continue to train regional repair technicians	*Medium-Long*
Employ full-time WTP operators in winter	*Medium-Long*
Complete water/wastewater system energy upgrades	*Medium*
Funding	
Seek match funding and coordinate projects to reduce costs where feasible	*Medium-Long*
Communication	
Continue the Energy Steering Committee efforts	*Medium-Long*
Review and update energy plan on a regular basis and present to communities	*Medium-Long*
Continue to integrate energy planning with village comprehensive plans	*Medium-Long*
Seek input from residents regarding their energy and heating needs and best solutions	*Medium-Long*
Education	
Monitor and recommend energy education programs to improve K-12 Alaska Smart Energy curriculum	*Medium-Long*
Continue to provide local energy education and continuation of Energy Wise program	*Medium-Long*
Educate all residential users on the operation of their heating system and how to perform basic system maintenance	*Medium-Long*
Train educators in energy efficiency practices and promote energy efficiency through energy fairs in the schools	*Medium-Long*
Transportation	
Construct Kotzebue to Cape Blossom road and associated utilities as needed	*Medium*
Construct deep-water port at Cape Blossom	*Medium-Long*
Design and Construct Noorvik-Kiana road and intertie	*Medium-Long*
Design and Construct road/intertie Red Dog to Noatak-Kivalina, Noorvik-Kiana-Selawik	*Long*
Design and construct roads or ice roads to connect village to energy/fuel distribution points	*Medium-Long*
Potential Game Changers	

PROJECTS	***Timeframe***
Remain informed and participate in meetings that have long term energy implications such as road or pipeline access into the region	*Medium-Long*
Continue to pursue natural gas as an energy source as it becomes available	*Medium-Long*
Identify and analyze future resource development projects that will require power	*Medium-Long*
Reassess natural gas as an energy source as it becomes available	*Medium-Long*

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Appendix A: Funding Opportunities for Energy Projects

Funding Opportunities for Energy Projects

The majority of energy funding resources accessed for Alaska projects come from either the State of Alaska or from U.S. Department of Energy. AHFC funds energy efficiency projects for residences, businesses, and buildings owned by municipalities and educational entities, such as the University of Alaska Anchorage. AEA provides energy audit services to commercial and governmental agencies, renewable energy funds, rural power systems upgrades, bulk fuel construction funds and alternative energy and energy efficiency development programs. AEA also provides economic assistance to rural customers where kilowatt hour charges for electricity are three to five times higher than more urban areas of the state.

Private foundations and corporations also provide funds for smaller projects, some of which can be energy improvements, but most of which are capital funds for construction or reconstruction projects.

In the table that follows, funding sources are listed by type of project and then funding agency. The description of the type of project eligible is included as well as if the funding eligibility is dependent on economic status of the applicant.

Program	Funding Agency	Description of Funding Opportunity	Restrictions for Eligibility	Comments
Direct Aid				
Power Cost Equalization	Alaska Energy Authority http://www.akenergyauthority.org/	To provide economic assistance to customers in rural areas of Alaska where the kilowatt-hour charge for electricity can be three to five times higher than the charge in more urban areas of the state. PCE only pays a portion of approximately 30% of all kWh's sold by the participating utilities.		AEA determines eligibility of community facilities and residential customers and authorizes payment to the electric utility. Commercial customers are not eligible to receive PCE credit. Participating utilities are required to reduce each eligible customer's bill by the amount that the State pays for PCE.
Low Income Home Energy Assistance Program -- LIHEAP	Department of Health and Social Services http://liheap.org/?page_id=361	Fuel assistance for low-income families.	Income-based	
Energy Efficiency Improvements				
Alaska Energy Efficiency Revolving Loan Fund Program	Alaska Housing Finance Corporation http://www.ahfc.us	Provides financing for permanent energy-efficient improvements to buildings owned by regional educational attendance areas, the University of Alaska, the State or municipalities in the state. Borrowers obtain an investment grade audit as the basis for making cost-effective energy improvements, selecting from the list of energy efficiency measures identified. All of the improvements must be completed within 365 days of loan closing.	Public facilities	

Program	Funding Agency	Description of Funding Opportunity	Restrictions for Eligibility	Comments
Commercial Energy Audit Program	Alaska Energy Authority http://www.akenergyauthority.org/	Funding for energy efficiency audits for privately owned commercial buildings across Alaska. The program provides reimbursements of qualified commercial energy audits for privately owned commercial buildings up to 160,000 square feet. The maximum reimbursement is set by the building size and complexity and ranges from $1,800 for buildings under 2,500 square feet up to $7,000 for buildings from 60,000 and above.	Owners of commercial buildings	This funding was available in 2013/2014. Check website for notice of future funding availability. Application period is typically November to December.
Energy Efficiency Interest Rate Reduction Program	Alaska Housing Finance Corporation http://www.ahfc.us	AHFC offers interest rate reductions when financing new or existing energy-efficient homes or when borrowers purchase and make energy improvements to an existing home. Any property that can be energy rated and is otherwise eligible for AHFC financing may qualify for this program. Interest rate reductions apply to the first $200,000 of the loan amount. A loan amount exceeding $200,000 receives a blended interest rate rounded up to the next 0.125 percent. The percentage rate reduction depends on whether or not the property has access to natural gas.	Energy Rating Required	
Alaska Home Energy Rebate Program	Alaska Housing Finance Corporation http://www.ahfc.us	Homeowners may receive up to $10,000 for making energy-efficient improvements. Based on before and after energy audits. Rebate is based on final energy rating audit outcome.		Upfront cost for energy audit.
Second Mortgage Program for Energy Conservation	Alaska Housing Finance Corporation http://www.ahfc.us	Borrowers may obtain a second mortgage to finance home improvements or purchase a home in conjunction with an assumption of an existing AHFC loan and make repairs if need be.		The maximum loan amount is $30,000. The maximum loan term is 15 years. The interest rate is the Taxable Program or Rural Owner-Occupied, 15-year interest rate plus 0.375.

Program	Funding Agency	Description of Funding Opportunity	Restrictions for Eligibility	Comments
Village Energy Efficiency Program	Alaska Energy Authority http://www.akenergyauthority.org/	Upgrades are performed in rural Alaskan community buildings. There are currently three phases of funding with Phase II communities recently completed. Community selection was based on the status of the respective village's Rural Power System Upgrade (RPSU). The community either recently received or is slated to receive a new power system.		
Weatherization Program	Alaska Housing Finance Corporation http://www.ahfc.us	Weatherization programs have been created to award grants to nonprofit organizations for the purpose of improving the energy efficiency of low-income homes statewide. These programs also provide for training and technical assistance in the area of housing energy efficiency. Funds for these programs come from the US Dept. of Energy and AHFC.	-	
RurAL CAP Weatherization	RurAL CAP http://www.ruralcap.com	Rural Alaska Community Action Program, Inc. (RurAL CAP) manages a state program administered by Alaska Housing Finance Corporation that offers free weatherization services for low and middle-income residents in western and northern Alaska, the Municipality of Anchorage, and the City and Borough of Juneau. An Anchorage family of four with income up to $87,800 qualifies.	An income-based program	
RurAL CAP Energy Wise	RurAL CAP http://www.ruralcap.com	The Energy Wise Program engages rural Alaskan communities in behavior change practices resulting in energy efficiency and energy conservation. This tested model uses community-based social marketing to save energy – 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. Through Energy Wise, rural Alaskans reduce their energy consumption, lower	No income restrictions	Communities receive the following: ten locally hired and trained crew members; on site "launch week" by a RurAL CAP staff for hiring and training of local crews; one community energy fair to engage community residents and organizations. Households receive: Full day home visit from a trained,

Program	Funding Agency	Description of Funding Opportunity	Restrictions for Eligibility	Comments
		their home heating and electric bills, and save money.		locally hired crew; household energy consumption and cost assessment conducted with the resident; education on energy cost-saving strategies; an estimated $300 worth of basic, home energy efficiency supplies installed.
Infrastructure Development				
Alternative Energy & Energy Efficiency Development Program	Alaska Energy Authority http://www.akenergyauthority.org/	AEA's Alternative Energy and Energy Efficiency programs promote: 1.) Use of renewable energy resources and local sources of coal and natural gas alternatives to diesel-based power, heat, and fuel production; 2.) Measures to improve efficiency of energy production and end use.		
Bulk Fuel Construction Program	Alaska Energy Authority/Denali Commission http://www.akenergyauthority.org/	With substantial contributions from the Denali Commission, the bulk fuel upgrades program provides funding for the design/engineering, business planning and construction management services to build code-compliant bulk fuel tank farms in rural communities. The bulk fuel upgrade retrofit and revision program, with financial support from the Denali Commission, provides funding for repairs to enable affected communities to continue to receive fuel.		

Program	Funding Agency	Description of Funding Opportunity	Restrictions for Eligibility	Comments
Emerging Energy Technology Fund	Alaska Energy Authority http://www.akenergyauthority.org/	The Authority may make grants to eligible applicants for demonstration projects of technologies that have a reasonable expectation to be commercially viable within five years and that are designed to: test emerging energy technologies or methods of conserving energy; improve an existing energy technology; or deploy an existing technology that has not previously been demonstrated in Alaska.		Eligible applicants: An electric utility holding a certificate of public convenience and necessity under AS 42.05; an independent power producer; a local government, quasi-governmental entity, or other governmental entity, including tribal council or housing authority; a business holding an Alaska business license; or a nonprofit organization.
Renewable Energy Fund	Alaska Energy Authority http://www.akenergyauthority.org/	Solar water heat, photovoltaics, landfill gas, wind, biomass, hydroelectric, geothermal electric, fuel cells, geothermal heat pumps, CHP/cogeneration, hydrothermal, waste heat, transmission or distribution infrastructure, anaerobic digestion, tidal energy, wave energy, fuel cells using renewable fuels, geothermal direct-use		
Rural Power Systems Upgrades	Alaska Energy Authority/Denali Commission http://www.akenergyauthority.org/	Upgrades may include efficiency improvements, powerhouse upgrades or replacements, line assessments, lines to new customers, demand-side improvements and repairs to generation and distribution systems.		
Tier 1 Grant Program	Rasmuson Foundation http://www.rasmuson.org	Grants for capital projects, technology updates, capacity building, program expansion and creative works, including building construction/renovation/restoration, technology upgrades in community facilities, and capacity building grant support.		

Federal Funding Opportunities				
Program	**Funding Agency**	**Description of Funding Opportunity**	**Restrictions for Eligibility**	**Comments**
EERE Tribal Energy Program	U.S. Department of Energy DOE http://energy.gov/eere/office-energy-efficiency-renewable-energy	Various grants for energy efficiency and renewable energy projects, including: Biomass, energy efficiency, geothermal, hydropower, solar photovoltaics, solar water heat, wind, and other renewable energy projects.		
Rural Utilities Service Assistance to High Energy Cost Rural Communities Program	U.S. Department of Agriculture USDA http://www.rurdev.usda.gov/UEP_Our_Grant_Programs.html	Funds may be used to acquire, construct, extend, upgrade, or otherwise improve energy generation, transmission, or distribution facilities and to establish fuel transport systems that are less expensive than road and rail.		
Renewable Energy System and Energy Efficiency Improvement Guaranteed Loan and Grant Program	USDA Rural Development – Rural Energy for America Program (REAP) http://www.rurdev.usda.gov/BCP_ReapResEei.html	The Rural Energy for America Program (REAP) provides financial assistance to agricultural producers and rural small businesses in rural America to purchase, install, and construct renewable energy systems; make energy efficiency improvements to non-residential buildings and facilities; use renewable technologies that reduce energy consumption; and participate in energy audits, renewable energy development assistance, and feasibility studies.		