Anaqtuuvak / Anaktuvuk Pass • *Atqasuk / Atqasuk* • *Utqiabvik / Barrow* • *Qaaktubvik / Kaktovik*
Nuiqsat / Nuiqsut • *Tikigaq / Point Hope* • *Kali / Point Lay* • *Ulbuniq / Wainwright*

NORTH SLOPE

REGIONAL ENERGY PLAN

FINAL DRAFT

Prepared for

NORTH SLOPE BOROUGH

May 2015

WHPacific

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Prepared by

WHPacific, Inc.

Table of Contents

Acknowledgments v

Acronyms and Abbreviations vii

Executive Summary 1

1 Introduction 1-1

1.1 Vision 1-2

1.2 Methodology 1-3

1.3 Organization 1-4

1.4 Issues and Goals 1-4

2 Regional Background 2-1

2.1 Physical Conditions 2-2

2.1.1 Location 2-2

2.1.2 Geology 2-3

2.1.3 Hydrology 2-4

2.1.4 Climate 2-5

2.2 Demographics 2-7

2.2.1 Current Population 2-7

2.2.2 Trends 2-8

2.3 Economy 2-9

2.4 Housing 2-11

2.4.1 Regional Housing Assessment 2-11

2.4.2 Housing Organizations 2-12

2.5 Planning 2-13

2.6 Regional Contacts 2-14

2.7 Energy Background 2-14

2.7.1 Utilities 2-14

2.7.2 Electricity 2-16

2.7.3 Propane 2-19

2.7.4 Fuel 2-20

2.7.5 Oil and Gas 2-22

2.7.6 Natural Gas 2-24

2.7.7 Transportation 2-24

3 Regional Energy Analysis 3-1

3.1 Energy Resources 3-3
3.1.1 Oil and Gas 3-3
3.1.2 Coal 3-4
3.1.3 Geothermal 3-5
3.1.4 Hydroelectric 3-6
3.1.5 Biomass 3-6
3.1.6 Wind 3-6
3.1.7 Solar 3-6
3.2 Energy Efficiency Opportunities 3-7
3.2.1 Baseline Energy Data 3-7
3.2.2 Weatherization 3-9
3.2.3 Water and Sewer 3-10
3.2.4 Heat Recovery 3-11
3.2.5 Interties 3-12
3.2.6 Other Energy Efficiency Technology 3-13
3.3 Regional Energy Priorities 3-14
4 Community Summaries 4-1
4.1 Anaktuvuk Pass 4-4
4.2 Barrow 4-16
4.3 Kaktovik 4-22
4.4 Nuiqsut 4-28
4.5 Point Hope 4-34
4.6 Point Lay 4-40
4.7 Wainwright 4-46
5 Community Outreach 5-52
5.1 Community Comments 5-2
6 Implementation Plan 6-4
6.1 Regional Priorities 6-2
7 Glossary 7-1
8 Works Cited 8-1

Tables of Exhibits, Figures and Tables

Exhibit 1: Energy Timeline 1-3

Exhibit 2. NSB 2010 Population by Community 2-8
Exhibit 3: North Slope Borough Population Growth 1970-2010 2-9
Exhibit 4: Projected Population Growth 2010-2030 2-9
Exhibit 5. Comparison of Percent of Occupied Housing Completing Energy Programs 2-11
Exhibit 6. Comparison of Overcrowded Housing 2-12
Exhibit 7: NSB Average Annual Residential kWh Electricity Used 2-17
Exhibit 8: Average Power Cost Equalization Rates 2-19
Exhibit 9: North Slope Oil and Gas Production 2-22
Exhibit 10. Alpine Field Oil and Gas Production History 2-23
Exhibit 11: Anaktuvuk Pass Average Hourly Solar Radiation (CCHRC) 3-7
Exhibit 12: Heat Recovery System Illustration 3-12

Figure 1. North Slope Region Planning Area 2-2
Figure 2: Regional Land Status 2-3
Figure 3. Hydrology Features on the North Slope 2-4
Figure 4: Comparative Cost of Energy and Groceries 2-16
Figure 5: Regional Surface Transportation 2-26
Figure 6: Potential Energy Resources 3-2
Figure 7. Alaska LNG Project Overview 3-3
Figure 8. North Slope Oil and Gas Activity 3-4
Figure 9. Regional Coal Resources 3-5
Figure 10. North Slope Community Location Map 4-2

Table 1. Energy Issues and Goals 1-5
Table 2-1: Climate Data for the North Slope 2-5
Table 2-2: Average Heating Degree Days, November 2013 through October 2014 2-6
Table 2-3: Average Household Income in North Slope Communities 2-10
Table 2-4: Regional Entities Serving the North Slope Borough 2-14
Table 2-5. North Slope Power and Light Electrical Rates 2-18
Table 2-6: NSB Power Generation Costs 2-18
Table 2-7: North Slope Propane Costs by Community 2-20
Table 2-8: Fuel Rates in the North Slope Region 2-21
Table 2-9: Residential and School Heating Fuel Usage 2-21

Table 2-10: North Slope Borough Inter-village Trails 2-25
Table 12. Number of Public Buildings with Energy Survey or Audits 3-9
Table 3-2: 2010 Energy Efficiency and Conservation Block Grants on the North Slope 3-10
Table 3-3: NSB Energy Costs for Water Sewer 3-11
Table 3-4: Regional Energy Project Information 3-15
Table 16: Community and Leadership Meetings and Participants 5-2
Table 17: Example of Cost Evaluation for Energy Efficiency Projects 6-9

Appendix A: Funding Sources

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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
ASRC	Arctic Slope Regional Corporation
AVEC	Alaska Village Electric Cooperative
BIA	Bureau of Indian Affairs
BLM	Bureau of Land Management
BEES	Building Energy Efficiency Standards
CDR	Concept Design Report
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
EEM	Energy Efficiency Measures
EIS	Environmental Impact Statement
EPA	U.S. Environmental Protection Agency
ETF	Energy Technology Fund
EUI	Energy Use Index
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
IGA	Investment Grade Audit
IPP	Independent Power Producer
ISER	Institute for Social and Economic Research
kW	Kilowatt
kWh	Kilowatt hour
Mcf	One thousand cubic feet
MWh	Megawatt hours

NAHASDA	Native American Housing and Self Determination Act
NIST	National Institute for Standards and Technology
NOAA	National Oceanic and Atmospheric Administration
NRECA	National Rural Electric Cooperative Association
NREL	National Renewable Energy Laboratory
NSB	North Slope Borough
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
RUBA	Rural Utility Business Advisor
TAPS	Trans-Alaska Pipeline System
TED	The Energy Detective
UAF	University of Alaska Fairbanks
UCG	Underground Coal Gasification
USACE	United States Army Corps of Engineers
WtE	Waste to Energy
WTP	Water Treatment Plant

Executive Summary

EXECUTIVE SUMMARY

This section provides a condensed version of the North Slope Energy Plan

EXECUTIVE SUMMARY

In late 2014 the North Slope Borough took a pro-active step to review the energy-related situation in its communities and hired WHPacific, Inc. to help develop the *North Slope Regional Energy Plan*. Due to logistic and Arctic climate design challenges for energy infrastructure, including maintenance and operation, this plan would provide a regional energy vision that would then provide the framework for future energy development in the North Slope. It was the vision of past leaders that was used as the foundation of this energy planning effort. Since the 1970's the North Slope Borough has provided modern infrastructure, as well as energy subsidies to local residents to help with these challenges. The cost of maintenance, operation, subsidies and upgrades to this infrastructure has cost the North Slope Borough millions of dollars.

This energy plan coincides with the updates to the North Slope Area-wide Comprehensive Plan, which allows a holistic approach to future projects in North Slope communities. This plan shows the current energy resources within the North Slope Borough and presents options for reducing energy costs while maintaining or improving the current level of service provided. Analysis collected previously by federal, state and local energy specialists and relied heavily on the assistance of North Slope Borough Department Directors and staff, as well as community leaders, was used to prepare a *draft* energy plan. It is an expansion of previous studies and data collection and lays out issues, goals and prioritized energy projects obtained through a series of community meetings and document reviews. The goal is for this plan to become a living document that provides a tool for current and future generations on energy-related projects.

The energy planning efforts are based on a local, grassroots perspective. Each community was visited and its issues, goals and prioritized projects are highlighted on individual community and energy profiles. These "snapshots" in time show the current energy-related conditions.

The chart below summarizes the issues, goals and potential projects. These projects are given more detail throughout the plan.

ENERGY ISSUES	ENERGY GOALS	POTENTIAL PROJECT(S)
	Energy Efficiency & Conservation	
Lack of education in energy-efficiency and conservation, no tracking of energy costs, inefficient housing design for Arctic climate and no present best practices in place.	Provide adequate energy education in all levels and areas, calculate life-cycle costs for all energy systems, set standards and best practices for Arctic climate appropriate design and construction.	▪ Energy-wise educational visits to all residential homes ▪ Data metering and collection for all energy systems ▪ Design and build for Arctic climate and set standard for all construction in the NSB ▪ Implement through an ESCO program all recommendations on energy audits
	Maintenance and Operations	
Lack of trained workforce in energy-related systems at the local level, causing high maintenance and operations expenses.	Continue to train and develop a local workforce of operators and repair technicians for all energy systems. Train local workforce to do construction upgrades for efficiency.	▪ Institute a curriculum on energy-related jobs with local secondary and college educators to promote and design Arctic appropriate approach
	Energy Financing	
Outside funding for energy projects is limited and highly competitive, NSB capital funding is very short-term, SOA PCE rates are very low due to NSB subsidies, costs for energy systems continues to grow – stressing current budgets, high non-payment of utility bills, even with subsidies.	Seek Federal and State technical assistance for planning of future energy projects, collaborate funding efforts, develop comprehensive financial strategy for maximizing energy funding.	▪ Create a funding database for collaboration of federal, state, local and private funds for energy projects
	Energy Infrastructure	
Inappropriate designed energy systems has led to very high M&O costs, failing systems (due to design flaws and climate change) continues to drive the costs up on all infrastructure – roads, water and sewer, housing stock, transmission lines, energy systems rely heavily on diesel and need upgrades to accept renewable systems.	Assess current infrastructure and develop an implementation plan for upgrades, assess housing stock conditions, upgrades systems to accept renewable energy, diversify energy sources through use of alternatives.	▪ Implementation plan for current needs ▪ Energy audits on all commercial/public buildings ▪ Assess current energy systems for upgrades to be more efficient
	Planning	
Lack of effective planning efforts for implementation of recommendations for energy savings and projects.	Incorporate the North Slope Energy Plan into the NSB Planning and CIP process.	▪

Communication		
Logistics of the NSB communities hinders effective communication between entities and project partners, general public lacks understanding of current systems, conservation measures and available programs.	Utilize communication structure in place to continue to educate and bring awareness and resources to the NSB residents, educate energy users on energy consumption, energy systems and resources available.	▪ Implement an “Energy-wise” program to help NSB consumers understand energy systems, distribution costs, usage and conservation

Chapter 1

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.

INTRODUCTION

The North Slope Region of Alaska encompasses an area of nearly 95,000 square miles across northern Alaska with eight vibrant, yet isolated communities. The majority of its residents are Iñupiat. For much of the year, the region is in darkness, with temperatures staying well below zero. None of the eight North Slope communities are connected by road, making the movement of goods and people dependent primarily on air and water transportation. The geography and harsh environment make staying warm and generating electricity difficult and expensive. As energy costs continue to rise and new energy technology emerges, leaders have recognized the need to develop a new coordinated energy approach to bring costs down while maintaining or improving the level of service.

This push to improve energy options is not new. In the 1970s, oil and gas revenues from the North Slope began to dominate Alaska's economy. With the wealth resulting from this development, the North Slope Borough (NSB) constructed energy infrastructure projects including modern power plants and local electrical distribution lines. They also gave energy subsidies to local residents to help offset the high cost of heating their homes and using electricity. But, even as the infrastructure took shape, leaders looked to the future and began to advocate energy resource management, energy conservation, and alternative energy development. These topics were the focus of priorities adopted by the NSB Assembly in 1981. Unfortunately, these priorities were not fully implemented. This energy plan is intended to honor the cultural wisdom of sustainable planning understood by those early leaders by presenting a path to implement their priorities, now and far into the future.

Photo 1. Eben Hopson, NSB's first mayor

The Energy Plan is intended to accomplish the following:

- Provide an energy profile for the region and each community in the Borough that clearly demonstrates their energy issues, the current energy usage and their energy priorities.
- Provide direction for reducing the Borough's operational expenses for energy in the face of declining revenues.
- Outline a process for educating residents about energy conservation measures.
- Assist in obtaining grants for the Borough and villages that reduce energy costs.
- Develop guidance for sound alternative resource development.
- Help to identify and set priorities for actions by the Borough and its villages.
- Save costs and increase comfort for residents resulting from energy efficiency improvements.
- Be a part of the Borough's Comprehensive Plan.

The Energy Plan is not intended to:

- Remain a static document. The plan should evolve as time passes to reflect current economic realities, political constraints and opportunities, and technology.
- Serve as a design document. The plan is not intended to capture a high level of detail surrounding energy efficiency projects, and most recommended projects will require standard pre-design and design documentation.

1.1 VISION

The North Slope energy vision was created to serve as a clear guide for future energy actions and is intended to be an inspiration and provide the framework for strategic planning.

To provide affordable energy, keep our people warm, and be the leaders in bringing the most economical, sustainable energy to rural Arctic communities.

1.2 METHODOLOGY

The data collected for this report was gathered from existing data in published reports including the 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, Institute of Social and Economic Research (ISER) information and data collected by numerous stakeholders. Current energy data was derived from information provided by North Slope Borough departments, the Arctic Slope Regional Corporation (ASRC), Barrow Utilities and Electric Co.-Op (BUECI), Village Corporations, City and Tribal officials, and Power Plant personnel. NSB departments that provided information included Public Works, Capital Improvement Management (CIPM), the Mayor's Office, Administration and Finance, Planning and the Grants Division.

Throughout the process, stakeholder input was solicited and the project team and Borough staff met to discuss progress. The North Slope Borough contracted with WHPacific, Inc. to assist in preparation of this report. The timeline for the plan is illustrated in **Error! Reference source not found.**.

Exhibit 1: Energy Timeline

Energy stakeholders in the North Slope Region are diverse and interested in energy discussions. In the fall of 2013, a kick off meeting for the energy planning process was held in Barrow. Attendees included representatives from the NSB Mayor's office, Administration and Finance, Public Works, CIPM and arctic Slope Regional Corporation (ASRC). This group was kept informed and met to discuss the plan throughout the process.

Other stakeholders key to the development of this energy plan include Barrow Electrical Utility Co-Op Incorporated, local city, tribal, village corporations, federal and state agency staff; and the general public. Near the beginning of the project, industry participants were interviewed to provide information and they provided input into a wide array of energy issues as they relate to their particular fields throughout the process.

In February 2014, planners conducted trilateral meetings in each of the NSB communities with city, tribal, and village corporation leaders, and in many cases with representatives from ASRC. These meetings served as a means to introduce the plan, identify ideas and comments on energy issues and goals and pinpoint an energy champion to represent each community on a North Slope Regional Energy Plan Steering Committee.

Several common themes emerged in these meetings:

- Leaders were interested in improving energy efficiency and are open to new approaches;
- Community members are frustrated with the pace at which energy efficiency projects occur;
- Residents are very interested in home weatherization to improve efficiency and livability;
- Fuel availability should be improved; and

- Although energy audits have been performed in many public facilities across the NSB, community leaders were unaware that any audits were done.

A draft plan was completed in late 2014 and planners visited each of the communities to present the draft, discuss energy priorities with local leaders and the public and make presentations about energy conservation to the local school children. The final draft was presented to the NSB Planning Commission for review in May 2015.

1.3 ORGANIZATION

This plan contains the following chapters:

- Introduction – an overview of the regional energy issues and challenges, the goals of the plan, methodology, and stakeholders involved.
- Regional Background – summarizes physical, demographic, and energy use characteristics of the region.
- Regional Energy Resources – a detailed look at the energy resources of the North Slope region. Outlines regional energy priorities.
- Community Summaries – an overview of the eight North Slope communities, their energy profiles and local energy priorities.
- Implementation Plan – a summary of actions and strategy for completing the energy priorities

1.4 ISSUES AND GOALS

The energy plan steering committee and stakeholders developed a list of issues that focused on six topic areas; energy efficiency and conservation, maintenance and operations, energy infrastructure, planning, energy financing and communication. These are presented below along with corresponding goals.

Table 1. Energy Issues and Goals

ENERGY ISSUES	ENERGY GOALS
Energy Efficiency & Conservation	
1. There is a lack of education in energy-efficiency and conservation.	▪ *Maximize the use of education, community awareness and program implementation for energy conservation and efficiency in all areas: residential, commercial, industrial and transportation.*
2. Actual costs of energy in region are not tracked adequately.	▪ *Calculate life-cycle energy costs for all the NSB, including: water and sewer systems, infrastructure, housing and power generation.*
3. Houses and associated infrastructure are not usually built with arctic cold climate design.	▪ *Always build arctic appropriate, energy efficient buildings.*
4. No general energy-efficiency practices are in place.	▪ *Encourage standard of energy-efficiency and conservation practices.*
Maintenance and Operations	
5. Many operators lack the proper training needed to maintain and operate new technology and energy equipment installed in the villages.	▪ *Develop a well-trained workforce of operators and repair technicians that keep existing and new energy systems operating in communities and individual buildings continually and efficiently.*
6. There is a lack of readily available trained personnel to repair new energy and heating systems.	
Energy Financing	
7. Energy project financing from outside sources are limited and highly competitive.	▪ *Seek Federal and State agency assistance for Borough energy planning and management efforts with a full range of grants and technical assistance with collaborative funding.*
8. While NSB capital funding for energy projects may be available in the short term, there is concern about long term availability to fund future capital energy projects.	▪ *Develop and implement a comprehensive financial strategy for maximizing energy funding.*
9. The state PCE rates are very low due primarily to NSB energy subsidies.	
10. The costs for on-going operations of the energy systems continues to grow without corresponding increases to budget.	
11. There is a high non-payment of utility bills.	

Energy Infrastructure	
12. Inadequate infrastructure remains a prevailing deficit throughout the region, including roads, transmission lines, sewer and water systems and inefficient building performance.	▪ *Assess current infrastructure and develop a plan to upgrade, retrofit, or redesign systems for climate change and environment.*
13. Failing systems causes high costs to the NSB due to climate change and inadequate design.	▪ *Determine the need for new infrastructure to maximize the energy savings.*
14. Power plants are not designed to accept alternative energy sources.	▪ *Integrate power systems that can effectively capture alternative energy.*
15. Energy systems rely heavily on diesel which is finite and constantly increasing in costs.	▪ *Reduce fuel costs by diversifying energy sources through use of practical energy alternatives.*
Planning	
16. There is a lack of effective planning efforts that showcase current energy demands, systems and costs that could help streamline future energy projects.	▪ *Incorporate energy into NSB Planning and CIP process.*
Communication	
17. The logistics of the North Slope Borough hinders effective communication between entities implementing energy systems.	▪ *Continue effective communication through outreach and inter-departmental collaboration.*
18. The public lacks an understanding of energy systems, conservation measures, and available programs.	▪ *Educate energy users on how their actions impact energy consumption, how their energy/heating system operates, and what energy resources are available to them.*

Chapter 2

Regional Background

REGIONAL BACKGROUND

This chapter summarizes relevant physical, demographics and energy use characteristics of the North Slope region.

REGIONAL BACKGROUND

The people of the North Slope thrive in a physical environment that presents great challenges. Extreme weather and great distances can transform a simple task elsewhere into a major hurdle. Despite these challenges, a rich cultural heritage, a strong social fabric, and hard work have helped to create vibrant communities throughout the region. This section provides an overview of the physical conditions, demographics, economy, regional contacts and energy use for the North Slope region as a whole.

2.1 PHYSICAL CONDITIONS

2.1.1 LOCATION

The North Slope Borough is the largest municipality in the United States, encompassing over 94,000 square miles, including more than 8,000 miles of arctic coastline. The Borough stretches across all of Alaska's northern coast, extending from the Chukchi Sea in the west to the Alaska-Canada border on the east. It comprises over 15 percent of the state's total land area.

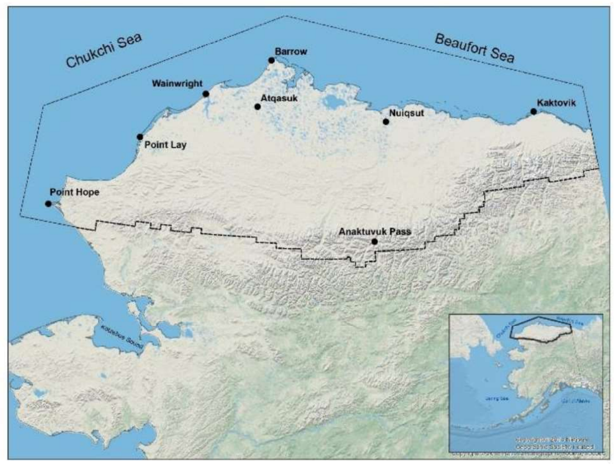


Figure 1. North Slope Region Planning Area

The majority of the land on the North Slope Borough is managed by federal and state agencies. Federal and state lands comprise most of the NSB. Other landowners include regional and village Native corporations, and to a lesser extent, private individuals.

Barrow, the northernmost city in North America, is the economic, service, and administrative center of the region. Many local businesses provide support services to oil field operations. It is also the area's transportation hub, with jet service connecting to Anchorage. The North Slope is home to Alaska's major oil production facilities at Prudhoe Bay. Figure 2 shows the land status of the North Slope region.

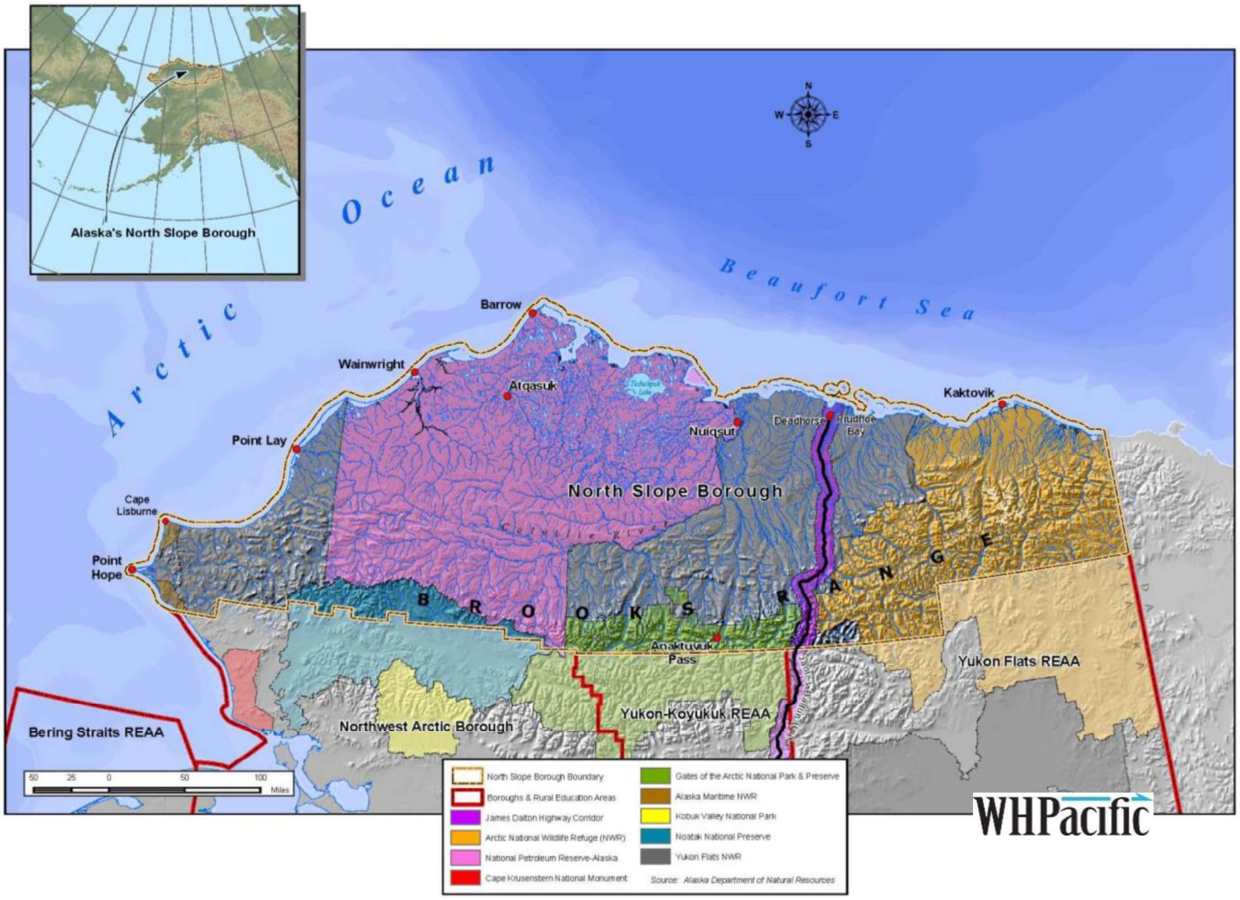


Figure 2: Regional Land Status

2.1.2 GEOLOGY

The geology of the North Slope region is dominated by the Brooks Range fold and thrust belt to the south and the Colville basin to the north. 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. The foreland basin filled with a thick sequence of organic-rich shale and sandstone. As this sediment was buried and heated, large volumes of oil and gas were liberated. These hydrocarbons migrated and were trapped into subsurface structures such as the Barrow Arch, which runs along the coast from Barrow to Prudhoe Bay. 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 and the major rivers continued to rework these sediments as the ice receded.

2.1.3 HYDROLOGY

Major North Slope rivers include the Colville, Kuparuk, Sagavanirktok and Canning Rivers begin in the Brooks Range. The Colville River is approximately 350 miles in length, stretching from the De Long Mountains to the Arctic Ocean where it forms a large delta near Nuiqsut. It is the largest river in Alaska that is not glacier fed. The river is frozen for more than half the year and floods each spring. When frozen, the Colville River can be used as an ice road for transportation. Once the freshwater ceases to flow, a saltwater wedge forms under the ice. Salinity in the Colville River extends approximately 37 miles from the mouth.

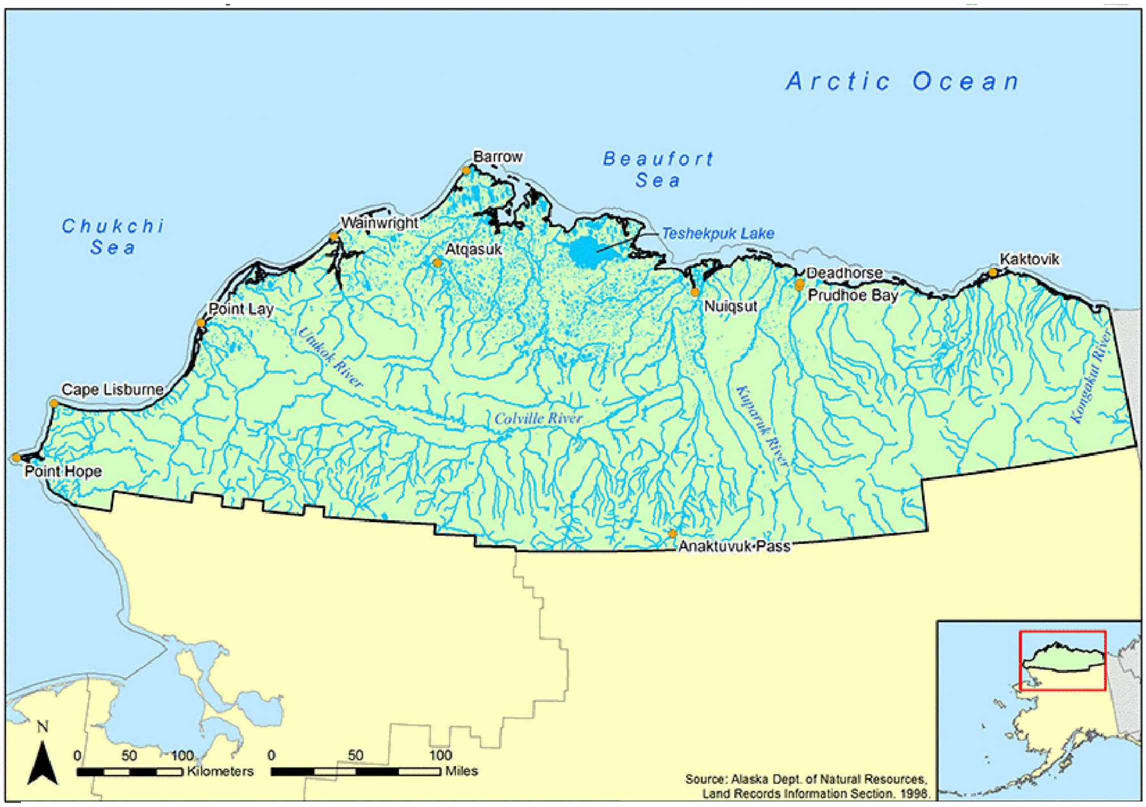


Figure 3. Hydrology Features on the North Slope

The Kuparuk River enters a bay on the Beaufort Sea between Beechey Point and Prudhoe Bay. The north-flowing river is about 200 miles long, and its delta is about three miles wide. The Sagavanirktok River is about 180 miles long and originates on the north slope of the Brooks Range, flowing north to the Beaufort Sea near Prudhoe Bay. The Canning River flows through parts of the North Slope beginning in the Franklin Mountains of the Brooks Range. It flows generally north for 125 miles through the arctic National Wildlife Refuge and enters Camden Bay west of Kaktovik on the Beaufort Sea. (United States Geological Survey, 2013)

River, stream and lake habitats support more upland mammal and birds than any other coastal habitat. They provide a conduit for freshwater component of estuaries and link the upland and marine environments. Also, they provide a travel corridor for upland mammals. Some pools in the deltas of these rivers do not freeze to the bottom and provide overwintering habitat for fish.

The arctic coastal plain has the largest expanse of arctic fen and thaw lakes in the world. Many of the lowland areas are considered wetlands. Polygon-shaped structures form from temperature-induced cracks. Pingos, or ice-cored mounds, appear throughout the tundra. Because wetlands store water longer than other areas, water becomes more nutrient rich, and this water provides important nutrients to coastal waters as a result of spring floods (Glenn Gray and Associates, 2007).

2.1.4 CLIMATE

Much of the North Slope climate is arctic, with long, very cold winters and short, cool summers. Temperatures range from -56 to 78 °F. Precipitation is light, with an average of five inches a year and snowfall averaging 20 inches a year. However, Anaktuvuk Pass in the Brooks Range has a continental climate. Climate data for the North Slope communities is given in Table 2-1.

Table 2-1: Climate Data for the North Slope

	Extreme summer high, °F	Extreme winter low, °F	Annual precip. inches	Annual snowfall, inches	Chukchi Sea Break-up, avg.	Chukchi Sea Freeze-up, avg.	Days below freezing
Anaktuvuk Pass	91	-56	11	63	N/A	N/A	N/A
Atqasuk	78	-56	5	22	N/A	N/A	300
Barrow	78	-56	5	20	Mid-June	October	324
Kaktovik	78	-56	5	20	N/A	N/A	N/A
Nuiqsut	78	-56	5	20	N/A	N/A	297
Point Hope	78	-49	10	36	Late June	Mid-September	N/A
Point Lay	78	-55	7	21	Late June	September	N/A
Wainwright	80	-56	5	12	Mid-July	September	N/A

Source: (Alaska Department of Community and Regional Affairs, 2014)

While there is some variation across the region, weather patterns are similar. In Barrow, the sun does not set between May 10th and August 2nd each summer and does not rise between November 18th and January 24th each winter.

2.1.4.1 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 determine 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 Table 2-2 indicate average heating degree days for each month in Anaktuvuk, Barrow, Kaktovik, Nuiqsut, Point Lay, and Wainwright. New York's heating degree days, shown for comparison, indicate a much warmer climate and therefore needs much less energy required to heat its buildings.

Table 2-2: Average Heating Degree Days, November 2013 through October 2014

	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	Oct	ANNUAL
Anaktuvuk Pass	1,893	2,174	1,967	1,964	2,014	1,562	924	545	451	538	936	1,536	16,504
Barrow	1,723	2,075	2,227	2,020	2,142	1,805	1,192	948	858	855	945	1,343	20,226
Kaktovik	1,677	2,107	2,129	2,097	2,152	1,719	1,069	911	734	798	894	1,227	17,514
Nuiqsut	1,889	2,238	2,348	2,092	2,354	1,877	1,130	748	561	674	907	1,306	18,124
Pt. Lay	1,644	2,048	2,120	2,023	2,194	1,726	1,121	829	623	618	844	1,318	17,108
Wainwright				1,994	2,063	1,779	1,134	870	724	724	875	1,277	
New York	598	814	1,124	937	845	412	122	12	0	2	40	194	5,100

Source: www.degreedays.net

2.1.4.2 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 North Slope region, some of these impacts include coastal erosion, increased storm effects, earthquakes, 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. The rate of erosion east of Point Barrow has doubled in the past 50 years from 20 feet to 45 feet per year and the length of the summer season is expected to increase between by between three and six weeks by the end of the century (Planning, 2014). 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.

The arctic has heated up twice as fast as the rest of the planet in the past three decades. By August 2013, sea ice had lost 76 percent of its volume compared to 1979, according to the University of Washington's Polar Ice Center (Lippert, 2013). One effect of climate change is an increase in lightning strikes and as the summers get warmer and dryer, so too do the soils, which are flammable and able to burn more deeply when dry. In 2007, near Anaktuvuk Pass, lightning-sparked forest fires burned 401 square miles releasing an estimated 2.3 million tons of carbon into the atmosphere (UAF, 2011).

Photo 2: Anaktuvuk River Fire, North Slope, Alaska. Photo credit: Alaska Fire Service

Adapting to the impacts of climate change before they become critical is important to the wellbeing of the people and infrastructure of the North Slope. Energy infrastructure will be vulnerable to more extreme weather events, rising sea levels, and thawing permafrost. Strategies for adaptation to climate change will need to be developed and continually updated as new information becomes available.

Climate change and changing weather patterns will force adaptation at a rapid pace. The consequences could prove devastating for northern climates if planning efforts do not factor these effects into future design of infrastructure and energy systems.

> "I really hope that we can settle all preparatory work for the Polar Code by next year [2014] … The new code will come into force in 2016 or in early 2017. This is a possible and realistic target and I'm sure we can achieve that."
>
> *Secretary General of the IMO, Koji Sekimizu, 18 October 2013*

Climate change is also opening new arctic shipping routes. Once only navigable in the summer months every seven years or so, the summer sea ice is vanishing at a rapid pace, opening up potentially lucrative trade routes between the Atlantic and Pacific Oceans. (UAF, 2011) Multi-year sea ice has declined 50% since 2005 (NSB Planning, 2014). As arctic sea ice and Antarctic continental ice diminishes, the season for accessing these environments lengthens. However, the Polar Regions remain the most remote and challenging work sites on the globe, subject to climate extremes and at the furthest limit of logistic support. This poses unique challenges and requires specialized expertise to mitigate danger and maximize efficiency.

Ice breaker escorts helped make the first commercial passage of a containership through the arctic in 2013. Also in 2013, a Russian ship with fifty two passengers called the MV Akademik Shokalskiy became trapped in shifting pack ice in Antarctica, raising concerns about potential rescue efforts in arctic shipping lanes (Bruno, 2013). To address concerns with the opening of the arctic shipping lanes, the International Maritime Organization (IMO) created a Polar Code. The Polar Code is not finalized and has not been adopted, however, it contains provisions regarding vessel operations in the Polar Regions such as machinery requirements, ship structure, etc. While the Code could bring safety and efficiency improvements, some worry that the requirements could significantly increase the costs of goods and energy to communities in the arctic. The Alaska Arctic Policy Commission and the National Strategy for the Arctic Region (NSAR) are working to address the potential cost increases that could result from the current proposed code.

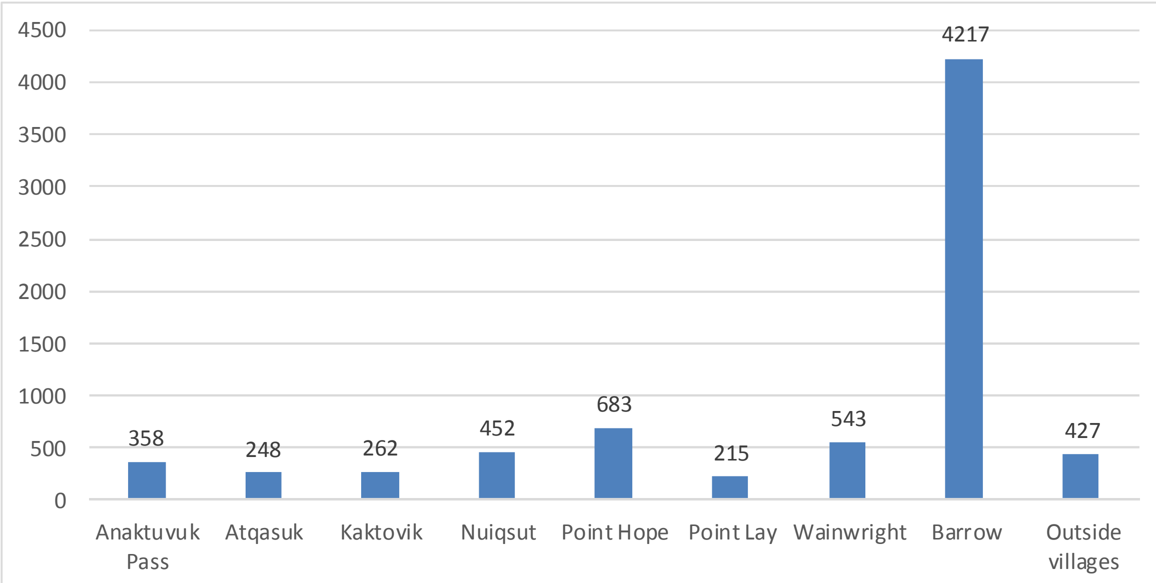
2.2 DEMOGRAPHICS

Demographics shape current and future energy demands. Understanding current demand can help to pinpoint inadequacies and identify opportunities for efficiency improvements. Projections of future energy use can help leaders to tailor improvements or new facilities to optimally meet community needs. This section provides an overview of current NSB demographics and future trends.

2.2.1 CURRENT POPULATION

As of January 1, 2014 (based on tax records), the total population of the North Slope Borough was about 7,905 as shown in Exhibit 2. This figure does not included the approximately 11,000 oil field workers who are employees on the North Slope, mostly in Prudhoe Bay east to the Alpine Development Project (NSB Planning, 2014). Over 5,500 of the residents are Iñupiat. Barrow residents make up about 60 percent of the region's population.

Exhibit 2. NSB 2010 Population by Community

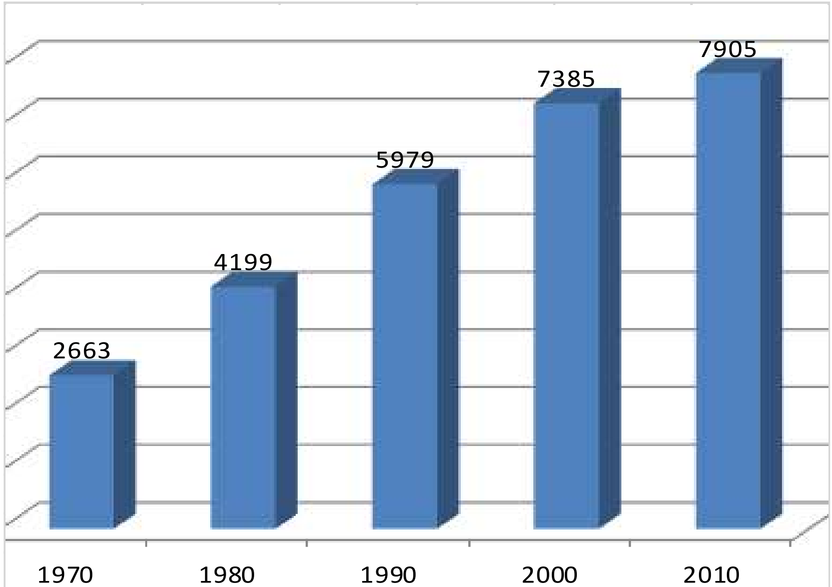


Residents in the North Slope Borough are significantly younger than residents of Alaska as a whole. At 27, the median age – or midpoint of the population – for the North Slope Borough is about nine years younger than the median age for the state as a whole (36.1). This young population will have an effect on future demand for services within the Borough, including education, housing, and employment (North Slope Borough, 2005). The effect will likely also extend to increased demands on the energy infrastructure within the Borough.

2.2.2 TRENDS

Borough and U.S. census data for the region reveals that between 1970 and 2010 the population grew from 2,633 to 7,905 as shown in Exhibit 3. The exhibit is based on the census of the eight communities of Anaktuvuk Pass, Atqasuk, Barrow, Kaktovik, Nuiqsut, Point Hope, Point Lay and Wainwright; Prudhoe Bay has not been included. It is estimated that the population of the Prudhoe Bay oil field is 2,175 people, but at any given time several thousand transient workers live there to support personnel (NSB Planning, 2014).

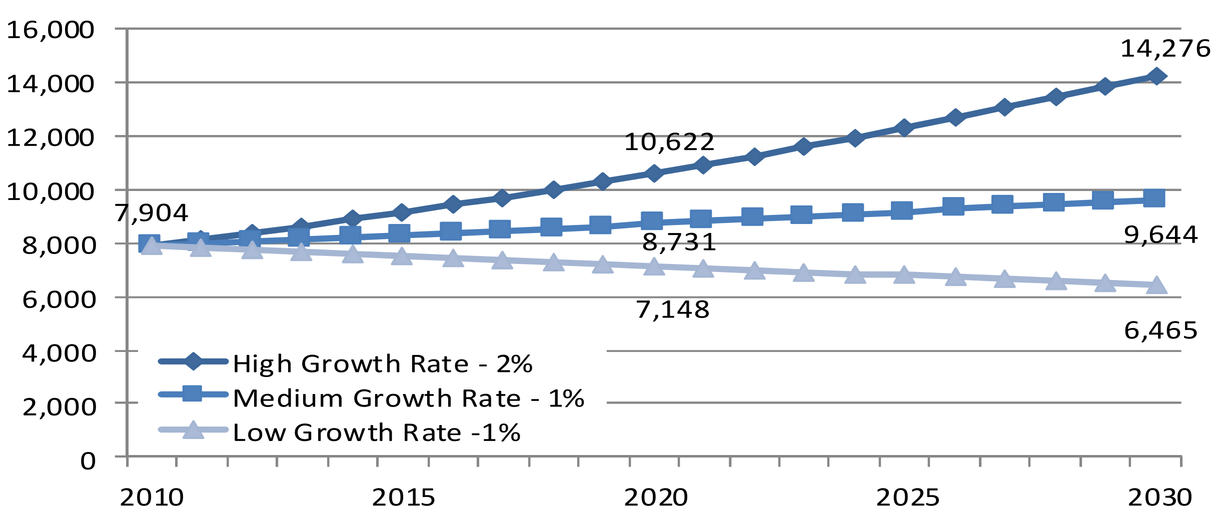
Exhibit 3: North Slope Borough Population Growth 1970-2010



Source: U.S and NSB Census data

Over the past 40 years, the overall population in the region has increased about two percent annually. At a two percent growth rate, the population would exceed 14,000 persons in 2030. Based on the fact that the growth has slowed in recent years, the assumption is for a more modest one percent growth rate. This results in a population of approximately 9,644 by 2030, as shown in Exhibit 4.

Exhibit 4: Projected Population Growth 2010-2030



A modest increase in energy use could be expected from population increase, but employment is likely to have a more direct relationship to energy demand (North Slope Borough, 2008).

2.3 ECONOMY

The majority of the Iñupiat residents on the North Slope Borough use subsistence foods, with over 53 percent receiving half or more of their diets from subsistence foods (North Slope Borough, 2011). Subsistence activities take place over a vast area as a result of the large-scale migration patterns of some subsistence resources. Borough residents also use offshore areas for subsistence hunting and fishing of a wide variety of marine mammals, birds and fish. They use onshore areas for hunting and fishing and gathering of eggs and plants. Subsistence use changes from year-to-year and throughout time, depending on the availability of a specific species (Glenn Gray and Associates, 2007).

In some ways, subsistence foods represent income. When opportunities for employment tighten, residents can adjust to smaller incomes by increasing their use of subsistence foods. For many North Slope residents, rather than replacing subsistence, the cash economy enables individuals to participate in subsistence by providing money for snow machines, boats, outboard motors, and whaling supplies. The combination of subsistence and employment contribute to the overall village economy. Successful hunters redistribute their take to others, particularly to relatives and the elderly, who may not be able to provide for their own needs. Seasonal or part-time work makes up a large percentage of available work. Wage earners carry out subsistence activities during non-work time such as vacations, weekends, and after work hours. In other instances, a family member works in a wage-paying job and sponsors someone else in their subsistence pursuits. A sponsor receives a measure of status and also part of the catch for assisting the hunt (Glenn Gray and Associates, 2007).

Other economic drivers in the region include oil, gas and mineral development; tourism and commercial recreation; arts and crafts; and retail and commercial services. According to the Alaska Department of Labor and Workforce Development, the largest sector of employment in the region is local governments, employing 1,944 individuals in 2012.

Oil and gas revenues play a significant role in the economics of the North Slope and the rest of Alaska. Local and state oil revenues provide funding for water and sewer facilities, schools, health clinics, fire stations, and local roads and airports. In addition, the arctic Slope Regional Corporation and local village Native corporations have businesses that provide oil field services and some individuals from NSB villages also are employed by oil companies (NSB Planning, 2014).

Unemployment in the North Slope Region has gone down over the past decade after a high of over 10 percent in 2004. The average household income varies from a low of $53,134 in Point Lay to a high of $91,832 in Barrow as shown in Table 2-3.

Table 2-3: Average Household Income in North Slope Communities

Community	Average HH Income
Anaktuvuk Pass	$58,673
Atqasuk	$84,861
Barrow	$91,832
Kaktovik	$57,716
Nuiqsut	$72,591
Point Hope	$58,691
Point Lay	$53,134
Wainwright	$62,493
North Slope Borough	**$80,178**

Source: (North Slope Borough, 2011)

2.4 HOUSING

2.4.1 Regional Housing Assessment

The 2014 AHFC Alaska Housing Assessment used a variety of sources to analyze statewide and regional housing. Below is a summary of the assessment for houses in the North Slope region.

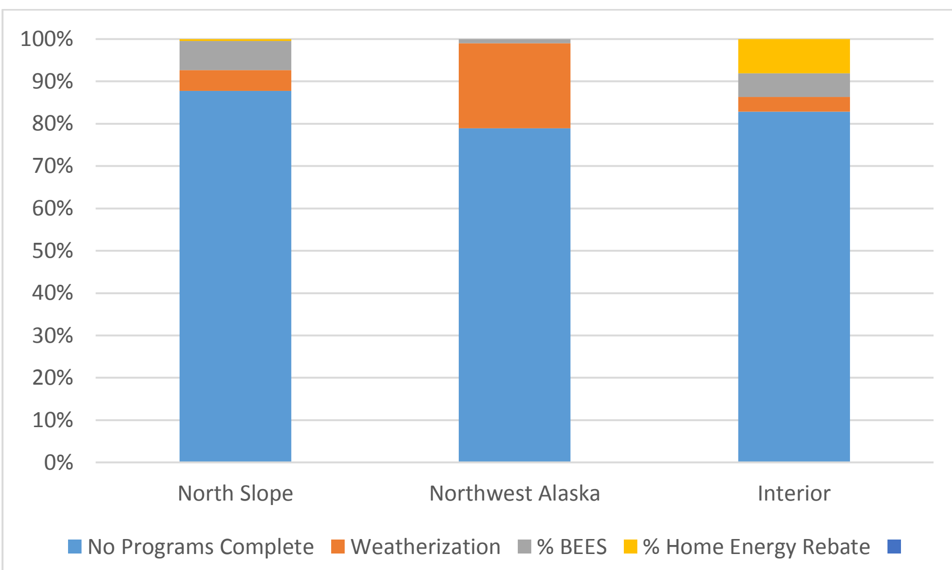
Housing Units. There are currently 2,517 housing units in the North Slope region. Of these, 1,966 are occupied, 160 vacant units are for sale or rent, and the remaining 391 are seasonal or otherwise vacant units.

Energy. The average home size is 1,134 square feet and uses 175,000 BTUs of energy per square foot annually. This is 28% more than the statewide average of 137,000 BTUs per square foot per year and the second highest energy use index in the state.

Energy Costs. Using AKWarm estimates, average annual energy cost for homes in the region is $3,200 (subsidized rate), which is approximately 1.1 times more than the cost in Anchorage, and 1.5 times more than the national average. Discounting Barrow and Nuiqsut that rely on relatively inexpensive natural gas the average energy costs for the remaining North Slope villages are much higher.

Energy Program. Since 2008, approximately 5% of housing units in the region have completed an AHFC Home Energy Rebate or Weatherization program, and an additional 7% have been certified to meet the Building Energy Efficiency Standards (BEES), compared to 21% statewide. Exhibit 5 shows the comparison of North Slope participation in energy efficiency programs compared to nearby regions. It illustrates that participation in energy efficiency programs has so far been limited in the North Slope.

Exhibit 5. Comparison of Percent of Occupied Housing Completing Energy Programs



Source: Source: 2014 AHFC Housing Assessment

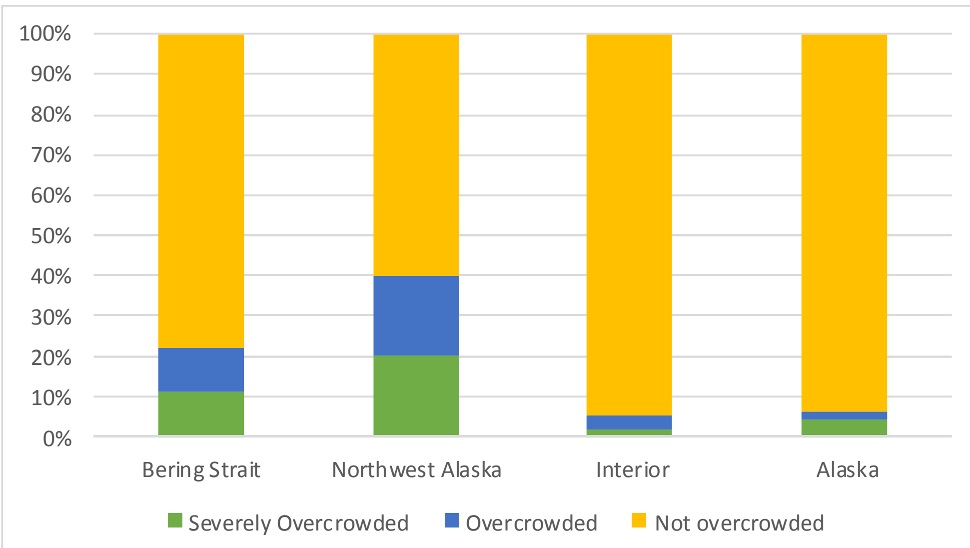
Housing Quality. Within current housing stock, newer homes have better energy performance. On average, homes built in the 1970s are currently rated at 2-star-plus compared to a current average rating of 4-star-plus for homes built after 2000. The Tagiugmiullu Nunamiullu Housing Authority (TNHA) reports that new houses currently being constructed in the region have 6 star BEES ratings.

Air-tightness. Within current housing stock, newer homes are tighter. On average, homes built in the last decade meet the 2009 BEES standard of air-changes. In contrast, homes built in the 1980s are 1.2 times leakier than those built since 2000.

Ventilation. An estimated 684 occupied housing units (or 35%) in the North Slope region are relatively air-tight and lack a continuous ventilation system. These houses are at higher risk of moisture and indoor air quality-related issues.

O**vercrowding**: More than 21% of occupied units are estimated to be either overcrowded (14%) or severely overcrowded (8%). This is roughly 7 times the national average and makes the region the fourth most overcrowded ANCSA region in the state. A 2013 assessment done by the United States Housing and Urban Development (HUD) indicates that there is a regional shortage of 538 units of affordable housing and an urgent need to rehabilitate 859 units (TNHA, 2013). Below in Exhibit 6 is a comparison of the overcrowding in the North Slope Region, nearby Northwest and Interior Alaska and the state.

Exhibit 6. Comparison of Overcrowded Housing



Source: 2014 AHFC Housing Assessment

Affordability. According to American Community Survey (ACS) data**,** approximately 13% of households in the region spend 30% or more of total income on reported housing costs, including rent, water and sewer utilities, and energy costs. Using AKWarm estimates, the average annual energy costs constitute approximately 4% of census median area (Alaska Cold Climate Research Center, 2014).

2.4.2 HOUSING ORGANIZATIONS

There are several entities in the North Slope region responsible for housing improvements.

Tagiugmiullu Nunamiullu Housing Authority (TNHA) – TNHA serves all the communities on the North Slope and administers several housing programs. In 2013 and 2014, TNHA constructed homes using Sustainable Design Standards (SDS). The homes are tailored to the arctic environment and include solar panels, 10 inches of polyurethane spray foam insulation (R-60 rating), LED lighting and a stand-alone a "Life Water" sewer treatment plant. These features all resulted in energy savings. They also are built with a unique foundation that can address changes in the permafrost depth. This allows relocation of the entire house, if needed, saving significant rebuilding (and thus energy) costs (Breer, 2014).

Native Village of Barrow Housing Department - The Native Village of Barrow Housing Department serves low-income tribal members in the Barrow area and within the tribe's approved service area. They strive to "provide decent, safe, sanitary and affordable housing, decrease homelessness and increase affordable rental housing and home ownership opportunities through the provisions of supportive services and financial assistance programs" (Native Village of Barrow, 2014).

Arctic Slope Native Association – The Arctic Slope Native Association (ASNA) serves all the communities of the North Slope by providing healthcare. In September 2013, ASNA opened a new hospital in Barrow and added over 120 full time positions. To accommodate these new positions, they purchased a few lots and are building Structurally Insulated Panel (SIP) homes on them along with the first "remote wall" home in Barrow. ASNA hired an AHFC inspector and rater to perform energy audits, blower door tests, and formally energy rate the homes as they are completed. The first home was completed in August 2014 and the next two homes will be completed by January and rated at that time including the remote wall construction home. They anticipate a 5 star plus energy rating (Welles, 2014).

Native Village of Point Hope – The Native Village of Point Hope uses the block grant approach to housing which was enabled by the Native American Housing Assistance and Self Determination Act of 1996 (NAHASDA).

North Slope Borough Housing Solutions Group –The Mayor of the North Slope Borough formed the Housing Solutions Group to focus on reducing the housing shortage and over-crowdedness and to address the cost of construction and transport in the North Slope region by providing outreach services and technical assistance. The goal is to do this with a combination of services in land acquisition, financial consultation, different construction methods, and collaboration of different entities in the North Slope area (North Slope Borough, 2014).

2.5 PLANNING

In October 2005, the North Slope Borough published an update to their 1983 comprehensive plan. The plan outlined planning issues, goals, objectives and policies, and presented a path to implementation. Included in the plan were profiles of each of the North Slope Borough villages. The plan identified a goal of energy self-sufficiency for NSB communities, and presented the following energy objectives:

- Identify energy conservation strategies for public and private structures and vehicles;
- Develop alternative energy sources for Borough communities, such as coal, natural gas and wind power; and
- Look for ways that oil and gas development can provide natural gas to village communities.

The plan also identified goals to develop gas supply facilities in communities with close proximity to natural gas, and to obtain grants and other funding sources to develop supply and distribution facilities. To reach this goal, the plan proposed that the NSB should:

- Identify communities for potential gas supply development;
- Develop business relationships with funding partners and the resource development industry;
- Define roles and responsibilities for operations and maintenance; and
- Identify and apply for funding for project development, implementation, and maintenance.

The NSB has made partial progress toward meeting these objectives; funding for alternative energy studies was applied for and received, wind feasibility studies have taken place or are currently underway, the Nuiqsut natural gas project was completed and the design for a transmission line from Barrow to Atqasuk is moving forward.

The NSB is currently preparing Comprehensive Plans for each of the villages. This Energy Plan will be a component of the Comprehensive Plans.

2.6 REGIONAL CONTACTS

Table 2-4 provides contact information for entities serving the North Slope region as a whole.

Table 2-4: Regional Entities Serving the North Slope Borough

Native Corporation	ASRC (Arctic Slope Regional Corporation) P.O. Box 129 Barrow, AK 99723 Phone: 907-852-8633 Fax: 907-852-5733 Website URL: http://www.asrc.com
Borough	North Slope Borough P.O. Box 69 Barrow, AK 99723 Phone: 907-852-2611 Fax: 907-852-0337 Website URL: http://www.north-slope.org
Native Association	Arctic Slope Native Association P.O. Box 1232 Barrow, AK 99723 Phone: 800-478-3033 Website URL: http://www.arcticslope.org
IRA Council	Iñupiat Community of the Arctic Slope P.O. Box 934 Barrow, AK 99723 Phone: 907-852-4227 Fax 907-852-4246 E-mail: executive@Iñupiatgov.com, kimlem@gci.net Website URL: http://www.Iñupiatgov.com

2.7 ENERGY BACKGROUND

2.7.1 UTILITIES

Energy services are provided to all the region's communities (except Barrow) by the Borough. Barrow energy services are provided by the Barrow Utilities and Electrical Co.-Op. Inc. (BUECI). BUECI provides Barrow with electricity, natural gas and water and sewer services. Their electricity extends to about 1,950 residential and commercial customers.

Eight divisions make up the NSB Public Works Department with two divisions that deal directly with energy:

- The **Division of Power and Light** operates and maintains the power plants and distribution of electric energy in all seven villages (except Barrow), and responds to problems, such as power grid failures and residential power outages.
- The **Division of Fuel and Natural Gas** is responsible for the delivery of energy-related services to the residents of the Borough outside of Barrow.

Other divisions are critical, as well, to energy planning and implementation. The Division of Water and Sewer provides services outside of Barrow including the production, treatment, and delivery of water, waste water collection and processing; they respond to trouble calls, such as exterior service freeze-ups; and they administer the Operations and Maintenance contract of the Barrow Utilidor System.

The NSB Public Works Department's mission is:

"to sustain and improve the quality of life for the North Slope Borough residents by providing a wide range of cost-effective and well-coordinated essential municipal services."

http://www.north-slope.org/departments/public-works

The Borough does not currently have a specific energy department or dedicated personnel. These departments all shape North Slope Borough energy policy through their work (North Slope Borough, 2014).

Public Works. This department manages village roads, airports, and solid waste treatment, maintains and repairs all NSB-owned facilities and equipment, provides road maintenance, transit service, and solid waste management in Barrow, and operates light, power, water, sewer, and fuel delivery services in the seven villages (not including Barrow).

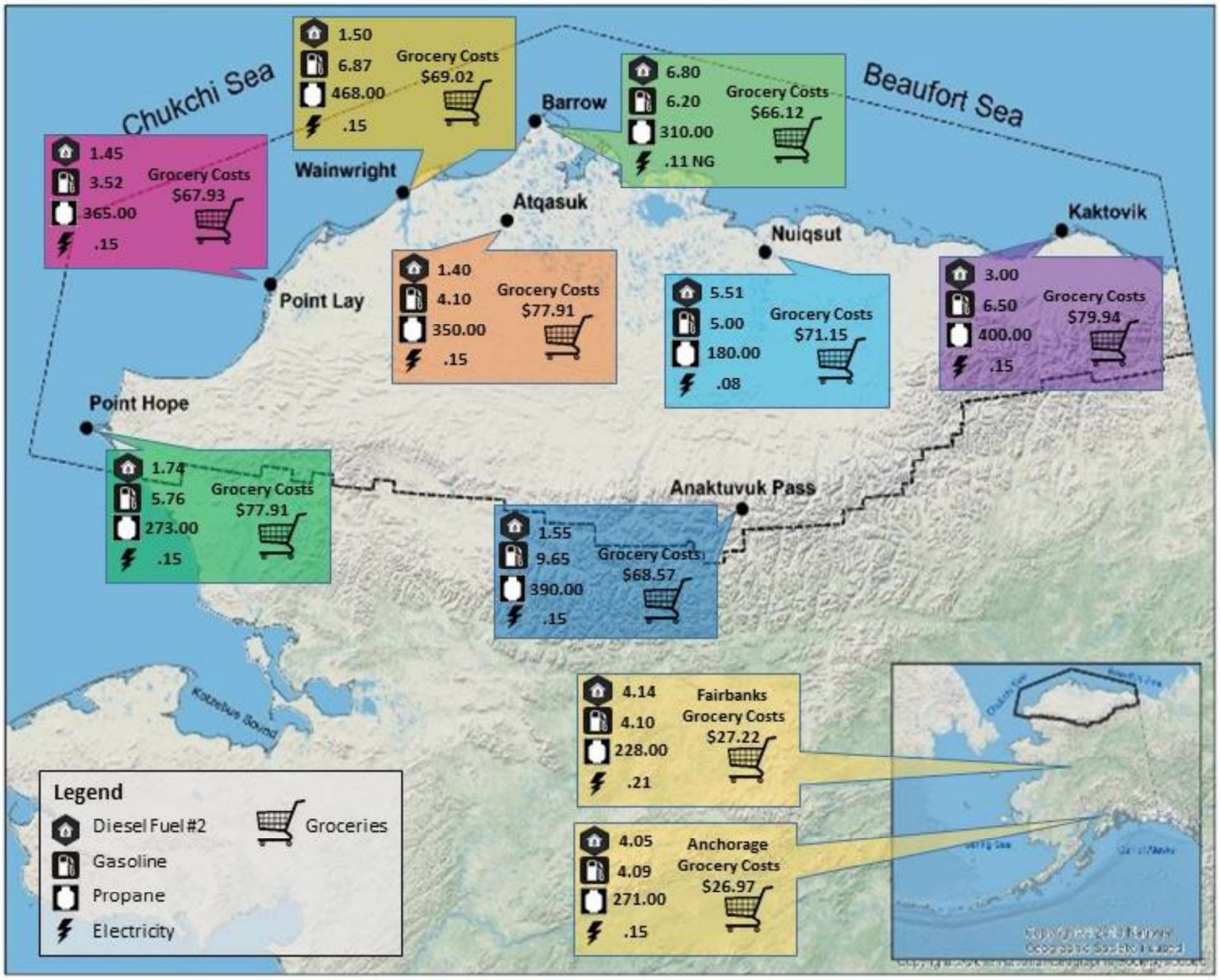
Planning and Community Services. The Planning Department is responsible for planning and land use regulation to protect resources and plan for future growth. This department contributes to the Borough's 6-Year Capital Improvement Program (CIP) Plan and is responsible for preparation of comprehensive plans for each community.

Capital Improvements Projects and Management (CIPM). CIPM implements the Borough's capital program.

Administration and Finance. The Department of Administration is responsible for budgeting, financial management, operational support, risk management, assessment, grant development and administration, and support for Prudhoe Bay facilities.

The following map shows energy and grocery costs across the NSB region. It also includes similar costs in Anchorage and Fairbanks for comparison.

Figure 4: Comparative Cost of Energy and Groceries

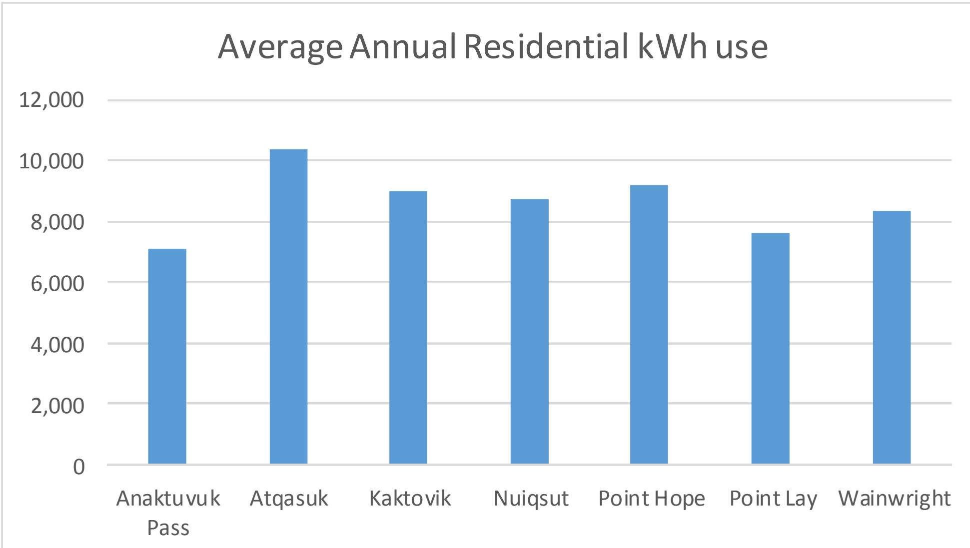


2.7.2 ELECTRICITY

Two thirds of the North Slope Borough electricity generation uses natural gas, with only 34% produced from fuel oil. Natural gas is used for electric generation in Barrow and Nuiqsut. Production from the Barrow Gas Fields provides heat and electricity for approximately 4,400 residents, government services and businesses in Barrow. Residential consumers in the North Slope Borough use the same levels of electrical energy as urban areas in Alaska, making this region unique in energy consumption for rural Alaska. Based on the calendar year (CY) 2013 State of Alaska Power Cost Equalization (PCE) program data, average annual electricity consumption in the NSB ranges from 7,100 kWh – 10,500 kWh. Atqasuk and Point Hope show the highest levels of consumption and Anaktuvuk Pass and Point Lay show the lowest as illustrated in Exhibit 7.

The kilowatt-hour (kWh) is commonly used as a billing unit for energy delivered to consumers by electric utilities. Except for Hawaii, Alaska has the highest residential rate per kWh in the United States and ranks 10th in average energy consumption (U.S. Energy Information, 2012). Measurements of the average annual kWh used by village show that Atqasuk uses more kWh on average and Anaktuvuk Pass the least, as shown in Exhibit 7.

Exhibit 7: NSB Average Annual Residential kWh Electricity Used



Source: 2013 AEA PCE Report

There are on-site diesel generating plants in all the Borough villages. The plants use conventional diesel engines to drive generators that provide local electricity. Dual redundant step-up transformers connect the plants to the distribution systems. Back-up emergency generators are in place at all public facilities in all the communities, however, a catastrophic loss of a power plant would require additional back-up systems to allow continuing services (North Slope Borough, 2008).

The power distribution systems in North Slope Borough villages are typically well-designed grid systems which consist of two three-phase main feeders interposed with several three-phase branch feeders. The distribution systems are designed for a light power load, which is typical of systems in small communities in Alaska. Generally, the systems are repaired only as needed, with no scheduled regular maintenance for the 30 or 40 years since installation. The systems operate within an arctic, marine environment, with moist salt air, high winds, an extreme range of annual temperatures, and significant ice load, and can be subject to outages.

According to the NSB Village Distribution Systems Report of Conditions and Proposed Power Grid Improvement Projects, 2011, power plant upgrades are needed. Upgrades include improvements such as relocating power lines, investigating power distribution to sewage treatment plants and adding electrical poles. These improvements have a total cost of about $6,000,000 (North Slope Borough, 2011). The study also recommends a program of general maintenance and upgrades of the distribution systems borough wide.

2.7.2.1 ELECTRIC RATES

The North Slope consumer's electric rate is generally below the state average electrical rate of 20 cents per kWh (Melendez, 2012). This low rate is due to the fact that the NSB subsidizes electricity rates for residents. Residential rates for NSB residents (not including Barrow) range from 8 to 35 cents per kWh. The first 600 kWh of electricity is waived for the handicapped and seniors (over 60) as shown in Table 2-5. NSB staff reports that electrical bill collection is a problem.

Table 2-5. North Slope Power and Light Electrical Rates

Residential Rate		
kWh	**Unit Cost**	**Village**
0-100	15.00 Minimum	All
0-600	$0.15 per kWh	all except Nuiqsut
0-600	$0.08 per kWh	Nuiqsut Only
601 +	$0.35 per kWh	all except Nuiqsut
Elderly or Handicapped (Seniors over 60) Rate		
kWh	**Unit Cost**	**Village**
0-600	No Charge	all
601 +	$0.35 per kWh	all except Nuiqsut
601 +	$0.08 per kWh	Nuiqsut Only
Commercial (including heat trace) Rate		
kWh	**Unit Cost**	**Village**
0-75	$15.00 minimum	all
0-1,000	$0.20 per kWh	all
1,001-10,000	$0.30 per kWh	all
10,000+	$0.35 per kWh	all except Nuiqsut
10,000+	$0.08 per kWh	Nuiqsut Only

Source: NSB Administration and Finance Utility Billing Electrical and Water Rates, per Ordinance No 2006-18.

The actual cost for the NSB to produce electricity is much higher than the electrical rates charged. Costs include fuel, maintenance and operations, equipment depreciation/amortization and administration costs. The actual production costs range from 50 cents to $1.05 per kWh as shown in Table 2-6. This compares to the 2013 average electrical production cost for approximately 181 rural communities in Alaska of about 49 cents a kWh (Alaska Energy Authority, 2013).

Table 2-6: NSB Power Generation Costs

Community	Total Expenses	FY2013 kWh Generated	Production Cost per kWh
Anaktuvuk Pass	3,576,919.59	3,974,000	1.05
Atqasuk	2,508,074.49	3,410,160	0.91
Kaktovik	3,053,963.63	4,806,050	0.76
Nuiqsut	2,410,018.36	6,046,940	0.50
Point Hope	3,117,702.80	6,629,820	0.56
Point Lay	2,448,005.02	3,458,160	0.88
Wainwright	3,700,507.48	6,681,650	0.64

Source: NSB, June 2014

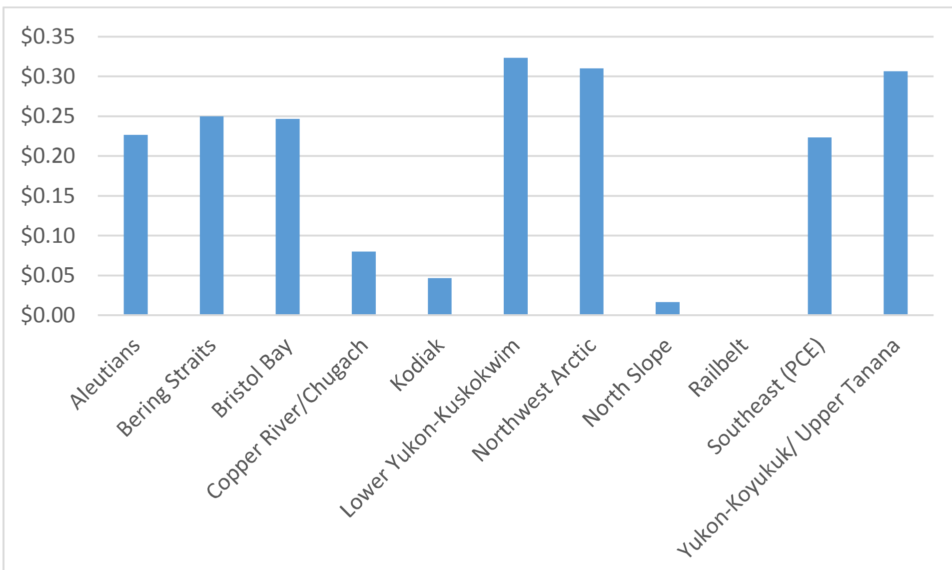
2.7.2.2 POWER COST EQUALIZATION

The Power Cost Equalization (PCE) program was created in 1985 as part of a statewide energy plan. The intent of the program was to provide economic assistance toward energy costs to residents of rural Alaskan communities not on the road system. The rationale for the program is that rural consumers often pay three to five times the rate of urban consumers, and do not reap the benefit of large state-subsidized energy infrastructure projects completed in urban areas. The PCE program was a way to extend benefits to far flung communities through rate relief (Alaska Energy Authority, 2013).

The AEA and the Regulatory Commission of Alaska (RCA) both receive reports from utilities that details electrical statistical data by community. AEA reports are provided monthly and utilities deliver an annual report to RCA. RCA uses that annual report to calculate the PCE rate using both fuel and non-fuel rates. RCA provides the rate to the AEA.

The PCE program subsidizes an average of about 3 cents per kWh up to 500 kWh per month for the NSB villages (excluding Barrow). This is very low in comparison to most rural communities which average a PCE subsidy of about .20 cents per kWh as shown in Exhibit 8: Average Power Cost Equalization Rates. The primary reason for the discrepancy is due to the generous subsidy that NSB already gives its customers. If the NSB required consumers to shoulder more of the costs, the PCE rate could be expected to increase. (Cox, 2014).

Exhibit 8: Average Power Cost Equalization Rates



2.7.3 PROPANE

Propane may be a cost effective choice for household use, such as for cooking. In the early '80s when electricity costs were high, more residents used propane for cooking. Over time, propane-fired appliances were replaced by electrical appliances and by the early 2000s, the number of propane appliances had dropped significantly. Propane remains popular for use in camp cooking and whaling camps. There are many advantages to propane over diesel such as the following:

- Propane and natural gas can be used in many of the same appliances and facilities, without major modifications.
- Propane condenses to a liquid under relatively little pressure, so it can be transported more easily by truck or barge than natural gas.
- Propane reverts to a gas when released from pressure, so spills are not a problem, as they are with fuel oil.

- Propane burns cleaner than fuel oil

Disadvantages of propane are that it takes more space to transport and store than an equivalent amount of energy in fuel oil. That's because liquid propane produces less energy, per gallon, than fuel oil (132,000 Btu/gal versus 92,000 Btu/gal). Propane requires pressurized storage tanks, and more of them. Another disadvantage is that because propane is heavier than air, it can be a fire threat if accidentally released. Residential propane tanks and lines need to be well-insulated from the cold, because at very cold temperatures, propane turns from gas to liquid —meaning whatever was fueled by the propane would stop working.

The cost of propane shipped into the North Slope remain high. The costs range from $180 to $400 per 100 pounds for residents as shown in Table 2-7. This compares with a cost in Anchorage of $106 per 100 pounds.

Table 2-7: North Slope Propane Costs by Community

Community	Propane $/100# ob bottle
Anaktuvuk Pass	$390
Atqasuk	$350
Barrow	$310
Kaktovik	$400 Res $1,300 Com
Nuiqsut	$180
Point Hope	$273
Point Lay	$365
Wainwright	$468

2.7.4 FUEL

Transportation and storage contribute to the high cost of fuel in the North Slope. 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. In addition to fuel costs, the Borough spends over $1 million on regulatory compliance and oil spill response preparedness annually. This includes the following compliance programs (Dellabona, 2009):

- *U.S. Environmental Protection Agency* – Spill Prevention Control and Countermeasures Plan – SPCC Plan
- *U.S. Coast Guard Operations Manual* – Coast Guard Operations Manual Site Inspections and Exercises
- *Alaska Department of Environmental Conservation* (ADEC) – Oil Discharge Prevention and Contingency Plan-C Plan, API 653 Internal and External Tank Inspections, API 570 Tank farm Piping inspections, Cathodic Protection Surveys, Site Inspections and Exercises Power Plant Air Pollutant Fees

Since 2004, fuel rates have approximately doubled. Still residents do not bear the brunt of their high costs due to subsidies for heating fuel provided by the Borough. Fuel rates are shown in Table 2-8.

Table 2-8: Fuel Rates in the North Slope Region

Community	Diesel Commercial	Diesel Residential	Diesel Senior	Gas Commercial	Gas Residential	Gas Senior
Anaktuvuk Pass	$9.25	$1.55	$1.00	$9.65	$9.65	
Atqasuk	$4.10	$1.40	$1.26	$4.90	$4.10	$3.69
Barrow	$6.80	$6.80		$6.20	$6.20	$5.58
Kaktovik	$8.50	$2.50		$8.50	$5.60	
Nuiqsut	$6.91	$2.30		$6.40	$5.00	
Point Hope	$7.44	$1.99		$5.50	$5.50	
Point Lay	$4.25	$1.45	$1.00	$3.52	$3.52	$3.52
Wainwright	$7.30	$1.50		$6.87	$6.87	

Most households use diesel to heat homes, with the exception of Barrow and Nuiqsut. An estimated 506,107 gallons of diesel #2 residential heating oil was used in 2013 throughout the region. The Public Works Department at the NSB distributes the heating fuel to the local village corporations at no charge. In turn, the village corporation charges the residential customers the cost for delivery only. These delivery costs vary from community to community as shown in Table 2-8.

Based on Borough records, an estimated average of 800 gallons of heating fuel is used a year per household. The number of gallons used for residential and school heating is shown in Table 2-9. The average cost of heating fuel delivered to the home is $2.44 per gallon, while seniors and the handicapped are charged a reduced rate of $1.09 per gallon in some communities. The average cost of a gallon of gas is $5.81 for most residents, while seniors and the handicapped are charged a reduced rate of $4.26 per gallon in some communities. (NSB, 2014).

Table 2-9: Residential and School Heating Fuel Usage

Community	Residential Heating Fuel, gallons/year	School Heating Fuel, gallons/year
Anaktuvuk Pass	42,255	23,868
Atqasuk	54,247	32,430
Barrow	0	SKW/Eskimos Inc.
Kaktovik	70,828	64,424
Nuiqsut	0	0
Point Hope	166,137	49,480
Point Lay	38,378	39,415
Wainwright	134,262	61,735

Consolidation of fuel purchase can reduce costs. Organization and cooperatives that consolidate fuel purchases to reduce fuel costs in Alaska includes Alaska Village Electric Cooperative (AVEC). They purchase about five million gallons annually for the 52 communities in the interior and western Alaska villages that they serve. Northstar Gas also purchases about 5 million gallons and serves villages on the Lower Kuskokwim. Western Alaska Fuel Group, who serves communities in Bristol Bay, Seward Peninsula and Kotzebue Sound, purchases about six to seven million gallons a year. The NSB also consolidates fuel purchases with fuel barges to Barrow. Recently the Borough switched over from diesel to ultra-low sulfur diesel to comply with EPA regulations.

2.7.5 OIL AND GAS

In 1900, the U.S. Navy provided the first written documentation about petroleum resources in the North Slope region. The U.S. Geological Survey (USGS) followed this report in 1901 by completing the first comprehensive geological survey for the region. The survey results, published in 1904, noted the presence of geological formations that could have petroleum deposits as well as natural oil seepages near Cape Simpson (NSB Planning, 2014).

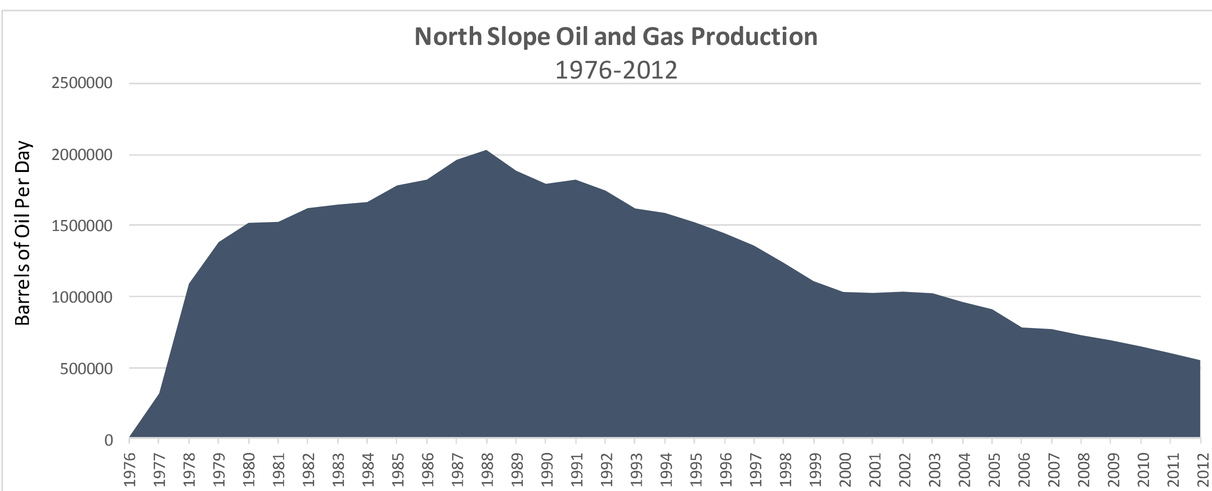
Today, the North Slope Region is considered one of the largest hydrocarbon provinces in North America, with numerous oil and gas leases in place. There are two major developments on the North Slope: Prudhoe Bay, and the Alpine oil field located in the area known as the National Petroleum Reserve – Alaska (NPR-A). In addition, gas fields near Barrow supply energy to that community.

Prudhoe Bay - Commercial oil exploration started in Prudhoe Bay area in the 1960s and the field was discovered on March 12, 1968, by Humble Oil (which later became part of Exxon) and Atlantic Richfield Company (ARCO). Production did not begin until June 20, 1977.

Prudhoe Bay is the largest oil field in both the United States and in North America, covering 213,543 acres. It is located about 200 miles east of Barrow, 400 miles north of Fairbanks and 650 miles north of Anchorage. The amount of recoverable oil in the field is more than double that of the next largest field in the United States, the East Texas oil field. The field is operated by BP; partners are ExxonMobil and ConocoPhillips Alaska. Development at Prudhoe Bay includes drilling rigs and processing facilities, along with a cluster of support services at Deadhorse. The North Slope Borough provides water and sewer and solid waste services in Prudhoe Bay and Deadhorse in support of oil industry use of the area known as Service Area 10, or SA10.

North Slope oil production peaked in 1989 at 2 million barrels per day, but fell to 943,000 barrels per day in December, 2006 and has declined since. Exhibit 9 illustrates the history of oil and gas production in the North Slope from 1976 – 2012.

Exhibit 9: North Slope Oil and Gas Production



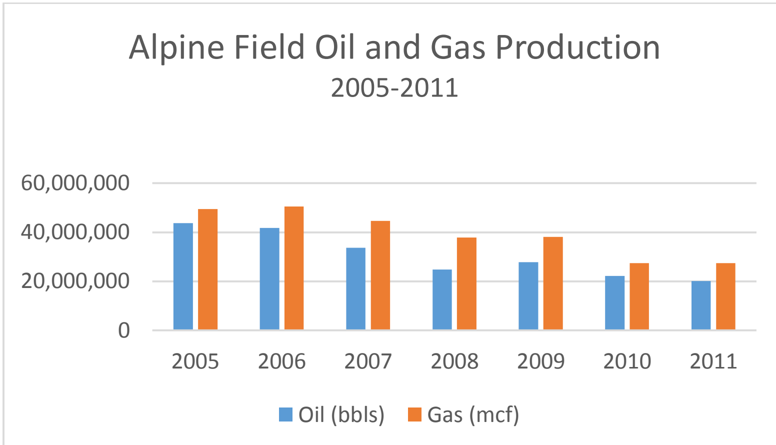
Source: State of Alaska, Oil and Gas Commission

NPR-A – NPR-A was established by President Warren Harding in 1923. Atqasuk, Barrow, Nuiqsut and Wainwright are located within or immediately adjacent to the NPR-A which is located north of the Brooks Range and west of the Colville River. It covers about 37,000 square miles, or 38.9% of the Borough.

In 2000, production began in the Alpine Oil Field. Located in the Colville River Delta twelve miles from Nuiqsut, the Alpine Oil Field is the first oil discovery on Native lands in Alaska (Arctic Slope Regional Corporation, 2014). Alpine Oil Field currently employees about two dozen residents from Nuiqsut who have jobs building ice roads, catering at work camps, drilling and security (Alex DeMarban, 2014).

Production at the Alpine Oil Field has greatly exceeded expectations but has been in a decline in recent years as shown in Exhibit 10 (State of Alaska, Alaska Oil and Gas Commission, 2014).

Exhibit 10. Alpine Field Oil and Gas Production History



Source: State of Alaska Oil and Gas Commission

Barrow - In the 1940s the U.S. Navy produced a small amount of gas out past the Naval Arctic Research Laboratory in Barrow, to fuel the lab. After World War II, the line was extended to Barrow. In 1980, two other fields were developed, the east Barrow and Walakpa fields, to provide additional gas to the growing Barrow community. Soon thereafter, Congress passed the Barrow Gas Field Transfer Act of 1984.

> *Barrow Gas Field Transfer Act of 1984*- This legislation directed the Secretary of the Interior to convey to the North Slope Borough the subsurface estate held by the U.S., including the Barrow gas fields and the Walakpa gas site, and any related support facilities, other lands, interests and funds with the right to continue to explore for, develop and produce gas for local use. (Lavrakas, 2013). The act also provided the right to the NSB to exploit gas and entrained liquid hydrocarbons from federal test wells in the National Petroleum Reserve-A (NPR-A) for local village utility uses (Atqasuk, Barrow, Nuiqsut and Wainwright).

Although oil production is a crucial source of operating revenue for the NSB, production is declining (Oil and Gas and Conservation Commission, 2014). The industry is currently developing additional fields to supplement the existing drill sites and boost production. The region also has significant natural gas reserves, and work is underway to develop these reserves to provide a future revenue source for the NSB (North Slope Borough, 2014). Currently, industry is exploring other areas to boost production.

Oil and gas development in the North Slope can limit impacts to subsistence and the natural environment. Noise, habitat alterations, oil spills and other activity can be damaging to wildlife and subsistence uses. As a result of these concerns, oil and gas industry activities are regulated by the state and federal agencies and the NSB, and future development must reflect a balance of stewardship of the land and economic growth.

2.7.6 NATURAL GAS

In 1999, the North Slope Borough constructed the Nuiqsut Natural Gas Pipeline to transport natural gas from the ConocoPhillips Alpine production pad to the village of Nuiqsut, located within the Colville River Delta. Nuiqsut joins the community of Barrow utilizing natural gas to provide heat and generate electricity.

The state's major oil companies are also taking steps to tap into the huge natural gas reserves on the North Slope. In July 2014, they applied for a permit from the U.S. Department of Energy to export Liquefied Natural Gas (LNG). The permit requested permission to export up to 20 million metric tons of LNG each year for three decades. The application indicated that total production would be 3.5 billion cubic feet of natural gas daily with some of gas being siphoned off for in-state use. They plan to have five take off points for local consumption (Alex DeMarban, 2014).

2.7.7 TRANSPORTATION

The vastness of the region and large distances between communities can make travel difficult and energy and other goods costly on the North Slope. North Slope communities are not accessible by road, and air travel is the primary means of year-round long distance transportation. In winter, this is supplemented by travel to other communities or subsistence areas by snowmachine using winter trails and in some instances ice roads are used. Within each community, a network of gravel roads accesses services and residential areas.

While air travel is the only year-round mode of transportation, a patchwork of surface transportation modes – varied depending on the time of year – support the movement of passengers and cargo within the North Slope. Alaska Airlines provides passenger service and freight delivery between Barrow, Fairbanks and Anchorage. Northern Air Cargo and Everts Air Cargo offer large cargo and fuel shipment. Rav'n Air provides small passenger service. Barges deliver freight during the summer months to Point Hope, Point Lay, Wainwright, Barrow, Nuiqsut and Kaktovik. "Cat-trains" have been used to transport freight or fuel overland from Barrow to Atqasuk during winter months (Alaska Department of Community and Regional Affairs, 2014).

Industry prepares a 12-mile long ice road between Nuiqsut and the Alpine oil production field in winter and from Alpine oil field to the Dalton Highway. Nuiqsut residents are permitted to use these ice roads to access the Dalton Highway and beyond to Fairbanks. Fuel for community use is transported primarily by barge in summer and by air or ice road in winter. Permitting is underway to make the route between Nuiqsut and Alpine Oil Field a permanent route. In 2014, the Alaska Corps of Engineers approved a wetland permit for placing gravel fill along the alignment of the proposed road (called the Nuiqsut Spur Road). The road will belong to the local Native Corporation and will provide a route to allow better access to subsistence hunting and fishing areas and to employees who work at Alpine and live in Nuiqsut.

The Dalton Highway stretches from near Fairbanks to Deadhorse near the Prudhoe Bay oil fields, but does not access any North Slope Borough communities directly. The road was initially constructed in 1974 to support work on the Trans-Alaska Pipeline System (TAPS), was opened to the public as far as Disaster Creek in 1981, and opened to public access as far as Deadhorse in 1994. There are several worksites along the route that provide support services for seasonal workers and a limited number of permanent residents.

Recently, there has been an increase in winter overland travel to the Dalton Highway from communities such as Anaktuvuk Pass, Atqasuk, Barrow, Kaktovik, Nuiqsut and Wainwright, using trucks, SUVs or rollagons. This usually occurs in the spring when the weather is warmer and the light returns. The main motivation is to purchase vehicles and also cheaper goods in Fairbanks or Anchorage. In 2013, the oil industry established an ice road to Teshukpuk Lake located about 85 miles southeast of Barrow, but this is not anticipated to be an annual event.

Photo 3: Ice road to Kuparuk, North Slope. Photo credit: Wordpress.com

One proposed transportation project under consideration in the North Slope Borough is the Foothills West Transportation Access project. It would entail construction of an all-season gravel road from the Dalton Highway to Umiat, Alaska. The road would access oil and gas resources west of the Dalton Highway along the northwestern foothills of the Brooks Range, and within the National Petroleum Reserve-Alaska (NPR-A). The Department of Transportation and Public Facilities has stated that "The road would provide both exploration and development opportunities for the area as well as facilitate a more economically feasible NPR-A development." (ADOT&PF, 2014). Drilling took place along this route in the summer of 2014.

In 2011, the United States Army Corps of Engineers (USACE) began to prepare an environmental impact statement (EIS) for the project, but the State of Alaska Department of Transportation and Public Facilities (DOT&PF) is currently re-evaluating plans for future EIS work. In response, the USACE has suspended work and closed the EIS project file. If DOT&PF decides to proceed and provide project plan information, the USACE would notify agencies and the public within 30 days after the request to re-open the file and continue the EIS process. If no additional information is provided, it is anticipated that the USACE would file a notice of termination in the federal register at the end of 2014.

A network of marked winter trails is also used for surface transportation access via primarily snow machines across the North Slope. A trail connecting Barrow, Wainwright, Point Lay and Point Hope follows the northwest coastline. An east/west trail connects Deadhorse, Nuiqsut, Atqasuk and Wainwright, while a north/south trail links Nuiqsut and Anaktuvuk Pass. The following table outlines distances on winter trails between NSB communities:

Table 2-10: North Slope Borough Inter-village Trails

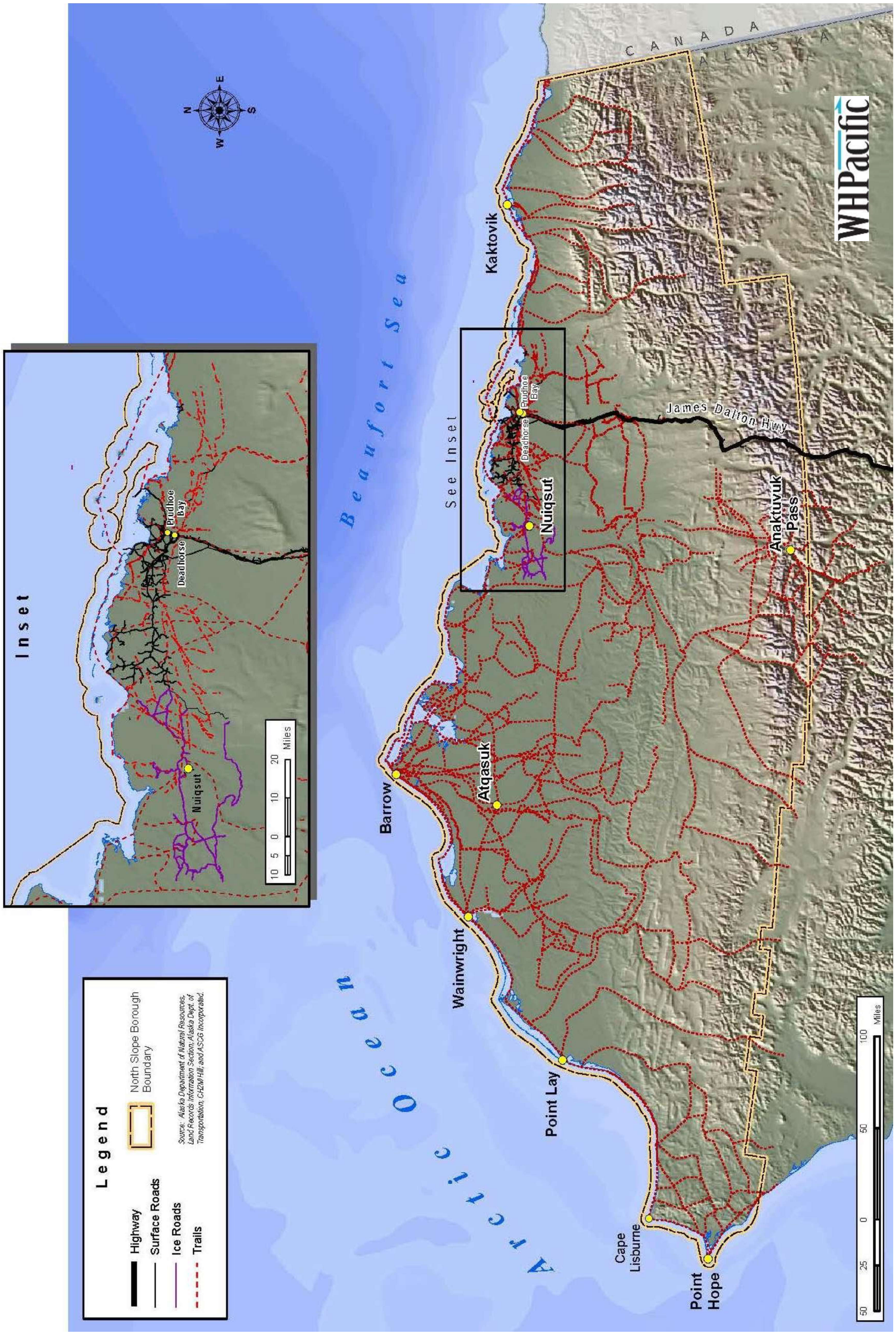
Trail Segments	Distance in Miles
Point Hope to Kivalina	80
Barrow to Atqasuk	60
Deadhorse to Nuiqsut*	60
Atqasuk to Wainwright	70
Barrow to Wainwright	90
Wainwright to Point Lay	100
Point Lay to Point Hope	120
Nuiqsut to Anaktuvuk Pass	140
Nuiqsut to Atqasuk	150
Total Mileage	870

* Trail is 17 miles from Nuiqsut to the existing Spine Road, then uses the existing Spine Road network to access Deadhorse and the Dalton Highway.

Source: Alaska Department of Transportation and Public Facilities, 2004

In addition to these inter-village routes, there are many trails used for subsistence access. Figure 5 shows the Ice roads, trails, roads and highways in the North Slope region.

Figure 5: Regional Surface Transportation



Source: 2005 NSB Transportation Plan

Chapter 3

Regional Energy Analysis

REGIONAL ENERGY ANALYSIS

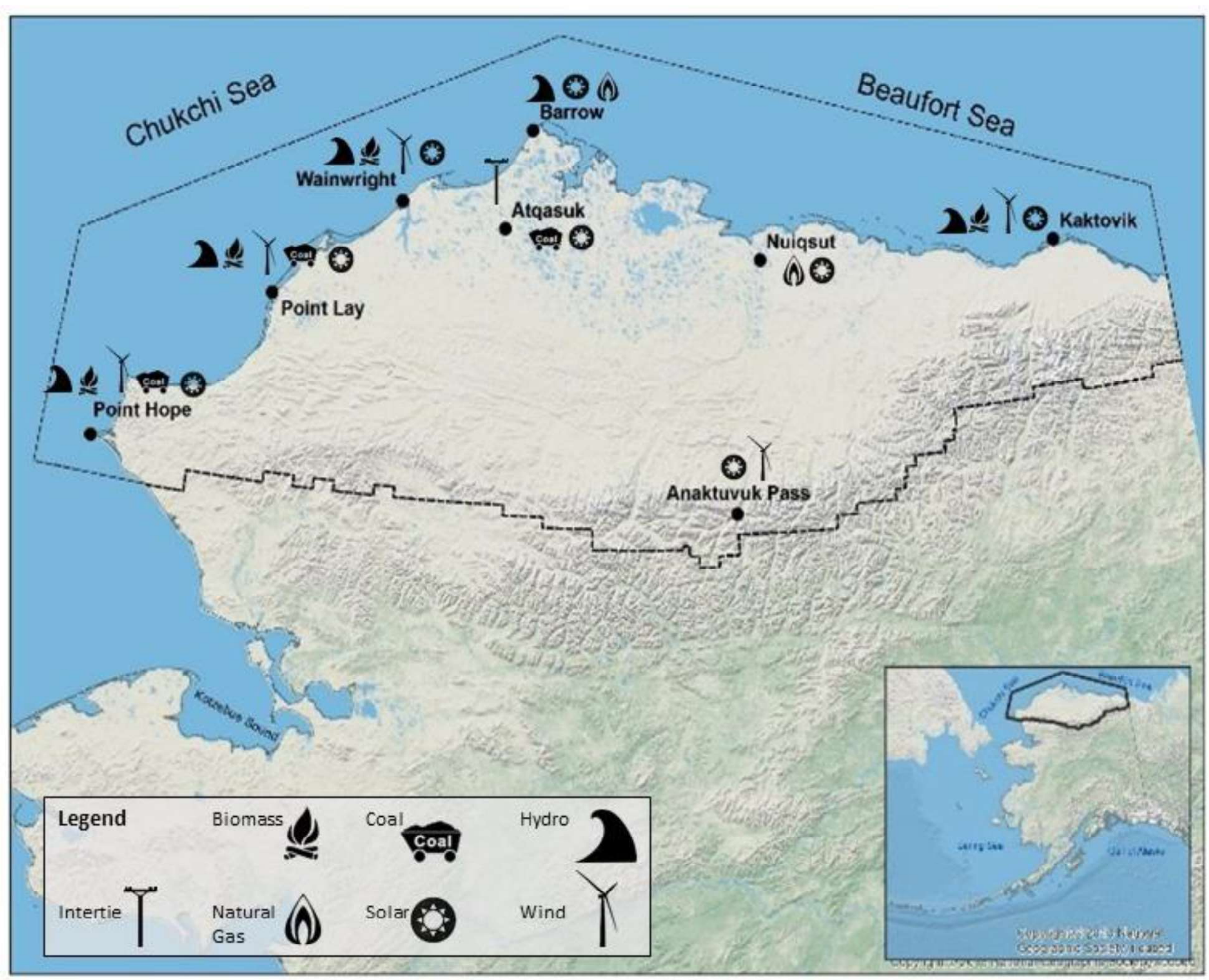
This chapter provides details about energy resources and potential opportunities in the North Slope region and outlines regional priorities

REGIONAL ENERGY ANALYSIS

Geographically, the North Slope Borough is the largest county-level political entity in the United States with vast energy resources. The breadth of the Borough presents both challenges and opportunities. Distances can make provision of services expensive and logistically complicated. However, the land presents opportunities: natural resources are plentiful, and wind and solar power development hold promise. The long winters in the Borough require enormous amounts of energy for heating buildings and keeping utilities operational, but new technology brings expanding potential for meeting these demands efficiently and affordably.

Many energy efficiency projects have been completed or are underway in the North Slope Borough, yet great potential remains for developing new, more efficient energy options on the North Slope. While energy efficiency measures are available to each of the North Slope communities, the following map shows other potential energy resources in the North Slope communities.

Figure 6: Potential Energy Resources



The following sections describe the potential energy resources and energy efficiency opportunities in the region, along with descriptions of regional priority energy projects proposed or already underway.

3.1 ENERGY RESOURCES

3.1.1 OIL AND GAS

As discussed in Chapter 2, the North Slope is a world-class hydrocarbon basin that boasts massive quantities of untapped oil and gas. Despite these vast resources, production from existing North Slope fields is declining at a much faster rate than it is being replaced. There is, however, oil and gas exploration that may find reserves that could reverse the downward trend (see Figure 8).

North Slope producers ExxonMobil, ConocoPhillips and BP, as well as pipeline company TransCanada and the state of Alaska are also in the process of an Alaska Liquefied Natural Gas (LNG) export project. If successful, it would be among the world's largest natural gas-development project. The companies estimate a cost of $45 billion to more than $65 billion (2012 dollars) for a project that includes a massive plant to cleanse produced gas of carbon dioxide and other impurities; an approximately 800-mile pipeline from Alaska's North Slope to the liquefaction plant; and an LNG plant, storage and shipping terminal at Nikiski, 60 air miles southwest of Anchorage along Cook Inlet (Alaska Natural Gas Transportation Projects, 2014).

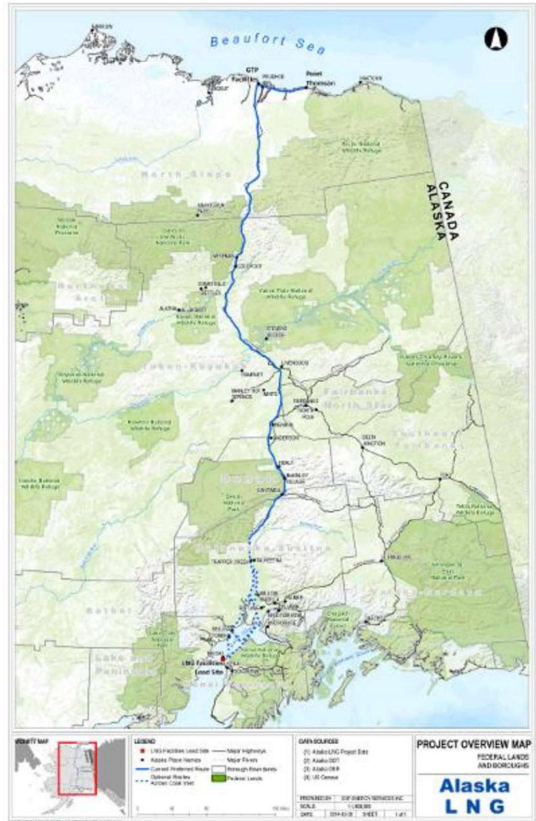
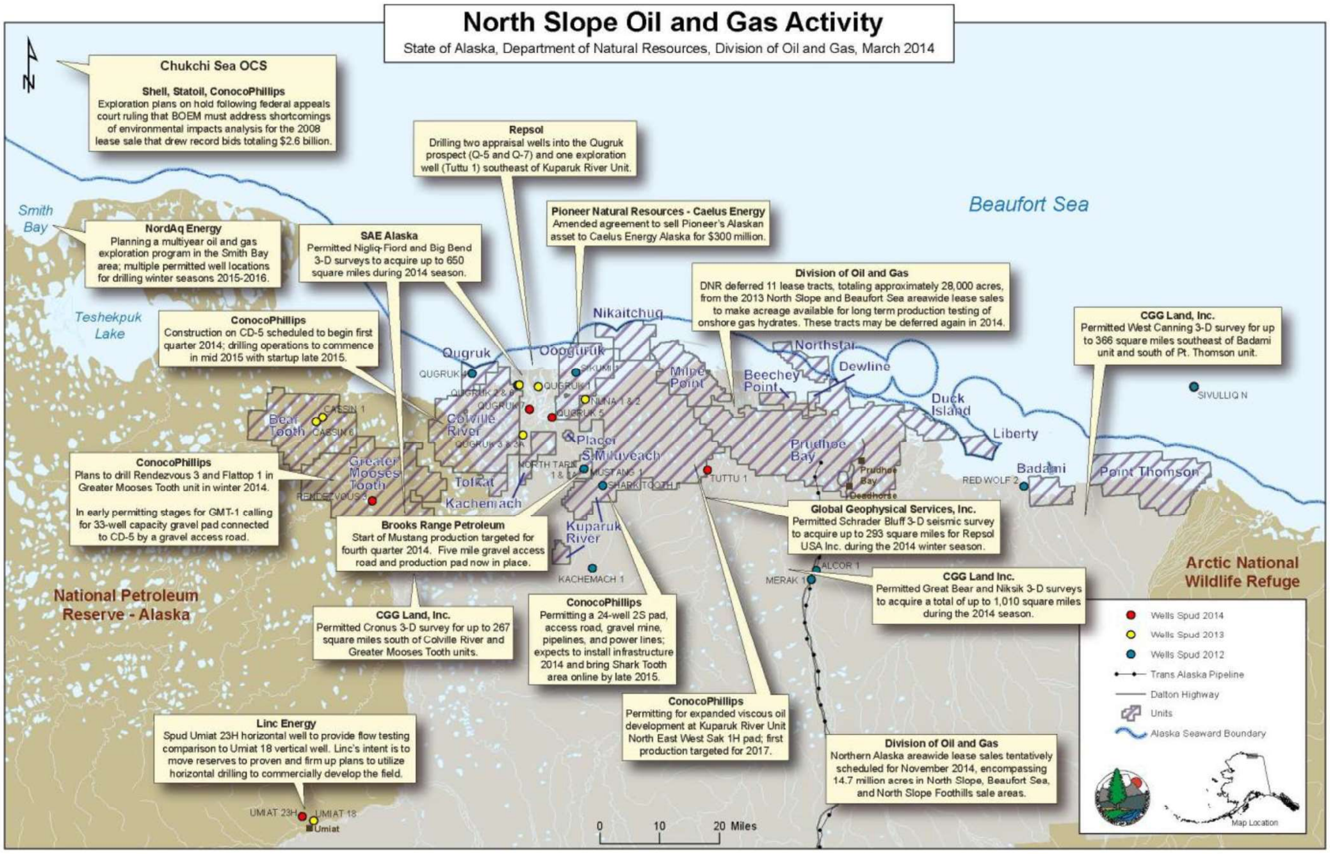


Figure 7. Alaska LNG Project Overview

The 42-inch-diameter pipeline would be built to carry 3 billion to 3.5 billion cubic feet of natural gas per day. Alaskans would use some of this gas, and running the pipeline and LNG plant would consume some. The plant would have the capacity to make up to 20 million metric tons a year of LNG, processing 2.5 billion cubic feet a day of gas. (Alaska Natural Gas Transportation Projects, 2014).

The project is in the pre-front-end engineering and design phase, which is expected to be completed in late 2015 or 2016 (Alaska Natural Gas Transportation Projects, 2014). Currently, industry is exploring other areas to boost production as shown in Figure 8.

Figure 8. North Slope Oil and Gas Activity



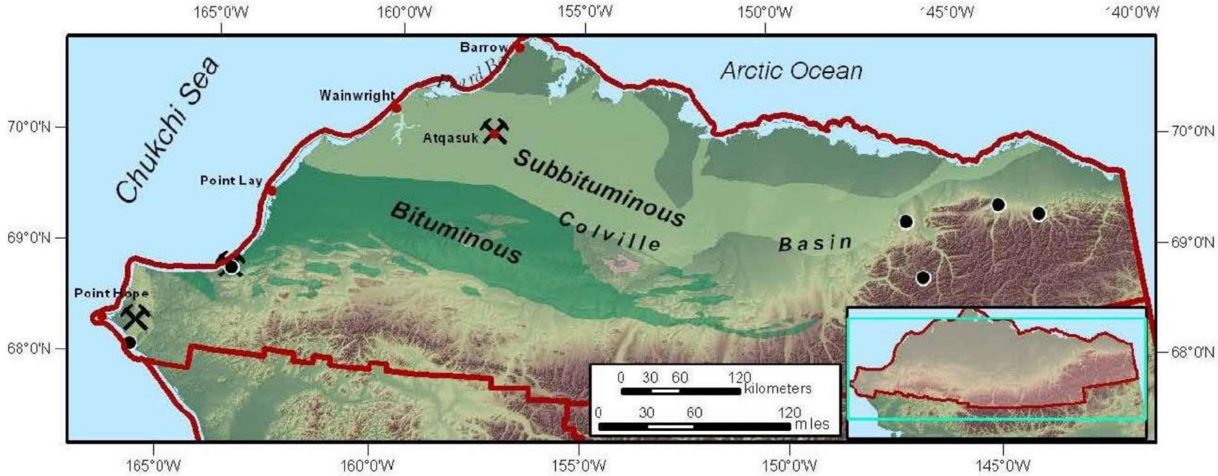
Source: Alaska Department of Natural Resources, 2014.

3.1.2 COAL

The Colville Basin, north of the Brooks Range, is the site of extensive bituminous and subbituminous coal deposits. It has been estimated that about one-third of the known U.S. coal resources are located in this area (S.A. Liss, 1989). The Cretaceous coals of the western North Slope are most relevant to discussions of rural energy due to their superior quality, rank and proximity to villages (Wartes, 2012). At the present time, there are no active coal mines in the North Slope region.

Figure 9 shows the extensive distribution of rocks bearing bituminous and subbituminous coal. Black dots indicate additional, more isolated reported coal occurrences.

Figure 9. Regional Coal Resources



Source: *Summary of fossil fuel and geothermal resource potential in the North Slope energy region* (Wartes, 2012)

ASRC, the regional Native Corporation, has assessed the coal resources in the Western arctic for more than thirty years. Four trillion tons of high quality bituminous and subbituminous coal are estimated to lie within the area known as the Northern Alaska Coal Province, an area extending 300 miles eastward from the Chukchi Sea. The Western arctic Coal is considered premium in quality due to its ultra-low sulfur content with an average of 0.23 percent sulfur, three percent moisture, and seven percent ash, it has a heating value in excess of 12,000 BTUs per pound (Arctic Slope Regional Corporation, 2014).

Small scale mining operations have used the coal in the North Slope region since the late 1800s for local resident (home and fish camps) and shipboard use (Laboratories, 1980). Many of the coal beds are exposed and close to villages. Coal underlies the villages of Atqasuk and Point Lay. Coal outcrops have also been located within 36 miles of Nuiqsut and Point Hope and coal deposits are indicated 50 miles north of Anaktuvuk Pass. The overburden is estimated to be between zero and 150 feet (Laboratories, 1980).

In 2007-2008, the U.S. Department of the Interior, with financial and logistical support from ASRC, NSB and the Olgoonik Corporation, conducted exploratory drilling for coal in Wainwright and the vicinity. They concluded that the coal bed methane (a form of natural gas extracted from coal beds) contained within shallow sub-permafrost coal seams underlying the area could serve as an alternative energy source for the community. The U.S. Geological Service has since conducted additional tests In Wainwright with similar conclusions. In 2011, the Borough applied for and received funding from State of Alaska Energy Authority (AEA) for a feasibility study to further investigate production of methane from the coal beds near Wainwright (Clark, 2014).

3.1.3 GEOTHERMAL

Currently there are no geothermal energy projects in operation in the region and there are very few recognized thermal springs in the North Slope region. Two are in the northeastern Brooks Range, not near any North Slope communities. The temperatures reported for these springs are relatively low (84°F and 120°F [29°C and 49°C]) and flow rates have not been measured (Motyka and others, 1983). Neither of these is close enough to a community to be an exploitable energy resource (Wartes).

In 2011, the NSB applied for funding to complete a geothermal study near Anaktuvuk Pass. The proposed study was to determine the feasibility of a geothermal ground source public heating system combined with waste heat from the existing Anaktuvuk Pass power plant and the waste water treatment plant. AEA did not fund this project and cited lack of reliable data to support the existence of geothermal resources in this area as the reason for rejecting the application.

3.1.4 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). Currently, there are no hydroelectric projects in the North Slope region.

"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" (Alaska Village Electric Cooperative, 2010).

According to the June 2008 North Slope Borough Master Plan and Emergency Utility Plan, much or all of Anaktuvuk Pass's electrical requirements during the summer months could be met by a hydroelectric project constructed on Contact Creek (North Slope Borough, 2008).

3.1.5 BIOMASS

Alaska's primary biomass fuels are wood, sawmill wastes, fish byproducts, and municipal waste. The North Slope environment generally does not support biomass for fuel. The one exception is the waste generated in Barrow.

3.1.6 WIND

Wind resource reports have been completed in six of the North Slope communities. As expected, communities near the coast experience higher winds than inland communities like Anaktuvuk Pass or Atqasuk. Wind power development and feasibility studies are complete for Point Hope, Point Lay and Wainwright, with Concept Design Reports (CDR) to be completed soon and design and permitting to follow. Funding has already been approved. Wind Resource Reports are complete for Anaktuvuk Pass and Atqasuk and Kaktovik. The Kaktovik Wind CDR is complete but it was not funded for design.

3.1.7 SOLAR

The world's northern latitudes offer a unique opportunity to take advantage of solar power. In Alaska, particularly in the North Slope of Alaska, there are great fluctuations in sunlight throughout the year. In the summer months (June-August), there is near 24-hour sunlight while in the winter, the sun is rarely seen. However, recent installations throughout the northern latitudes indicate that despite the long, dark winters, solar power can offset energy costs,

> The NSB Code of Ordinances recognizes the importance of solar energy to the residents of the Borough in the development of subdivisions and transportation corridors:
>
> "A conditional use or development will be granted if all of the standards set forth below are met…..
>
> > (F) Appearance and <u>solar access</u>. The proposal shall blend in with the general neighborhood appearance and shall not excessively deprive the neighbors of <u>solar access</u>. *Ordinance 75-6-23, passed 4-12-90*
>
> *Lots and Blocks: Specific Standards.*
>
> > (F) <u>Solar access.</u> For purposes of energy conservation and solar access, streets, blocks and lots should be designed where appropriate to have their long axes funning generally from east to west. This standard should be considered in connection with the prevailing wind direction…" *Ordinance 73-9-2, passed 4-5-83.*
>
> (North Slope Borough, 2014)

particularly in the spring when the sun reflects off the snow. In Ambler, the five solar panels installed in January 2013 at the power plant (8.4 kW) have displaced about 700 gallons of diesel fuel for a savings of almost $6,000 and a CO^2 offset of 13.08 tons. With the high cost of electricity and concern over climate change, solar power offers a potential solution to reducing the cost of energy (CCHRC).

In July of 2009, Tagiugmiullu Nunamiullu Housing Authority (TNHA) collaborated with Cold Climate Housing Research Center (CCHRC), Iḷisaġvik College and the Yukon River Inter-Tribal Watershed Council (YRITWC) to construct a prototype home in Anaktuvuk Pass, which included integrated Solar PV panels. The PV panels and wind generator were installed by YRITWC. Funding was received from the Denali Commission to monitor the home's energy use. All data is available online via CCHRC's website (Center, 2014). The hourly solar radiation is shown in Exhibit 11.

Photo 4. Anaktuvuk Pass Prototype Home (CCHRC)

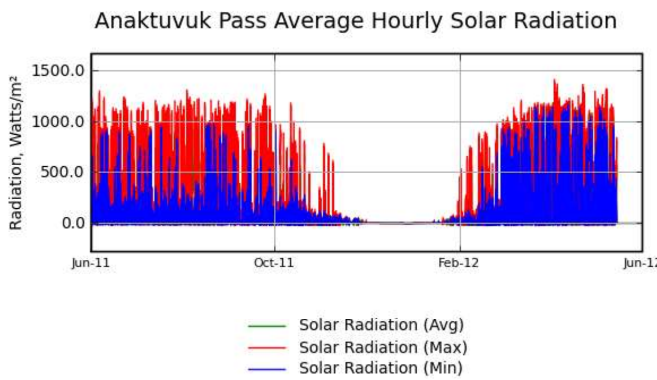


Exhibit 11: Anaktuvuk Pass Average Hourly Solar Radiation (CCHRC)

3.2 ENERGY EFFICIENCY OPPORTUNITIES

In the extreme climate of arctic Alaska, energy efficiency is the quickest way to receive the most benefit while limiting resources used. Many of the improvements, such as lighting controls and upgrades or setting back thermostats and optimizing automated controls, are relatively low cost with great energy saving benefits.

At a minimum, energy-efficiency in structures, both commercial and residential can accomplish the following:

- Conserve fuel and resources
- Lower the cost of energy consumers pay
- Stabilize energy consumption
- Promote consumer awareness
- Lessen the global emission of greenhouse gases, and
- Creates jobs

3.2.1 BASELINE ENERGY DATA

To improve energy efficiency and energy conservation it is important to understand how current energy system performs and how it performs relative to similar systems or the current system over time. Benchmarking and energy audits can help in this analysis.

Benchmarking is the preliminary data collection and analysis that takes place before an energy audit. Typical benchmark data consists of building age, square footage, occupancy, building drawings and historical energy use. By benchmarking a facility, owners and managers have the ability to see trends in a building's energy use and compare use and operating costs to other buildings. Also by benchmarking, facility owners become more aware of how their decisions on design, construction and operations dramatically affect energy usage and costs throughout the life of the building. Benchmarking serves as a valuable baseline tool to help owners understand if energy upgrades are effective.

In 2012, WHPacific completed a benchmarking effort for AEA for public facilities in communities statewide. The information was incorporated in the AEA's End Use Study that documented baseline data on energy use in residential and nonresidential buildings. The study included general information about 148 public facilities on the North Slope (excluding Barrow) derived from telephone surveys and was highly dependent on availability of building owners with knowledge of the building. The data included size, owner, age and building type. The study also included some limited energy information on 44 NSB public facilities. Generally, the energy information was limited to annual electricity use by kWh or the amount of fuel oil used annually. This information will be useful to compare after energy efficiency improvements are complete.

Another way of gathering baseline energy data is to perform a building energy audit. The audits are generally done by certified energy auditors and contain detailed physical information about the structure. The audits also identify low- or no-cost efficiency projects that can be undertaken in the short term to jump start conservation efforts. The scope of an energy audit generally includes evaluating the building shell, lighting, other electrical systems, and heating, ventilating, and air conditioning (HVAC) equipment. Measures are selected such that an overall simple payback period of 8 years or less could be achieved.

Energy Efficiency for Regional Planning

…Energy efficiency and conservation (EE&C) are the low hanging fruit of efforts to meet sustainable energy goals. In Alaska, a defining energy goal is to improve energy efficiency by 15% between 2010 and 2020.

AEA Energy Efficiency and Conservation

In 2011, the Alaska Housing Finance Company (AHFC) contacted all boroughs, cities and school districts, and offered a free investment grade audit (IGA report) to those who responded. They conducted audits on over 327 buildings statewide and prepared IGA reports that recommended energy efficiency projects tailored to the public facility. During this effort, AHFC performed energy audits on public facilities across the NSB. The sample included a wide range of building types throughout the region including audits schools, safety or fire departments, storage or public works buildings and the Iñupiat Heritage Center in Anaktuvuk Pass.

Energy audits were also part of a state and national Energy Efficiency Community Block Grant (EECBG) program available to municipalities and Tribes. These grants also included limited funding for recommended energy efficiency improvements identified in the energy audits. Below is a table summarizing energy benchmark data gathered from the AEA End Use Study and energy audits performed as part of the AHFC and state and federal EECBG programs.

Table 11. Number of Public Buildings with Energy Survey or Audits

Community	# of Public Buildings Surveyed or Audited		
	AEA Surveys	AHFC Audit	EECBG Audits
Anaktuvuk Pass	18	3	3
Atqasuk	25	3	1
Barrow	0	13	3
Kaktovik	30	3	0
Nuiqsut	28	2	1
Point Hope	21	2	2
Point Lay	13	3	0
Wainwright	13	2	2
TOTAL	148	31	12

Source: AEA End Use Study, Energy Efficiency.org and DOE Weatherization and Intergovernmental Program

The energy audits performed on the North Slope revealed that there are substantial opportunities to improve energy efficiency in buildings across the region. More details about recommended energy efficiency measures are contained in the individual audits and summarized in the Energy Profiles included in Chapter 4.

Residential baseline energy data in rural Alaska is woefully inadequate. Benchmark data is difficult to obtain per household. The best data is for those homes that received an energy audit, usually done with the Energy Rebate program as described in section 3.1.2 but participation in that program in the North Slope is extremely low.

3.2.2 WEATHERIZATION

Several state and federal programs address weatherization to varying degrees of success. The State of Alaska – Alaska Housing Finance Corporation (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 (AHFC Weatherization Programs, 2013). The North Slope Borough's Public Works Department manages these funds in the North Slope region. Since 2008, the weatherization program has weatherized nearly 100 homes in Anaktuvuk Pass, Atqasuk, Barrow, Kaktovik, Nuiqsut, Point Hope, Point Lay, and Wainwright.

The State of Alaska's Home Energy Rebate program, also managed by AHFC, has had minimal participants within the region. From 2008 through the middle of April 2014, only nine initial 'As-Is' energy ratings and one energy rebate in Barrow have occurred.

In 2012, AHFC's Supplemental Housing Development Grant program, which provides grants to Housing Authorities for certain construction features that HUD does not cover, awarded a grant to TNHA for $1.3 million for single family units "Sustainable Northern Shelters" in Anaktuvuk Pass, Atqasuk, Nuiqsut, Wainwright, Kaktovik, and Point Lay. A prototype home was constructed in Anaktuvuk Pass in 2009 and two prototype homes were constructed in 2010 in Atqasuk.

The Village Energy Efficiency Program (VEEP) provides energy efficiency audit and upgrade services to Alaska communities with population of 8,000 or less. Grants cover improvements for public and community buildings. This includes upgrades to the building envelope, domestic hot water, HVAC controls, heating, lighting, motors and pumps and ventilation. To date, North Slope communities have not participated in this grant program.

The Native Village of Barrow Housing Department has completed the following weatherization projects with funds provided by the Alaska Housing and Finance Corporation (AHFC):

- 14 New Construction homes
- 18 Substantial Rehabilitation homes
- 100+ Residential Emergency Repair Program participants (repairs of broken windows, doors etc. on a first come, first serve basis)

There were two weatherization programs that assisted North Slope communities with weatherization of public buildings using American Recovery and Reinvestment Act (ARRA) fund. In 2010, the Alaska Energy Authority distributed $5,180,490 to eligible Alaska cities and boroughs for energy projects through the Energy Efficiency and Conservation Block Grant (EECBG) program. The funding supported energy efficiency and conservation improvements to public buildings and public facilities. There was no matching fund requirement and projects had to be complete by August 2012. The program brought in $366,600 to the North Slope in five communities.

The Department of Energy (DOE) had a similar program for eligible Tribes or Tribal Consortiums that distributed a total of $215,600 to three North Slope communities. In addition, the Iñupiat Communities of the arctic Slope received $32,500, making the total Tribal EECBG grants awarded $248,100.

The state and federal EECBG grant amounts are summarized by community in Table 3-12.

Table 3-12: 2010 Energy Efficiency and Conservation Block Grants on the North Slope

Community	EECBG to City Grant Amount	EECBG to Tribe Grant Amount	TOTAL
Anaktuvuk Pass	$32,200	$42,800	$75,000
Atqasuk	-0-	$43,500	$43,500
Barrow	$173,800	$129,300	$303,100
Kaktovik	-0-	-0-	$0
Nuiqsut	$43,100	-0-	$43,100
Point Hope	$65,700	-0-	$65,700
Point Lay	-0-	-0-	$0
Wainwright	$51,800	$32,500	$84,300
TOTAL	**$366,600**	**$248,100**	**$614,700**

3.2.3 WATER AND SEWER

The NSB is responsible for the production, treatment, and delivery of water and wastewater collection for all seven villages. In Barrow, Barrow Utilities & Electric Co.-Op., Inc. (BUECI) is responsible for sewer and water in Barrow. The water delivery and sewer collection systems in the North Slope are predominately piped underground systems. Transmission varies by village and includes gravity, pressure, and vacuum systems. There are still a few homes that rely on water and sewer haul systems, especially in newly developed areas.

Water needs to be heated with fuel oil and kept constantly circulated with electric pumps to keep from freezing. The sewer mains and service lines are also heated during parts of the year with electrical heat trace or glycol circulation loops. As a result, energy costs associated with sewer and water utilities place a huge burden on the operator. The Borough reports that for water and sewer services they use almost 10.5 million gallons of fuel a year as shown by community in Table 3-13. Residents pay $69.00 a month for up to 3,000 gallons for water. Seniors pay $14.00 a month for up to 3,000 gallons. Any household using over 3,000 gallons/month is charged at the rate of $0.2 cents per gallon.

Table 3-13: NSB Energy Costs for Water Sewer

Community	Average Annual Water and Sewer System Electricity Use	Cost of Electricity Used by Water and Sewer Systems	Reported Annual Fuel Use for Sewer and Water Systems
	kWh	$	gallons
Anaktuvuk Pass	124,539	$496,726	1,494,467
Atqasuk	120,702	$473,450	1,448,419
Barrow	BUECI	BUECI	BUECI
Kaktovik	122,170	$481,659	1,466,036
Nuiqsut	116,041	$207,390	1,392,497
Point Hope	125,266	$503,157	1,503,190
Point Lay	87,342	$345,234	1,048,098
Wainwright	172,384	$696,331	2,068,608
Total	**868,444**	**$3,203,948**	**10,421,315**

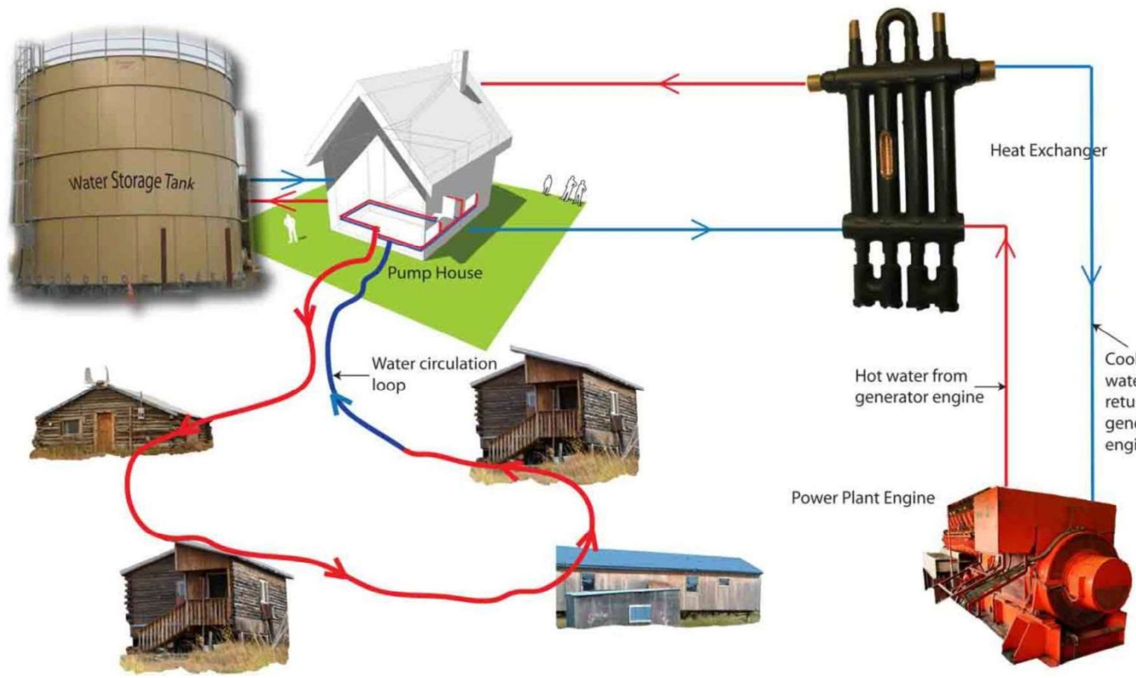
According to Alaska Native Tribal Health Consortium (ANTHC) sanitation systems account for between 10-35% of a community's total energy use (Dixon, 2013). According to recent studies done in the Northwest arctic, electric energy makes up approximately 30 to 33 percent of the annual utilities energy requirement, while heating requirements account for the remaining 67 to 70 percent of the load (Mitchell, 2013).

While the sewer and water systems in the region are generally considered sufficient for anticipated growth within the next 10-15 years (North Slope Borough, 2008), improvements can be made to insure reliability and to reduce energy use. Significant energy savings can occur through the capture of waste heat, incorporating the use of alternative energy and carefully calibrating the operating system, such as operating pressures and temperatures and pumping flow rates.

3.2.4 HEAT RECOVERY

The largest single energy saving measure is the implementation of waste heat recovery from the 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 12 illustrates the heat recovery system process.

Exhibit 12: Heat Recovery System Illustration



(Alaska Native Tribal Health Consortium, 2012)

In the North Slope, there are several heat recovery projects in place and more planned for the future.

3.2.5 INTERTIES

One means of reducing the cost of energy production is to share expenses and resources across a cluster of communities, but distances are so great between North Slope Borough communities that there are few locations where interties are economically practical. The NSB could consider transmission lines from Barrow to Atqasuk and Atqasuk and Wainwright if natural gas continues to be unavailable locally. Power generated using natural gas could be moved from Barrow to Atqasuk, and power generated from natural gas in Wainwright or Atqasuk could be moved between those communities. However, if natural gas were available in these communities, an intertie would no longer be needed (North Slope Borough, 2008).

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, 2014). This type of system may be practical in the North Slope Borough.

In 2011, the North Slope Borough applied for and received $210,000 for Atqasuk Transmission Line design and permitting from AEA’s Renewable Energy Fund program (Renewable Energy Alaska Project, 2011).

3.2.6 OTHER ENERGY EFFICIENCY TECHNOLOGY

Energy efficiency technology is advancing at a rapid pace with the government teaming with universities, national laboratories and industry to advance research, development and commercialization of energy efficient and cost effective building technologies. One way to advance energy efficiency is through better tracking of energy use. Below are several means of tracking energy use.

Individual meter units. Single outlet kilowatt monitors connect to appliances and assess efficiency of energy consumption by the kilowatt-hour. These units can monitor electricity consumption and expenses by the day, week, month, or year. By gaining awareness of consumption, the user can implement energy-efficiency measures.

TED meters. "The Energy Detective" meter (TED) 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 TED device. A "smart" energy meter placed within households allows each individual to monitor energy usage and predict monthly electric cost. The TED meter shows energy use in real time and also warns when the power cost equalization (PCE) or NSB subsidy limit has been reached (600 kWh), the point at which the cost dramatically increases. The average TED user saves 5-30% off their electricity bill when using these meters.

SmartGrid. "Smart grid" generally refers to a class of technology that uses computer-based remote control and automation to reduce electrical costs. These systems are made possible by two-way communication technology and computer processing that has been used for decades in other industries. Much in the way that a "smart" phone these days means a phone with a computer in it, smart grid means "computerizing" the electric utility grid. It includes adding two-way digital communication technology to devices associated with the grid (DOE). These smart grid upgrades add four features to the existing grid:

1. Upgrade power meters with TED meters, which have two-way communication capability – allowing the utility to retrieve data remotely, as well as disconnect or limit customers' electrical consumption for non-payment.
2. Install IHD (In Home Display) units 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 the utility to shut down small portions of the grid for repairs or upgrades instead of shutting down the entire grid.
4. Control usage by household and billing.

Other Technology. There are other ways that utilities can use technology to improve energy efficiency such as the following:

Microgrid**.** Microgrid power systems are small-scale power-generation solutions consisting of local power-generating facilities and individual homes and buildings equipped with wind and solar power systems. This type of distributed power generation is a lower-cost alternative to large-scale systems.

Microturbines. Microturbines generate both electric and thermal energy. Using both maximizes efficiency and minimizes a facility's energy bills. Using both energy outputs is called cogeneration or combined heat and power (CHP). Onsite CHP is far more fuel efficient and environmentally beneficial than utility power and traditional boiler methods. The grid-parallel electricity produced lowers a facility's demand on utility power and dramatically cuts monthly power bills. The heat can be used for water/steam/space heating and/or process heating or drying. This offsets fuel consumed by less efficient boilers or heaters. The heat output of microturbines can also be used to cool a facility via absorption chilling.

In addition to burning liquid fuels such as diesel, kerosene, jet fuel, and liquid bio fuels, microturbines can burn almost any carbon-based gaseous fuel: natural gas, propane, methane and other waste gases to create renewable power and heat. Waste material buried in landfills biodegrades over time to produce methane, carbon dioxide, and other gases. Treatment of domestic wastewater, agricultural waste and food processing waste using anaerobic digestion also produces methane and other gases. Many sites flare these waste gases; or worse yet vent them directly into the atmosphere. Methane has a greenhouse gas impact on the atmosphere that is 21 times that of carbon dioxide, and burning methane in a flare completely wastes its energy value (Capstone Microturbines).

***Fuel Additives*.** Fuel additive products can help maximize vehicle fuel efficiency and help to avoid problems such as rough idling, weak acceleration, stumbling and stalling. Fuel additives have lower emissions and therefore reduce toxic pollutants including nitrogen oxide, improving air quality. Prudhoe Bay Service Area 10 (SA-10) has reduced vehicle fuel consumption by 10-15% efficiency by using fuel additives in their vehicles.

Emerging Technologies. Researchers are in the process of advancing energy technology in many ways that have not yet come to market such as improved storage (like fuel cells and hydrogen energy storage and transport), harnessing the power of tidal energy, advancing battery manufacturing and biofuels (Zappa, 2014).

Tidal Energy. Advanced ocean power technologies fall into three general categories: ocean thermal energy conversion (OTEC), tidal energy, and wave energy. OTEC technology requires warm waters and therefore is not suitable for development in Alaska. However, tidal and wave energy may prove useful in expanding Alaska's energy diversity and providing stably priced power to Alaskan residents (REAP, 2014).

Waves and tidal currents off Alaska's coastline could generate more than 850 terawatt-hours of electrical energy annually if fully developed, according to two reports released by the U.S. Department of Energy (Spence, 2012).

In Homer, Alaska, the local electric utility, Homer Electric Association, has teamed with Ocean Renewable Power Company to investigate the potential for tidal and wave energy in Cook Inlet. Ocean Renewable Power Company has a permit that allows them to study the area and then to submit a license application for a pilot tidal project that could eventually produce up to 5 megawatts of electricity, enough to energize about 2,300 homes. They also have a permit to study the tidal energy potential near Fire Island near Anchorage (Spence, 2012).

The potential for tidal energy has not been investigated in the Arctic Ocean, but with the extreme climate and ice conditions, any water technologies will need to be arctic tested.

3.3 REGIONAL ENERGY PRIORITIES

The following table contains regional energy priorities. Local energy projects are identified in the Community Summaries contained in the next chapter. The regional projects were identified through capital projects lists and discussions with Borough officials and stakeholders. They are broken down into the following time tables:

- Immediate projects which are currently underway or expected to begin in the next 12 months,
- Short range, expected to start within 1-5 years,
- Medium range projects expected to take place between 5-10 years, and
- Long range projects which are expected to occur beyond 10 years and can be more speculative in nature.

Timeframe	Project Name	Estimated Costs in 2014 Dollars
Energy Efficiency and Education		
Immediate 0-1 year	Conduct community outreach and educational energy fairs. *Source: Trilateral Meetings, winter 2014, 2014 North Slope Regional Energy Plan*	TBD
	Collaborate with TNHA, Native Village of Barrow, CCHRC and other arctic building specialists to identify energy-efficient, arctic climate appropriate structures. *Source: 2014 North Slope Regional Energy Plan*	TBD
	Require bidders on all new facilities to research and present at least one demonstration energy conservation feature, system or material application. *Source: NSB 1981 Energy Policies*	TBD
	Incorporate energy policies in the employee handbook to encourage energy efficiency practices among NSB employees. *Source: NSB 1981 Energy Policies*	TBD
	Identify energy conservation strategies for public and private structures and vehicles. *Source: NSB 1981 Energy Policies*	TBD
Short 1-5 years	Implement RurAL CAP Energywise Program in each village. *Source: 2014 North Slope Regional Energy Plan*	TBD
	Integrate AKSmart Energy curriculum in schools. *Source: NSB Trilateral Meetings, winter, 2014, 1981 NSB Energy Policies*	TBD
	Install metering systems, such as TED and smart meter grids, to track and collect energy production, consumption and cost. *Source: 2014 North Slope Energy Regional Plan*	TBD
	Develop and maintain matrix showing current cost of energy. *Source: 2014 North Slope Regional Energy Plan*	TBD
	Conduct study to determine actual heating costs. *Source: 2014 North Slope Regional Energy Plan*	TBD
	Calculate life-cycle energy costs for all proposed new Borough facilities. *Source: 1981 NSB Energy Policies*	TBD
	Create a building code that emphasizes sound energy efficient arctic construction. *Source: NSB 1981 Energy Policies*	TBD
	Design and construct energy-efficient, arctic climate appropriate structures *Source: 2014 North Slope Regional Energy Plan*	TBD
	Complete energy audits on public buildings and implement recommendations. *Source: 2014 North Slope Regional Energy Plan*	TBD

Table 3-14: Regional Energy Project Information

Maintenance and Operations		
Immediate 0-1 year	Train employees for new systems, including water and sewer, housing and power generation. *Source: 2014 North Slope Regional Energy Plan*	TBD
Energy Infrastructure		
Short 1-5 years	Reassess current failing systems – such as water and sewer and redesign for environment and energy efficiency as needed. *Source: 2014 North Slope Regional Energy Plan*	TBD
	Reevaluate current design of systems and incorporate emerging energy technologies as appropriate. *Source: 2014 North Slope Regional Energy Plan*	TBD
	Upgrade fuel tanks for safety and capacity. *Source: Section 13 - Light, Power, and Heating Systems.*	$100,000

	Dispose of hazardous materials related to energy production throughout the NSB. *Source: Section 13 - Light, Power, and Heating Systems.*	$5,000,000
	Perform upgrades to power generation systems throughout the NSB. *Source: Section 13 - Light, Power, and Heating Systems.*	$5,500,000
	Invest in wind generation throughout the NSB wherever feasible. *Source: Section 13 - Light, Power, and Heating Systems.*	TBD
	Install generators at Walakpa Gas Field. *Source: Section 13 - Light, Power, and Heating Systems.*	$2,343,000
	Demolish, remove, and clean up out of service fuel tanks. *Source: Section 13 - Light, Power, and Heating Systems*	$1,230,000
	Install system to electronically manage fuel tanks most efficiently. *Source: Section 13 - Light, Power, and Heating Systems*	$1,500,000
	Upgrade village power distribution grids. *Source: Section 13 - Light, Power, and Heating Systems*	$5,778,000
	Install and upgrade fuel truck loading racks. *Source: Section 13 - Light, Power, and Heating Systems*	TBD
	Fuel delivery vehicles region wide. *Source: Section 13 - Light, Power, and Heating Systems*	$900,000
	Upgrade electric metering. *Source: Section 13 - Light, Power, and Heating Systems*	$150,000
	Upgrade fuel heater containments. *Source: Section 13 - Light, Power, and Heating Systems*	$300,000
	Upgrade to more efficient street lighting across the NSB. *Source: Section 13 - Light, Power, and Heating Systems*	$400,000
Long >10 years	Upgrade trucks serving the high voltage line. *Source: Section 13 - Light, Power, and Heating Systems*	$1,000,000
Planning		
Immediate 0-1 year	Adopt an energy element into the local and regional comprehensive plans. *Source: NSB 1981 Energy Policies*	TBD
	Refer to energy plan during the CIP review process. *Source: 2014 North Slope Regional Energy Plan*	TBD
Medium 5-10 years	Update the North Slope Regional Energy Plan on a regular basis. *Source: NSB 1981 Energy Policies*	TBD
	Update NSB Comprehensive Plan to include the North Slope Regional Energy Plan. *Source: NSB 1981 Energy Policies*	TBD

Energy Financing		
Short 1-5 years	Analyze current electrical costs, NSB electrical rates and consider ways to increase PCE subsidy. *Source: 2014 North Slope Regional Energy Plan*	TBD
	Provide incentives for bill payment through education and energy efficiency measures that reduce monthly bills. *Source: 2014 North Slope Regional Energy Plan*	TBD
Communication		
Immediate 0-1 years	Provide means to assist with communication between departments and energy plan implementation. *Source: 2014 North Slope Regional Energy Plan*	TBD
	Conduct community outreach meetings, school presentations and energy fairs in each village. *Source: 2014 North Slope Regional Energy Plan*	TBD

Chapter 4

Community Summaries

COMMUNITY SUMMARIES

This chapter provides an overview of each community, their energy use, and available energy resources and outlines local energy priorities.

COMMUNITY SUMMARIES

The eight communities on the North Slope are more isolated geographically from one another than those of any other Alaskan region. There is little opportunity for sharing of energy resources between communities, although there have been discussions of potential interties.

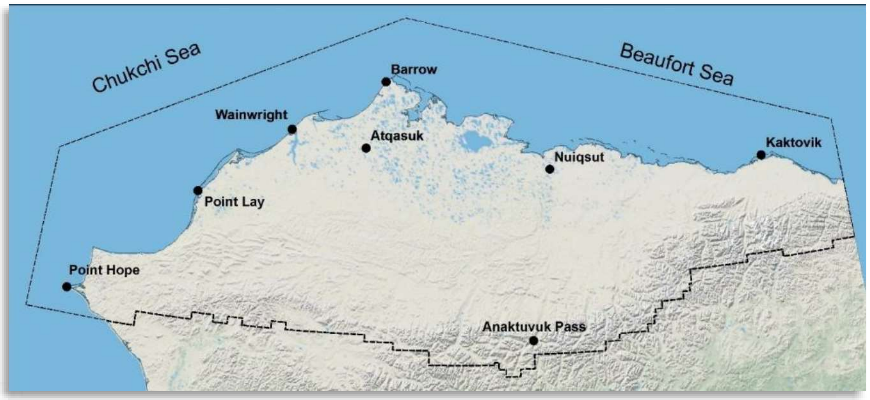


Figure 10. North Slope Community Location Map

The following sections contain a community and energy profile for each of the eight North Slope communities along with a list of energy priorities that was developed through literature research and with input by North Slope Borough staff, elected local and regional leaders, industry representatives, local leaders and the public.

The community profiles contain general information about the location, economy, historical and cultural resources, planning, demographics, contacts and infrastructure. In addition, the community profiles include information about AEA and DOE's Energy Efficiency Community Block Grants and Village Energy Efficiency Program (VEEP) program that funded energy efficiency improvements. Also included is information about the 2010 AHFC audits. These energy grade audits detail improvements that could be made to make buildings more energy efficient.

The energy profiles for each community provide an overview of energy production and distribution. It is intended to provide a snapshot of local energy conditions. Following the energy profiles for each community is a priority energy matrix with actions intended to reduce energy use and minimize energy costs to the utility and to the consumers.

Anaktuvuk Pass

Anaqtuuvak

Community and Energy Profile

Community Profile: Anaktuvuk Pass

Incorporation	4th Class City, 1959 / 2nd Class City, 1971		
Location	250 miles southeast of Barrow. 250 miles northeast of Fairbanks. Within the boundaries of the Gates of the arctic National Park and Preserve.		
Longitude	-151.7358	**Latitude**	68.1433
ANCSA Region	Arctic Slope Regional Corporation (ASRC)		
Borough/CA	North Slope Borough		
School District	North Slope Borough School District		
AEA Region	North Slope		

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

Economy

Subsistence based - harvesting caribou, fish, birds and berries. Employment: Private sector <25%; NSB 39%, NSBSD 23%. Arts sales: Carvings, caribou skin masks.

Climate	Avg. Temp.	Climate Zone	Heating Deg. Days
	-14/50	Continental	16,504

Natural Hazard Plan	
Hazard Mitigation Plan (Borough-wide)	2007

Community Plans	Year
Comprehensive Plan Update	2005

Alaska Native Name (definition)

Anaqtuuvak "Place of Caribou Droppings"

Historical Setting / Cultural Resources

Located on a historic caribou migration route, this is the last remaining settlement of the inland Iñupiat Eskimo, the Nunamiut, who left the Brooks Range and scattered in the 1900s. The Simon Paneak Memorial Museum is open year round. It provides information on the natural, geological and cultural history of the area, including the migration of people across the Bering Land Bridge, and displays early Nunamiut clothing, household goods and hunting implements.

Local Contacts	Email	Phone	Fax
North Slope Borough	lloyd.leavitt@north-slope.org	907-852-0200	907-852-0337
City of Anaktuvuk Pass	klwagner@cityofakp.org	907-661-3612	907-661-3613
Village of Anaktuvuk Pass	akp@Iñupiatgov.com	907-661-2575	907-661-2576
Nunamiut Corporation		907-661-3026	

Demographics	2000	2010		2013
Population	346	388	**Percent of Residents Employed**	72.00%
Median Age	23	25	**Denali Commission Distressed Community**	Yes
Avg. Household Size	3.6	3.6	**Percent Alaska Native/American Indian (2010)**	83.00%
Median Household Income	N/A	$47,143	**Low and Moderate Income (LMI) Percent (201x)**	44.9%

Electric Utility	Generation Sources	Interties	PCE?
North Slope Borough Public Works	Diesel	No	Yes

Landfill	Class	III	Permitted?	Yes	Location	2.1 miles northeast of community

Water/Wastewater System		Homes Served		System Volume
Water	Buried pipe system, well water	90% on water system		N/A
Sewer	Flush toilets 90%; Honey Buckets, 10%	**Water/Wastewater Energy Audit?**	No	
Notes				

Access					
Road	"Cat-trains" from the Trans-Alaska Pipeline haul road				
Air Access	Anaktuvuk Pass	**Runway 1**	4,760'x100'	**Runway 2**	N/A
		Runway 3	N/A	**Runway 4**	N/A
Dock/Port	No	**Barge Access?**	No	**Ferry Service?**	No

Energy Profile: Anaktuvuk Pass

Power House

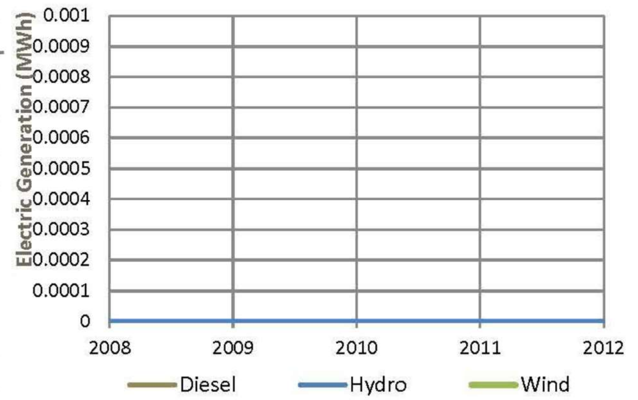
Utility	NSB Public Works, Utilities Division		
Generators	**Make/Model**	**Rated Capacity**	**Year**
Unit 1	Caterpillar 3412	325 kW	1994
Unit 2	Caterpillar 3412	325 kW	1994
Unit 3	Caterpillar 3412	325 kW	1994
Unit 4	Caterpillar 3512	910 kW	No Record
Unit 5	Caterpillar 3512	910 kW	No Record
Line Loss		**Yes**	
Heat Recovery?	**Public Works Building and Fire Station**		
Upgrades?			
Outage History/Known Issues			

Operators	No. of Operators	Training/Certifications

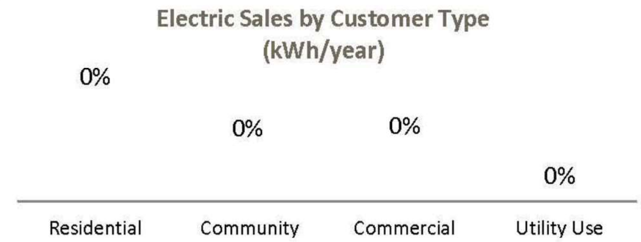
Maintenance Planning (RPSU)

Power Production

Diesel (kWh/yr)		Avg. Load (kW)	
Wind (kWh/yr)		Peak Load (kW)	734 kWh, April 2(
Hydro (kWh/yr)		Efficiency (kWh/gal)	
Total (kWh/yr)		Diesel Used (gals/yr)	



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



Electric Rates ($/kWh)		Cost per kWh Sold ($/kWh)	
Rate with PCE	0.15	Fuel Cost	
Residential Rate	0.15	Non-fuel Cost	
Commercial Rat	.20 -.35 (varies)	Total Cost	$1.05

Fuel Prices ($)	Utility/Wholesale	Retail	Senior
Diesel (1 gal)	9.25	1.55	1
Other Fuel? (1 gal)			
Gasoline (1 gal)	9.65	9.65	9.65
Propane (100#)	390	390	390
Wood (1 cord)			
Pellets			
Discounts?			

Alternative Energy	Potential	Projects	Status
Hydroelectric	Medium	Feasibility Study needed for Contact Creek	
Wind Diesel	Low	Class 2 Wind Resource (V3Energy)	
Biomass	Medium	Resource available – no studies	
Solar	High	CCHRC Prototype home	
Geothermal	Medium	Feasibility Study needed	
Oil and Gas	Low/Medium	Community reported natural gas as a possibility, further research needed	
Coal	Low	no known source near by	
Emerging Tech	Unknown		
Heat Recovery	High	NSB Public Wokrs Building and Fire Station	
Energy Efficiency			

Bulk Fuel

Tank Owner	Fuel Type(s)	Capacity	Age/Condition
NSB Public Works	Gasoline	37000 (2 tanks)	
NSB Public Works	Diesel	247972 (21 tanks)	

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

Cooperative Purchasing Agreements

Notes

Energy Profile: Anaktuvuk Pass

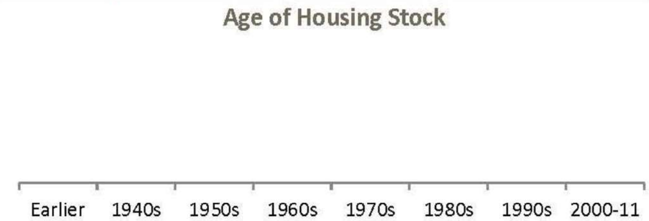
Housing Units	Occupied	Vacant	% Owner-Occup.
	99	19	60%

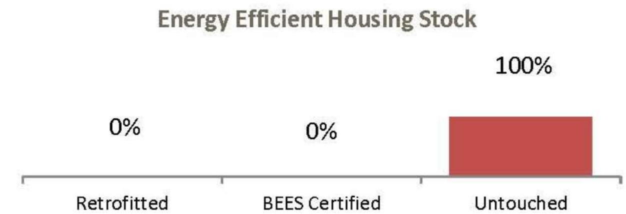
Regional Housing Authority | **Weatherization Service Provider**

Housing Need		Overcrowded	1-star

Energy Use	Average Home Energy Rating	Average Square Feet	Avg. EUI (kBTU/sf)

Data Quality





Lighting	Upgraded?	Owner	Notes

Non-residential Building Inventory

Building Name or Location	Year Built	Square Feet	Audited?	Retrofits Done?	In ARIS?
Fire station			AHFC		
M&O Shop			AHFC		
Nunamiut School					
Heavy equipment shop					
Simon Paneak Mem. Museum					
Airport terminal building					
Post office					
Senior Housing 5-Plex					
NPS Building Wind Turbine					
Presbyterian Pastor Housing					
Power Plant					
Sewer treatment building					
Washeteria					
Water treatment building					
Health center					
Public safety building			AHFC		
Tribal building			VEEP		
City bldg. / community hall			VEEP		
Nunamiut Corp. Office					
Nunamiut Lodge/Day Camp					

ENERGY OPPORTUNITIES/ALTERNATIVES – Anaktuvuk Pass		
Energy Opportunity	**Potential**	**Projects**
Existing Systems	High potential	E/E upgrades to systems
Interties	Low potential	
Wind	Low potential	Class 2 wind resource
Energy Efficiency (EE) program	High potential	E/E on public and community facilities audited. Residential E/E upgrades
Heat Recovery	High potential	Public Works Bldg., Fire Station
Hydroelectric	Medium potential	Feasibility study needed for Contact Creek
Solar	High potential	CCHRC prototype home
Biomass	Medium potential	Resource available – Feasibility study needed
Hydrokinetic	Unknown	
Geothermal	Medium potential	Study done – resource available
Gas	Low potential	
Coal	Low potential	
Emerging Technologies	Unknown	
Waste to Heat	Low potential	

PRIORITY ENERGY ACTIONS – Anaktuvuk Pass		
Timeframe	**Project Name**	**Estimated Costs in 2014**
Immediate 0-1 year	Adopt an Energy element into local comprehensive plan *Source: NSB 1981 Energy Policies*	TBD
	Participate in local community outreach meetings, school presentations and energy fairs *Source: Stakeholder Discussion, 2014*	TBD
	Train local utility operators for new systems, including water and sewer, housing and power generation as alternative and new technologies become available *Source: Stakeholder Discussion, 2014*	TBD
Short 1-5 years	Implement Energy Audits on School, City Building, IRA Building, Fire Station and M&O shop. *Source: Energy Audit, EECBG (AEA) , 2010, AHFC Energy Grade Audits*	$400,000
	Upgrade Electrical System *Source: Village Distribution Systems: Report of Conditions and Proposed Power Grid Improvement Projects, NSB, 2011*	$681,270
	Generator upgrade to accept alternative power *Source: Alaska Energy Authority, Alaska Energy Pathways, 2010*	$175,000
	Prepare Geothermal Feasibility Study *Source: AEA Renewable Energy Fund Application*	$200,000
	Conduct Hydroelectric Feasibility study on Contact Creek *Source: NSB Utility Master Plan and Emergency Utility Plan, June 2008*	$200,000
Medium 5-10 years	Develop Geothermal Resource if determined feasible *Source: AEA Renewable Energy Fund Application*	TBD
Long >10 years	Develop Hydroelectric Resource if determined feasible *Source: AEA Renewable Energy Fund Application*	TBD

Atqasuk

Atqasuk

Community and Energy Profile

Community Profile: Atqasuk

Incorporation	2nd Class City, 1982		
Location	On the arctic Coastal plain, on the banks of the Meade River. 60 miles southwest of Barrow.		
Longitude	-157.3958	**Latitude**	70.4694
ANCSA Region	Arctic Slope Regional Corporation (ASRC)		
Borough/CA	North Slope Borough		
School District	North Slope Borough School District		
AEA Region	North Slope		

Alaska Native Name (definition)

Atqasuk, "The Place to Dig the Rock that Burns"

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

Historical Setting / Cultural Resources

During World War II, bituminous coal was mined in Atqasuk and freighted to Barrow for use by government and private facilities. Called Meade River with Post Office 1951-'57. No residents in 1970; community reestablished in 1977.Located near the old Atqasuk village site and Tigaluk camp area. Abandoned sod houses, an old cellar and gravesite are evidence of early settlement.

Economy

Atqasuk's residents rely heavily on subsistence caribou hunting and fishing, cultural art sales and public sector employs 20.3 % of all workers.

Climate	Avg. Temp.	Climate Zone	Heating Deg. Days
	-38/64	Arctic	18,041

Natural Hazard Plan	
Hazard Mitigation Plan (Borough-wide)	2007

Community Plans	Year
Comprehensive Plan Update	2005

Local Contacts	Email	Phone	Fax
North Slope Borough	lloyd.leavitt@north-slope.org	907-852-0200	907-852-0337
City of Atqasuk	cityofatqasuk@hotmail.com	907-633-6811	907-633-6812
Atqasuk Village	icasatq@hughes.net	907-633-2575	907-633-2576
Atqasuk Corporation		907-852-8633	907-633-6213

Demographics	2000	2010
Population	250	268
Median Age	27.5	20
Avg. Household Size	4	4
Median Household Income	N/A	$56,250

	2013
Percent of Residents Employed	94.00%
Denali Commission Distressed Community	No
Percent Alaska Native/American Indian (2010)	92.27%
Low and Moderate Income (LMI) Percent (201x)	48.8%

Electric Utility	Generation Sources	Interties	PCE?
North Slope Borough Public Works	Diesel	No	No

Landfill	Class	III	Permitted?	Yes	Location	2.5 miles from airstrip

Water/Wastewater System

		Homes Served		System Volume
Water	Buried pipe system	87%		N/A
Sewer	Buried pipe system	Water/Wastewater Energy Audit?	No	
Notes	Haul/Tank system, 13% homes served			

Access

Road					
Air Access	Edward Burnell Sr. Memorial Airport, gravel, good	Runway 1	4,370'x90'	Runway 2	N/A
		Runway 3	N/A	Runway 4	N/A
Dock/Port	No	Barge Access?	No	Ferry Service?	No

Energy Profile: Atqasuk

Power House

Utility	NSB Public Works, Utility Division		
Generators	**Make/Model**	**Rated Capacity**	**Year**
Unit 1	Caterpillar 3508	450 kW	No Record
Unit 2	Caterpillar 3508	425 kW	No Record
Unit 3	Caterpillar 3512	650 kW	No Record
Unit 4	Caterpillar 3512	910 kW	No Record
Unit 5	Caterpillar 3512	910 kW	No Record
Line Loss			
Heat Recovery?		**No**	
Upgrades?			
Outage History/Known Issues			

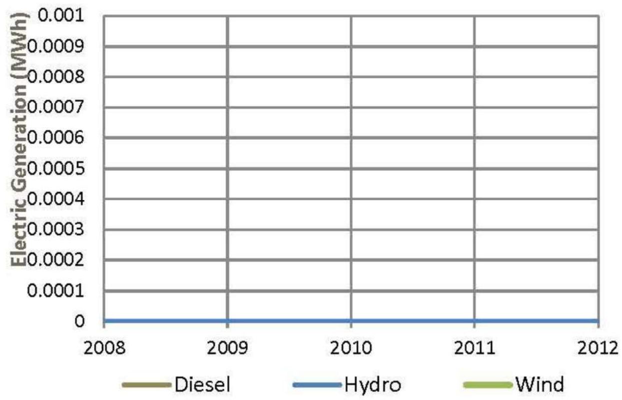
Operators

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

Maintenance Planning (RPSU)

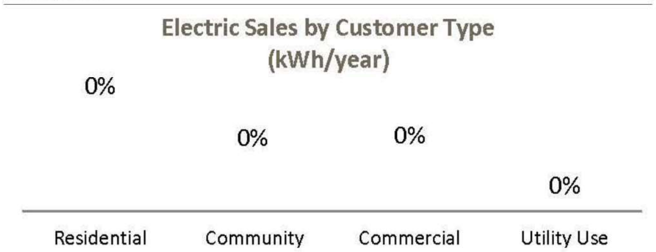
Power Production

Diesel (kWh/yr)		**Avg. Load (kW)**	
Wind (kWh/yr)		**Peak Load (kW)**	812 Oct. 2013
Hydro (kWh/yr)		**Efficiency (kWh/gal)**	
Total (kWh/yr)		**Diesel Used (gals/yr)**	



Electric Sales

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



Electric Rates ($/kWh)

Rate with PCE	0.15
Residential Rate	0.15
Commercial Rat	0.04

Cost per kWh Sold ($/kWh)

Fuel Cost	
Non-fuel Cost	
Total Cost	0.91

Fuel Prices ($)

Fuel Prices ($)	**Utility/Wholesale**	**Retail**	**Senior**
Diesel (1 gal)	4.1	1.4	1.26
Other Fuel? (1 gal)			
Gasoline (1 gal)	4.9	4.1	3.69
Propane (100#)			
Wood (1 cord)			
Pellets			
Discounts?			

Alternative Energy

Alternative Energy	**Potential**	**Projects**	**Status**
Hydroelectric	Unknown		
Wind Diesel	Medium	Class 3 wind resource	
Biomass	Low		
Solar	High		
Geothermal	Unknown		
Oil and Gas			
Coal	Medium	Subbituminous coal located, not extracted	
Emerging Tech	Unknown		
Heat Recovery			
Energy Efficiency			

Bulk Fuel

Tank Owner	**Fuel Type(s)**	**Capacity**	**Age/Condition**
NSB Public Works	Gasoline	70,000 (3 tanks)	
NSB Public Works	Diesel	644,625 (34 tanks)	

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

Cooperative Purchasing Agreements

Notes

Energy Profile: Atqasuk

Housing Units	Occupied	Vacant	% Owner-Occup.
	68	4	45%

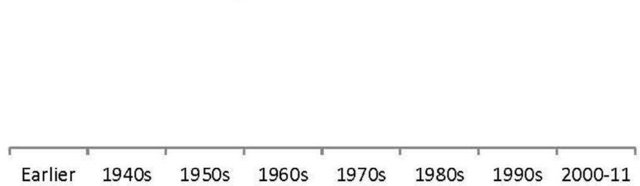
Regional Housing Authority	Weatherization Service Provider
Tagiugmiullu Nunamiullu	

Housing Need	Overcrowded	1-star

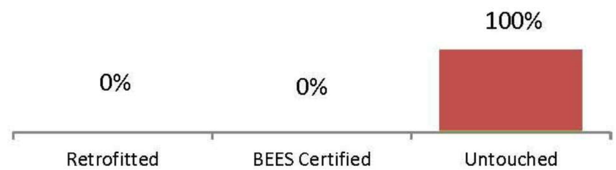
Energy Use	Average Home Energy Rating	Average Square Feet	Avg. EUI (kBTU/sf)

Data Quality

Age of Housing Stock



Energy Efficient Housing Stock



Lighting	Upgraded?	Owner	Notes

Non-residential Building Inventory

Building Name or Location	Year Built	Square Feet	Audited?	Retrofits Done?	In ARIS?
Fire station			AHFC	EECBG upgrades	
Meade River School			AHFC	EECBG upgrades	
Public Works/DMS			AHFC	EECBG upgrades	
Atqasuk Chapel					
School					
Generator building					
School utility building					
School maintenance building					
School service garage					
Taksiigvik Store					
Water utility building					
City office					
Health clinic					
Atqasuk tribal office					
Public safety office					
S&R facility					
Storage shop					
Vacuum building					
Washeteria					
Water treatment bldg.					

ENERGY OPPORTUNITIES/ALTERNATIVES – Atqasuk		
Energy Opportunity	**Potential**	**Projects**
Existing Systems	High potential	E/E upgrades to systems
Interties	High potential	Barrow-Atqasuk Transmission Line
Wind	Medium potential	Class 3 wind resource
Energy Efficiency (EE) program	High potential	E/E on public and community facilities audited. Residential E/E upgrades
Heat Recovery	High potential	
Hydroelectric	Unknown	
Solar	High potential	
Biomass	Low potential	
Hydrokinetic	Unknown	
Geothermal	Unknown	
Gas	Unknown	
Coal	Unknown	
Emerging Technologies	Unknown	
Waste to Heat	Unknown	

PRIORITY ENERGY ACTIONS – Atqasuk		
Timeframe	**Project Name**	**Estimated Costs in 2014**
Immediate 0-1 year	■ Adopt an Energy element into local comprehensive plan *Source: NSB 1981 Energy Policies*	■ TBD
	■ Participate in local community outreach meetings, school presentations and energy fairs *Source: Stakeholder Discussion, 2014*	■ TBD
	■ Train local utility operators for new systems, including water and sewer, housing and power generation as alternative and new technologies become available *Source: Stakeholder Discussion, 2014*	■ TBD
Short 1-5 years	■ Implement Energy Audits on School, USDW Building and Fire Station *Source: Energy Audit, EECBG (AEA) , 2010, AHFC Energy Grade Audits*	■ $500,000
	■ Upgrade Electrical System *Source: Village Distribution Systems: Report of Conditions and Proposed Power Grid Improvement Projects, NSB, 2011*	■ $688,272
	■ Generator upgrade to accept alternative power *Source: Alaska Energy Authority, Alaska Energy Pathways, 2010*	■ $175,000
	■ Atqasuk Transmission line Preliminary Design and Permitting *Source: AEA Renewable Energy Fund, Round VII, 2013*	■ $2,220,000
Medium 5-10 years	■ Atqasuk Transmission line construction. *Source: AEA Renewable Energy Fund, Round VII, 2013*	■ TBD
Long >10 years	■ Power Plant Upgrade NSB - CIP requested Upgrade *Source: Section 13 - Light, Power, and Heating Systems*	■ TBD

Barrow

Utqiabvik

Community and Energy Profile

Community Profile: Barrow

Incorporation	1st Class City, 1958. NSB, 1972		
Location	Northernmost US city, largest NSB community, uniquely situated in a location bordered by the Chukchi and Beaufort Seas of the Arctic Ocean.		
Longitude	-156.7886	**Latitude**	71.2906
ANCSA Region	Arctic Slope Regional Corporation (ASRC)		
Borough/CA	North Slope Borough		
School District	North Slope Borough School District		
AEA Region	North Slope		

Alaska Native Name (definition)

Utqiabvik, "Place where Owls are Hunted"

Taxes Type (rate)	Per-Capita Revenue
N/A	$80

Historical Setting / Cultural Resources

Cape Smyth Whaling and Trading Station, 1893; Presbyterian church, 1899; Post Office, 1901. Arctic Slope Regional Corporation is headquartered in Barrow. Exploration of the Naval Petroleum Reserve #4 (now the National Petroleum Reserve in Alaska) began in 1946.

Economy

Subsistence based - marine mammal hunting, inland hunting and fishing. Employment: full-time employees, 1,128. 46% employed in private sector, 53% in local government, and 1% in state government

Climate	Avg. Temp.	Climate Zone	Heating Deg. Days
	-22/50	Arctic	18,133

Natural Hazard Plan	
Hazard Mitigation Plan (Borough-wide)	2007

Community Plans	Year
Comprehensive Plan Update	2014

Local Contacts	Email	Phone	Fax
North Slope Borough	lloyd.leavitt@north-slope.org	907-852-0200	907-852-0337
City of Barrow	bob.harcharek@cityofbarrow.org	907-852-5211	907-852-5871
Native Village of Barrow	tolemaun@nvbarrow.net	907-852-4411	907-852-8844
Ukpeagvik Inupiat Corporation	http://www.ukpik.com/	907-852-4460	907-852-4459

Demographics	2000	2010		2013
Population	4,429	4,973	Percent of Residents Employed	95.30%
Median Age	28	27	Denali Commission Distressed Community	No
Avg. Household Size	4	4	Percent Alaska Native/American Indian (2010)	61.18%
Median Household Income	N/A	$84,293	Low and Moderate Income (LMI) Percent (201x)	33%

Electric Utility	Generation Sources	Interties	PCE?
BUECI	Natural Gas	No	No

Landfill	Class	II	Permitted?	Yes	Location	8 mi southeast of TOS facility

Water/Wastewater System		Homes Served	System Volume
Water	Buried pipe system	85.6% piped, 7.5% holding tanks, 6.2%	N/A
Sewer	Buried pipe system	Water/Wastewater Energy Audit? No	
Notes	Isatkoak Lagoon, buried distribution pipe in utilidor		

Access					
Road	No				
Air Access	Wiley Post-Will Rogers Memorial Airport,	Runway 1	7,100' x 150'	Runway 2	N/A
	asphalt, fair condition	Runway 3	N/A	Runway 4	N/A
Dock/Port	Yes	Barge Access?	Yes	Ferry Service?	No

Energy Profile: Barrow

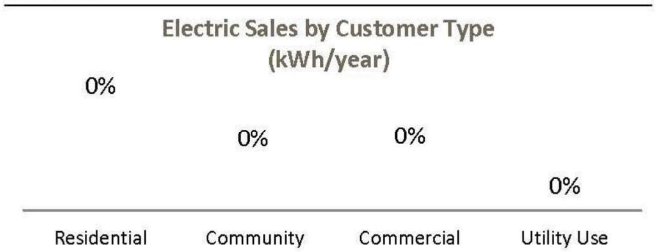
Power House

Utility	BUECI		
Generators	**Make/Model**	**Rated Capacity**	**Condition/Hours**
Unit 1	olar Turbine Centau	2.5 Mw	
Unit 2	olar Turbine Centau	2.5 Mw	
Unit 3	olar Turbine Centau	2.5 Mw	
Unit 4	olar Turbine Centau	4.75 Mw	
Unit 5	olar Turbine Centau	5.3 Mw	
Unit 6	Caterpillar 3608	1.5 Mw	
Unit 7	Caterpillar 3608	1.5 Mw	
Line Loss			
Heat Recovery?			
Upgrades?			
Outage History/Known Issues			

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

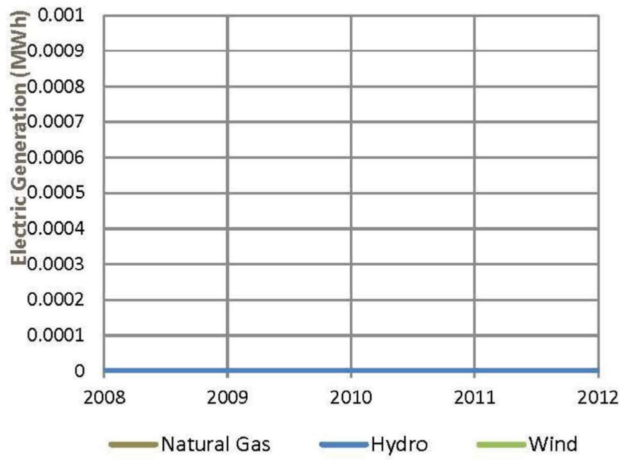
Maintenance Planning (RPSU)

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



Power Production

Natural Gas (kWh/yr)		Avg. Load (kW)	
Wind (kWh/yr)		Peak Load (kW)	
Hydro (kWh/yr)		Efficiency (kWh/gal)	
Total (kWh/yr)		Diesel Used (gals/yr)	



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

Fuel Prices ($)	**Utility/Wholesale**	**Retail**	**Senior**
Diesel (1 gal)	$ 6.80	$ 6.80	$ 6.80
Other Fuel? (1 gal)			
Gasoline (1 gal)	$ 6.20	$ 6.20	$ 5.58
Propane (100#)	$ 310.00	$ 310.00	$ 310.00
Wood (1 cord)			
Pellets			
Discounts?			

Alternative Energy	**Potential**	**Projects**	**Status**
Hydroelectric	Low		
Wind Diesel	Unknown		
Biomass	Low		
Solar	High		
Geothermal	Low		
Oil and Gas	High	Currently all electrical produced by Natural Gas	
Coal	Low		
Emerging Tech	Unknown		
Heat Recovery			
Energy Efficiency			

Bulk Fuel

Tank Owner	**Fuel Type(s)**	**Capacity**	**Age/Condition**
NSB Public Works	Jet A Diesel	250,000	
NSB Public Works	Jet B Diesel	250,000	
NSB Public Works	Diesel	522,850 (16 tanks)	

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

Energy Profile: Barrow

Notes

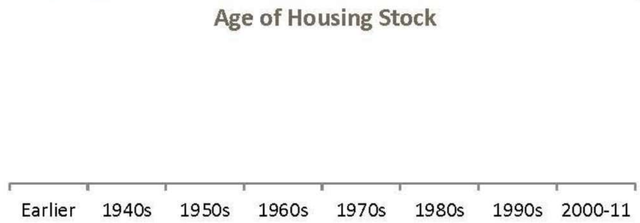
Housing Units	**Occupied**	**Vacant**	**% Owner-Occup.**
	1280	274	41%

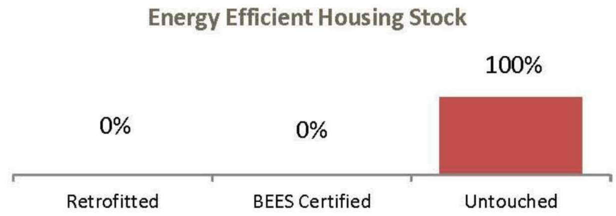
Regional Housing Authority	**Weatherization Service Provider**
TNHA	

Housing Need	**Overcrowded**	**1-star**

Energy Use	**Average Home Energy Rating**	**Average Square Feet**	**Avg. EUI (kBTU/sf)**

Data Quality





Lighting	**Upgraded?**	**Owner**	**Notes**

Non-residential Building Inventory

Building Name or Location	Year Built	Square Feet	Audited?	Retrofits Done?	In ARIS?
Barrow High School					
Eben Hopson Middle School					
Fred Ipalook Elem.School					
Kiita Learning Community					
3425C St. Wrhse Pub.Wks Shop					
3427C St. Wrhse Heavy Eq. Shop					
3429C St. Shop Barrow Hvy Eq. Storage					
Fire Station #1			AHFC		
Community Center/Youth Center				EECBG	
Municipal bus barn			AHFC		
Sanitation building			AHFC		
S&R hangar building			AHFC		
Shipping and receiving			AHFC		
Browerville fire station			AHFC		
Light duty shop					
Iñupiat Heritage Center			AHFC		
School Dist. Bus Barn				EECBG	

ENERGY IMPROVEMENT OPPORTUNITIES/ALTERNATIVES – Barrow		
Energy Opportunity	**Potential**	**Projects**
Existing Systems	Upgrades to current power systems	Ongoing
Interties	Low potential	
Wind	Unknown wind resource	
Energy Efficiency (EE) program	Energy Audits of public buildings Energy Audits of NSB buildings Water & Sewer E/E upgrades	Implement Recommendations Implement Recommendations Implement E/E recommendations
Heat Recovery	High potential	
Hydroelectric	Low potential	
Solar	High potential	Arctic Camp Solar Kit project
Biomass	Low potential	
Hydrokinetic	Low potential	
Geothermal	Low potential	
Gas	High potential	Expansion and efficiency of current systems
Coal	Low/Medium potential	
Emerging Technologies	Unknown	
Waste to Heat	Unknown	

PRIORITY ENERGY ACTIONS – Barrow		
Timeframe	**Project Name**	**Estimated Costs in 2014**
Immediate 0-1 year	Adopt an Energy element into local comprehensive plan. *Source: NSB 1981 Energy Policies*	TBD
	Participate in local community outreach meetings, school presentations and energy fairs. *Source: Stakeholder Discussion, 2014*	TBD
	Train local utility operators for new systems, including water and sewer, housing and power generation as alternative and new technologies become available. *Source: Stakeholder Discussion, 2014*	TBD
Short 1-5 years	Implement Energy Audits on C St. Shop/Warehouse, Heavy Equipment Shop, Heavy Equipment Storage building, Fire Station #1 &#2, Municipal Bus Barn, Barrow Sanitation Building, Search and Rescue Hangar, Shipping & Receiving Building, Light Duty Shop, Iñupiat Heritage Center Building, School District Bus Barn, Public Works Office building. *Source: Energy Audit, EECBG (AEA) , 2010, AHFC Energy Grade Audits*	$600,000
	Install heat recovery systems *Source: Alaska Energy Pathway, Alaska Energy Authority, July 2010*	$1,438,356
	Generator upgrade to accept alternative power *Source: Alaska Energy Authority, Alaska Energy Pathways, 2010*	$175,000
Medium 5-10 years	Utilize wind/diesel in combination where possible to decrease fossil fuel dependence. *Source: Alaska Energy Pathway, Alaska Energy Authority, July 2010*	$3,758,514
Long >10 years	Marine header and pipeline relocation. *Source: Section 13 - Light, Power and Heating Systems*	TBD

Kaktovik

Qaaktubvik

Community and Energy Profile

Community Profile: Kaktovik

Incorporation 2nd Class City, 1971

Location

On the north shore of Barter Island, between the Okpilak and Jago Rivers on the Beaufort Sea coast. It lies in the 19.6-million-acre arctic National Wildlife Refuge.

Longitude	**Latitude**
ANCSA Region	Arctic Slope Regional Corporation (ASRC)
Borough/CA	North Slope Borough
School District	North Slope Borough School District
AEA Region	North Slope

Alaska Native Name (definition)

Qaaktubvik, "Seining Place"

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

Historical Setting / Cultural Resources

Until the late nineteenth century, the island was a major trade center for the Iñupiat and was especially important as a bartering place for Iñupiat from Alaska and Inuit from Canada.

Economy

Subsistence based – fishing, whaling, caribou, and fowl. Employment: 79% residents employed: 35% in private sector and 65% in local government.

Climate	**Avg. Temp.**	**Climate Zone**	**Heating Deg. Days**
	-56/78	Arctic	17,514

Natural Hazard Plan	
Hazard Mitigation Plan (Borough-wide)	2007

Community Plans	**Year**
Comprehensive Plan Update	2005

Local Contacts	**Email**	**Phone**	**Fax**
North Slope Borough	lloyd.leavitt@north-slope.org	907-852-0200	907-852-0337
City of Kaktovik	office@cityofkaktovik.org	907-640-6313	907-640-6314
Kaktovik Village	nvkaktovik@starband.net	907-640-2042	907-640-2044
Kaktovik Inupiat Corporation		907-640-6120	907-640-6217

Demographics	**2000**	**2010**		**2013**
Population	286	308	**Percent of Residents Employed**	77.40%
Median Age	28	33	**Denali Commission Distressed Community**	No
Avg. Household Size	4	4	**Percent Alaska Native/American Indian (2010)**	88.70%
Median Household Income	N/A	$76,875	**Low and Moderate Income (LMI) Percent (201x)**	N/A

Electric Utility	**Generation Sources**	**Interties**	**PCE?**
North Slope Borough Public Works	Diesel	No	Yes

Landfill	**Class**	III	**Permitted?**	Yes	**Location**	1 mile south of town

Water/Wastewater System		**Homes Served**		**System Volume**
Water	Buried pipe system			N/A
Sewer	Buried pipe system	**Water/Wastewater Energy Audit?**	No	
Notes	9 septic holding tanks, good condition			

Access					
Road	No				
Air Access	Barter Island LRRS Airport, gravel, good condition	**Runway 1**	4,370' x 90'	**Runway 2**	N/A
		Runway 3	N/A	**Runway 4**	N/A
Dock/Port	No	**Barge Access?**	Yes	**Ferry Service?**	No
Notes					

Energy Profile: Kaktovik

Power House

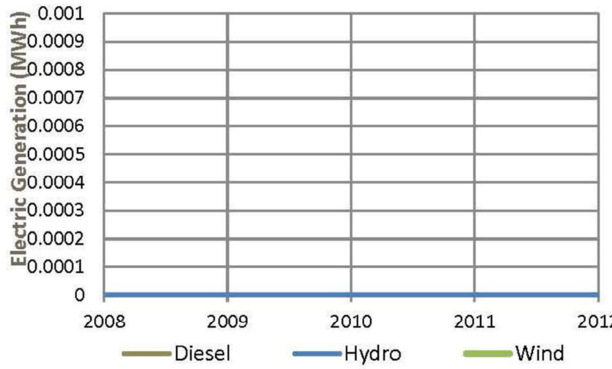
Utility	NSB Public Works, Utilities Division		
Generators	**Make/Model**	**Rated Capacity**	**Year**
Unit 1	Caterpillar 3512	910 kW	2000
Unit 2	Caterpillar 3512	910 kW	2000
Unit 3	Caterpillar 3508	450 kW	2000
Unit 4	Caterpillar 3508	450 kW	2000
Line Loss			
Heat Recovery?			
Upgrades?			
Outage History/Known Issues			

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

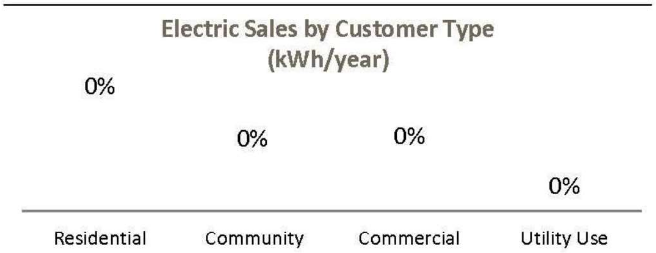
Maintenance Planning (RPSU)

Power Production

Diesel (kWh/yr)		**Avg. Load (kW)**	
Wind (kWh/yr)		**Peak Load (kW)**	771 Feb. 2014
Hydro (kWh/yr)		**Efficiency (kWh/gal)**	
Total (kWh/yr)		**Diesel Used (gals/yr)**	



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



Electric Rates ($/kWh)		**Cost per kWh Sold ($/kWh)**	
Rate with PCE	0.15	**Fuel Cost**	
Residential Rate	0.15	**Non-fuel Cost**	
Commercial Rat	.20-.35 (varies)	**Total Cost**	0.76

Fuel Prices ($)	**Utility/Wholesale**	**Retail**	**Senior**
Diesel (1 gal)	9	3	2.5
Other Fuel? (1 gal)			
Gasoline (1 gal)	7.5	5.6	
Propane (100#)	200	200	200
Wood (1 cord)			
Pellets			
Discounts?			

Alternative Energy	**Potential**	**Projects**	**Status**
Hydroelectric	Unknown		
Wind Diesel	High	Class 5-6 CDR completed (AEA funded), design funded (AEA) 2014	
Biomass	Low	Possibly pellets and/or small waste to heat	
Solar	High		
Geothermal	Unknown		
Oil and Gas			
Coal	Low		
Emerging Tech	Unknown		
Heat Recovery			
Energy Efficiency			

Bulk Fuel

Tank Owner	**Fuel Type(s)**	**Capacity**	**Age/Condition**
NSB Public Works	Gasoline	70,000 (3 tanks)	
NSB Public Works	Diesel	1,021,359 (34 tanks)	

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

Cooperative Purchasing Agreements

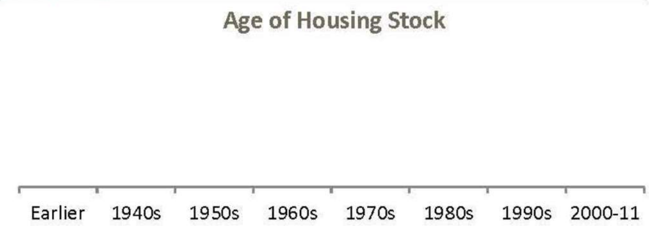
Notes

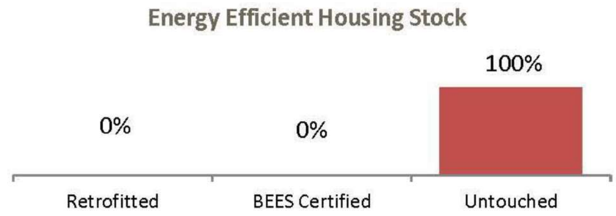
Energy Profile: Kaktovik

Housing Units	Occupied	Vacant	% Owner-Occup.	Regional Housing Authority	Weatherization Service Provider
	72	15	57%	Tagiugmiullu Nunamiullu	

Housing Need	Overcrowded	1-star	Energy Use	Average Home Energy Rating	Average Square Feet	Avg. EUI (kBTU/sf)

Data Quality





Lighting	Upgraded?	Owner	Notes

Non-residential Building Inventory

Building Name or Location	Year Built	Square Feet	Audited?	Retrofits Done?	In ARIS?
Senior Housing 5-plex					
Assembly of God					
Post Office					
Kikiktak Store					
KIC Fuel Station					
Presdyterian Church					
New Gym					
Waldo Arms Hotel					
Blue Hotel					
KIC Office					
DEW Line Station					
Sims Store					
Kaveolook School			AHFC		
Warm Storage EECBG			AHFC		
Public Safety Office EECBG			AHFC		
Health Clinic					
Marsh Creek Inn					
New Generator Bldg.					
Sewage Treatment Plant					
City of Kaktovik Office					
UIC Construction					
USDW Bldg.					
Telephone Bldg.					
SKW Office/Camp					
Tribal Office					
Vacuum Bldg.					
Water Treatment Plant					

ENERGY IMPROVEMENT OPPORTUNITIES/ALTERNATIVES – Kaktovik		
Energy Opportunity	**Potential**	**Projects**
Existing Systems	High potential	E/E upgrades to systems
Interties	Low potential	Logistics
Wind	High potential	Class 5-6 wind resource, CDR completed 2014
Energy Efficiency (EE) program	High potential	E/E on public and community facilities audited. Residential E/E upgrades
Heat Recovery	High potential	
Hydroelectric	Unknown	
Solar	High potential	
Biomass	Unknown	
Hydrokinetic	Unknown	
Geothermal	Unknown	
Gas	Low potential	
Coal	Low potential	
Emerging Technologies	Unknown	
Waste to Heat	Unknown	

PRIORITY ENERGY ACTIONS – Kaktovik		
Timeframe	**Project Name**	**Estimated Costs in 2014**
Immediate 0-1 year	Adopt an Energy element into local comprehensive plan *Source: NSB 1981 Energy Policies*	TBD
	Participate in local community outreach meetings, school presentations and energy fairs *Source: Stakeholder Discussion, 2014*	TBD
Short 1-5 years	Train local utility operators for new systems, including water and sewer, housing and power generation as alternative and new technologies become available. *Source: Stakeholder Discussion, 2014*	TBD
	Implement Energy Audits on School, Warm Storage Facility, Public Safety Office *Source: Energy Audit, EECBG (AEA) , 2010, AHFC Energy Grade Audit*	$300,000
	Upgrade Electrical System *Source: Village Distribution Systems: Report of Conditions and Proposed Power Grid Improvement Projects, NSB, 2011.*	$695,000
Medium 5-10 years	Wind Turbine Design and Permitting *Source: AEA Renewable Energy Fund*	$167,770
Long >10 years	Generator upgrade to accept alternative power *Source: Alaska Energy Authority, Alaska Energy Pathways, 2010*	$175,000
	Construct Wind Turbine *Source: Alaska Energy Pathway, Alaska Energy Authority, July 2010*	TBD

Nuiqsut

Nuiqsat

Community and Energy Profile

Community Profile: Nuiqsut

Incorporation	2nd Class City, 1975

Location

On the Colville River Delta, 136 miles southeast of Barrow. 10 miles from the ocean on the Nigliq Channel.

Longitude	-150.9764	**Latitude**	70.2175
ANCSA Region	Arctic Slope Regional Corporation (ASRC)		
Borough/CA	North Slope Borough		
School District	North Slope Borough School District		
AEA Region	North Slope		

Alaska Native Name (definition)

Nuiqsat

Historical Setting / Cultural Resources

Traditional Iñupiat gathering and trading place. The old village of Nuiqsut (Itqilippaa) was abandoned in the late 1940s, because there was no school. The village was resettled in 1973 by 27 families from Barrow.

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

Economy

Subsistence based. The Alpine Oilfield is located 8 miles from Nuiqsut and partially located on lands owned by the Kuukpik Native Corporation and ASRC. 71% residents employed: 45% in private sector and 55% in local government.

Climate	Avg. Temp.	Climate Zone	Heating Deg. Days
	-56/78	Arctic	18,124

Natural Hazard Plan	
Hazard Mitigation Plan (Borough-wide)	2007

Community Plans	Year
Comprehensive Plan Update	2005

Local Contacts	Email	Phone	Fax
North Slope Borough	lloyd.leavitt@north-slope.org	907-852-0200	907-852-0337
City of Nuiqsut	cityofnuiqsut@gmail.com	907-480-6727	907-480-6928
Native Village of Nuiqsut	native.village@astacalaska.net	907-480-3010	907-480-3009

Demographics	2000	2010		2013
Population	286	308	**Percent of Residents Employed**	70.70%
Median Age	28	33	**Denali Commission Distressed Community**	No
Avg. Household Size	3.6	4	**Percent Alaska Native/American Indian (2010)**	87.06%
Median Household Income	N/A	$95,833	**Low and Moderate Income (LMI) Percent (201x)**	60%

Electric Utility	Generation Sources	Interties	PCE?
North Slope Borough Public Works	Diesel	No	Yes

Landfill	**Class** III	**Permitted?**	Yes	**Location**	1 mile northwest of the community

Water/Wastewater System		Homes Served		System Volume
Water	Buried pipe system			N/A
Sewer	Buried pipe system	**Water/Wastewater Energy Audit?**	No	
Notes				

Access					
Road	No				
Air Access	Nuiqsut Airport, gravel, good condition	**Runway 1**	4,589' x 100'	**Runway 2**	N/A
		Runway 3	N/A	**Runway 4**	N/A
Dock/Port	Yes	**Barge Access?**	Yes	**Ferry Service?**	No
Notes					

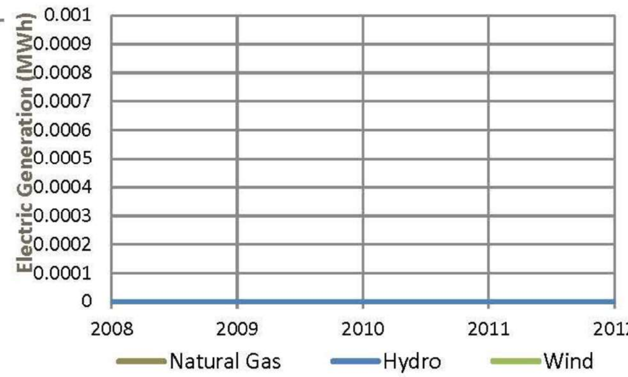
Energy Profile: Nuiqsut

Power House

Utility	NSB Public Works, Utilities Division		
Generators	**Make/Model**	**Rated Capacity**	**Year**
Unit 1	Caterpillar 3512	910 kW	2000
Unit 2	Caterpillar 3512	910 kW	2000
Unit 3	Caterpillar 3508	450 kW	2000
Unit 4	Caterpillar 3508	450 kW	2000
Unit 5	Caterpillar 3516	820 kW	2008
Unit 6	Caterpillar 3516	820 kW	2008
Line Loss			
Heat Recovery?			
Upgrades?			
Outage History/Known Issues			

Power Production

Natural Gas (kW	5,500,187	**Avg. Load (kW)**	
Wind (kWh/yr)		**Peak Load (kW)**	
Hydro (kWh/yr)		**Efficiency (kWh/gal)**	
Total (kWh/yr)		**Diesel Used (gals/yr)**	



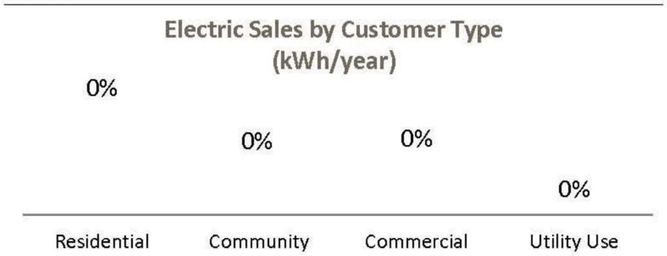
Operators

No. of Operators	**Training/Certifications**

Maintenance Planning (RPSU)

Electric Sales

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



Electric Rates ($/kWh)

Rate with PCE	0.15
Residential Rate	0.15
Commercial Rat	0.02

Cost per kWh Sold ($/kWh)

Fuel Cost	
Non-fuel Cost	
Total Cost	0.5

Fuel Prices ($)

Fuel Prices ($)	Utility/Wholesale	Retail	Senior
Diesel (1 gal)	6.91	2.3	2.3
Other Fuel? (1 gal)			5
Gasoline (1 gal)	6.4	5	
Propane (100#)		180	
Wood (1 cord)			
Pellets			
Discounts?			

Alternative Energy

Alternative Energy	Potential	Projects	Status
Hydroelectric	Unknown		
Wind Diesel	Unknown	Study needed	
Biomass	Unknown		
Solar	High		
Geothermal	Unknown		
Oil and Gas			
Coal	Low		
Emerging Tech	Unknown		
Heat Recovery			
Energy Efficiency			

Bulk Fuel

Tank Owner	Fuel Type(s)	Capacity	Age/Condition
NSB Public Works	Gasoline	74,000 (3 tanks)	
NSB Public Works	Diesel	613,600	

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

Cooperative Purchasing Agreements

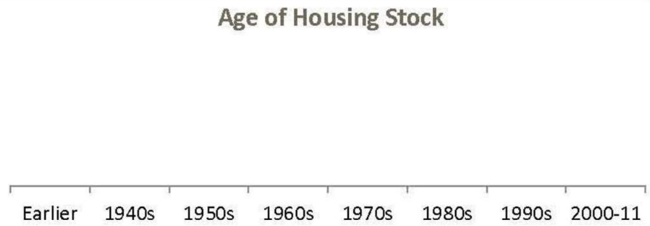
Notes

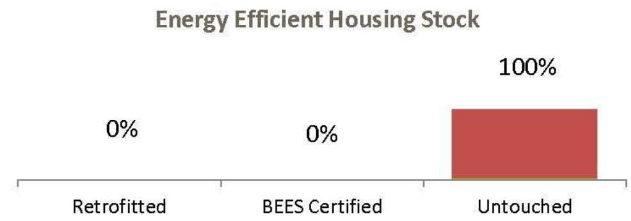
Energy Profile: Nuiqsut

Housing Units	Occupied	Vacant	% Owner-Occup.	Regional Housing Authority	Weatherization Service Provider
	114	22	54%	Tagiugmiullu Nunamiullu	

Housing Need		Overcrowded	1-star	Energy Use	Average Home Energy Rating	Average Square Feet	Avg. EUI (kBTU/sf)

Data Quality





Lighting	Upgraded?	Owner	Notes

Non-residential Building Inventory

Building Name or Location	Year Built	Square Feet	Audited?	Retrofits Done?	In ARIS?
Trapper School			AHFC		
Maintenance and operations shop			AHFC		
Kuukpik Corporation building					
Tribal offices					
City building					
Gas station					
Generator building					
Heavy equipment shop					
School					
Day Care Center					
Kuukpik Hotel					
Old generator building					
Post office					
Reli Office					
School gym					
School vocational shop					
Search & rescue facility					
Telephone building #301					
Warm storage					
Sewage treatment plant					
Arctic Wolf Camp					
NUC Office Building					

ENERGY IMPROVEMENT OPPORTUNITIES/ALTERNATIVES – Nuiqsut		
Energy Opportunity	Potential	Projects
Existing Systems	▪ High potential	▪ E/E upgrades to systems
Interties	▪ Low potential	▪ Logistics
Wind	▪ Unknown	▪ Wind Study needed
Energy Efficiency (EE) program	▪ High potential	▪ E/E on public and community facilities audited. Residential E/E upgrades
Heat Recovery	▪ Unknown	▪
Hydroelectric	▪ Unknown	▪
Solar	▪ High potential	▪
Biomass	▪ Unknown	▪
Hydrokinetic	▪ Unknown	▪
Geothermal	▪ Unknown	▪
Gas	▪ High – currently using natural gas	▪
Coal	▪ Low potential	▪
Emerging Technologies	▪ Unknown	▪
Waste to Heat	▪ Unknown	▪

PRIORITY ENERGY ACTIONS – Nuiqsut		
Timeframe	**Project Name**	**Estimated Costs in 2014**
Immediate 0-1 year	▪ Adopt an Energy element into local comprehensive plan. *Source: NSB 1981 Energy Policies*	TBD
Short 1-5 years	▪ Train local utility operators for new systems, including water and sewer, housing and power generation as alternative and new technologies become available. *Source: Stakeholder Discussion, 2014*	TBD
	▪ Implement Energy Audits on Trapper School and OM Shops *Source: 2010, AHFC Energy Grade Audit Source: AHFC 2011*	$250,000
Medium 5-10 years	▪ Upgrade Electrical System. *Source: Village Distribution Systems: Report of Conditions and Proposed Power Grid Improvement Projects, NSB, 2011.*	TBD

Point Hope

Tikigaq

Community and Energy Profile

Community Profile: Point Hope

Incorporation	2nd Class City, 1966

Location

Point Hope is located near the tip of Point Hope peninsula, a large gravel spit that forms the western-most extension of the northwest Alaska coast, 330 miles southwest of Barrow.

Longitude	-166.8081	**Latitude**	68.3478
ANCSA Region	Arctic Slope Regional Corporation (ASRC)		
Borough/CA	North Slope Borough		
School District	North Slope Borough School District		
AEA Region	North Slope		

Alaska Native Name (definition)

Tikigaq

Historical Setting / Cultural Resources

Point Hope peninsula is one of the oldest continuously occupied Iñupiat Eskimo areas in Alaska. Several settlements have existed on the peninsula over the past 2,500 years, including Old and New Tigara, Ipiutak, Jabbertown, and present Point Hope. Moved to new site, east of old, due to erosion and storm surge flooding. The Tikeraqmuit retain strong cultural traditions after more than a century of outside influences.

Taxes Type (rate)	Per-Capita Revenue
N/A	$160

Economy

Point Hope residents (Tikeraqmuit Inupiat Eskimos) are dependent upon marine subsistence. This highly favorable site, with its abundant resources, has enabled the Tikeraqmuit to retain strong cultural traditions after more than a century of outside influences. 70% residents employed: 42% in private sector and 58% in local government.

Climate	Avg. Temp.	Climate Zone	Heating Deg. Days
	-49/78	Arctic	N/A

Natural Hazard Plan	
Hazard Mitigation Plan (Borough-wide)	2007

Community Plans	Year
Comprehensive Plan Update	2005

Local Contacts	Email	Phone	Fax
North Slope Borough	lloyd.leavitt@north-slope.org	907-852-0200	907-852-0337
City of Point Hope	akphogov@hotmail.com	907-368-2537	907-368-2835
Native Village of Point Hope	peggy.frankson@tikigaq.org	907-368-2330	907-368-2332

Demographics	2000	2010		2013
Population	764	831	**Percent of Residents Employed**	68.10%
Median Age	22	28.1	**Denali Commission Distressed Community**	No
Avg. Household Size	4	4	**Percent Alaska Native/American Indian (2010)**	89.47%
Median Household Income	N/A	$83,125	**Low and Moderate Income (LMI) Percent (201x)**	41%

Electric Utility	Generation Sources	Interties	PCE?
North Slope Borough Public Works	Diesel	No	Yes

Landfill Class	III	**Permitted?**	Yes	**Location**	1 mile west of the community

Water/Wastewater System		Homes Served		System Volume
Water	Buried pipe system			N/A
Sewer	Buried pipe system	**Water/Wastewater Energy Audit?**	No	
Notes	Lake 7 mi away; Holding tank septic system serves 23 homes			

Access					
Road	No				
Air Access	Point Hope Airport, asphalt, fair condition	**Runway 1**	4,000' x 75'	**Runway 2**	N/A
		Runway 3	N/A	**Runway 4**	N/A
Dock/Port	Yes	**Barge Access?**	Yes	**Ferry Service?**	No
Notes					

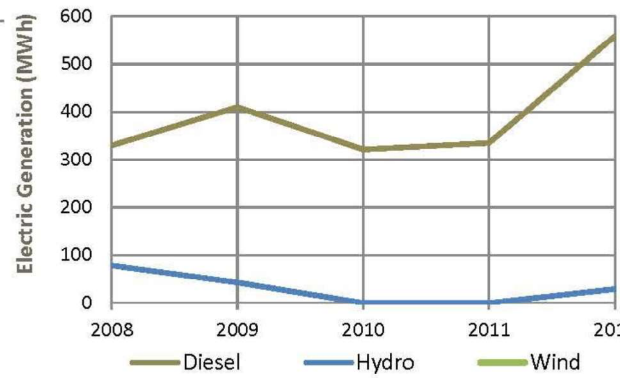
Energy Profile: Point Hope

Power House

Utility	NSB Public Works, Utilities Division		
Generators	**Make/Model**	**Rated Capacity**	**Year**
Unit 1	Caterpillar 3512	665 kW	1995
Unit 2	Caterpillar 3512	665 kW	1995
Unit 3	Caterpillar 3512	910 kW	2008
Unit 4			
Line Loss			
Heat Recovery?			
Upgrades?			
Outage History/Known Issues			

Power Production

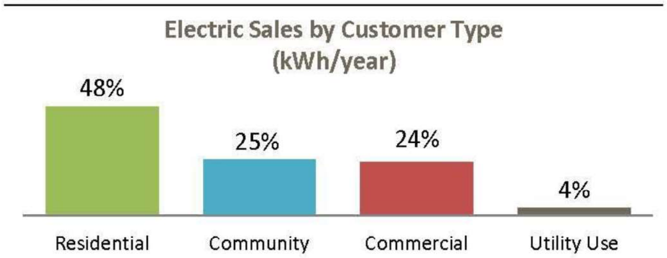
Diesel (kWh/yr)		Avg. Load (kW)	
Wind (kWh/yr)		Peak Load (kW)	1342 Sep. 2013
Hydro (kWh/yr)		Efficiency (kWh/gal)	
Total (kWh/yr)		Diesel Used (gals/yr)	



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			



Electric Rates ($/kWh)		Cost per kWh Sold ($/kWh)	
Rate with PCE	0.15	Fuel Cost	
Residential Rate	0.15	Non-fuel Cost	
Commercial Rat	0.03	Total Cost	0.56

Fuel Prices ($)	Utility/Wholesale	Retail	Senior
Diesel (1 gal)	7.44	1.99	1.99
Other Fuel? (1 gal)			
Gasoline (1 gal)	5.51	5.5	5.5
Propane (100#)			
Wood (1 cord)			
Pellets			
Discounts?			

Alternative Energy	Potential	Projects	Status
Hydroelectric	Unknown		
Wind Diesel	High	Class 6 wind, CDR 2014 (AEA) Design funded (AEA)	
Biomass	Low		
Solar	High		
Geothermal	Unknown		
Oil and Gas			
Coal	Low/medium		
Emerging Tech	Unknown		
Heat Recovery			
Energy Efficiency			

Bulk Fuel

Tank Owner	Fuel Type(s)	Capacity	Age/Condition
NSB Public Works	Gasoline	156,000 (2 tanks)	
NSB Public Works	Diesel	1,165,626 (37 tanks)	

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

Cooperative Purchasing Agreements

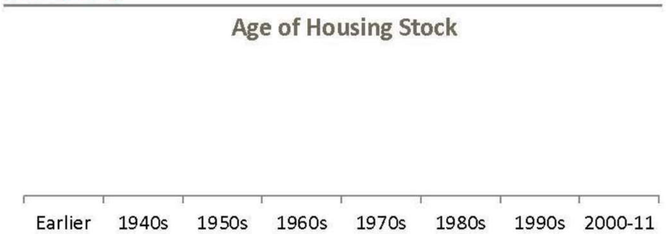
Notes

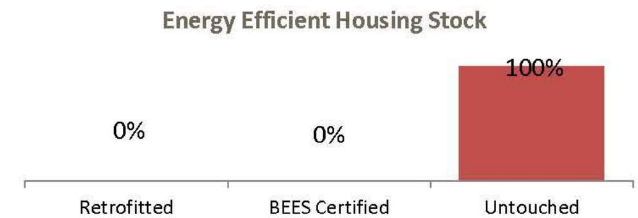
Energy Profile: Point Hope

Housing Units	Occupied	Vacant	% Owner-Occup.	Regional Housing Authority	Weatherization Service Provider
	186	35	65%	Tagiugmiullu Nunamiullu	

Housing Need	Overcrowded	1-star	Energy Use	Average Home Energy Rating	Average Square Feet	Avg. EUI (kBTU/sf)

Data Quality





Lighting	Upgraded?	Owner	Notes

Non-residential Building Inventory

Building Name or Location	Year Built	Square Feet	Audited?	Retrofits Done?	In ARIS?
USDW Building			AHFC		
Fire station			AHFC		
Ilisagvik College					
Native Village of Point Hope					
Tikigaq Corporation					
City buildings (4)					
Airport electrical building					
Airport terminal building					
Generator building					
Point Hope Assembly of God					
Post office					
Search & rescue facility					
SRE building					
Water treatment plant					
Water treatment plant					
Warm storage					
Health clinic					
Pt. Hope clinic					
Public safety office					
Tikigaq School					

ENERGY IMPROVEMENT OPPORTUNITIES/ALTERNATIVES – Pt. Hope		
Energy Opportunity	**Potential**	**Projects**
Existing Systems	▪ High potential	▪ E/E upgrades to systems
Interties	▪ Low potential	▪ Logistics
Wind	▪ High potential	▪ Class 6 wind resource, CDR completed 2014, Design 2014/15
Energy Efficiency (EE) program	▪ High potential	▪ E/E on public and community facilities audited. Residential E/E upgrades
Heat Recovery	▪ High potential	▪
Hydroelectric	▪ Unknown	▪
Solar	▪ High potential	▪
Biomass	▪ Low potential	▪
Hydrokinetic	▪ Unknown	▪
Geothermal	▪ Unknown	▪
Gas	▪ Low potential	▪
Coal	▪ Low/medium potential	▪
Emerging Technologies	▪ Unknown	▪
Waste to Heat	▪ Unknown	▪

PRIORITY ENERGY ACTIONS – Pt. Hope		
Timeframe	**Project Name**	**Estimated Costs in 2014**
Immediate 0-1 year	Adopt an Energy element into local comprehensive plan. *Source: NSB 1981 Energy Policies*	TBD
	Wind Turbine Design and Permitting *Source: AEA Renewable Energy Funds*	$146,667
Short 1-5 years	Train local utility operators for new systems, including water and sewer, housing and power generation as alternative and new technologies become available. *Source: Stakeholder Discussion, 2014*	TBD
	Implement Energy Audits on USDW Building and Fire Station *Source: 2010, AHFC Energy Grade Audit Source: AHFC 2011*	TBD
Medium 5-10 years	Upgrade Electrical System. *Source: Village Distribution Systems: Report of Conditions and Proposed Power Grid Improvement Projects, NSB, 2011.*	$85,000
Long >10 years	Replace fuel pump house with more energy efficient upgrade *Source:*	$1,411,000
	Wind Turbine Construction *Source: Alaska Energy Authority, Alaska Energy Pathways, 2010*	TBD

Point Lay

Kali

Community and Energy Profile

Community Profile: Point Lay

Incorporation	No incorporated city government

Location

Point Lay is located south of the Kokolik River mouth, about 300 miles southwest of Barrow.

Longitude	-163.0118	**Latitude**	69.7359
ANCSA Region	Arctic Slope Regional Corporation (ASRC)		
Borough/CA	North Slope Borough		
School District	North Slope Borough School District		
AEA Region	North Slope		

Alaska Native Name (definition)

Kali, "Mound"

Historical Setting / Cultural Resources

Point Lay is one of the more recently established Inupiaq villages on the Arctic coast and has historically been occupied year-round by a small group of one or two families. In 1974, the village moved from the old site on a gravel barrier island just offshore. The old village site is now used as a summer hunting camp. In the late 1970s, due to seasonal flooding from the Kokolik River, the village relocated again to a site near the Air Force Distance Early Warning station to the south. Point Lay is probably the last remaining village of the Kuukpaagruk people.

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

Economy

Based on subsistence hunting, fishing and whaling with 25% of workers employed by the public sector, including school, tribe, health clinic, NSB and local store. Major food sources include caribou, moose, fish, whale, local fowl, berries and local beach greens.

Climate	Avg. Temp.	Climate Zone	Heating Deg. Days
	-55/78	Arctic	17,108

Natural Hazard Plan	
Hazard Mitigation Plan (Borough-wide)	2007

Community Plans	Year
Comprehensive Plan Update	2005

Local Contacts	Email	Phone	Fax
North Slope Borough	lloyd.leavitt@north-slope.org	907-852-0200	907-852-0337
Native Village of Point Lay	pointlay@Iñupiatgov.com	907-833-2575	907-833-2576

Demographics	2000	2010
Population	260	274
Median Age	18	21
Avg. Household Size	4	4
Median Household Income	N/A	$76,250

	2013
Percent of Residents Employed	80.20%
Denali Commission Distressed Community	No
Percent Alaska Native/American Indian (2010)	88.36%
Low and Moderate Income (LMI) Percent (201x)	N/A

Electric Utility	Generation Sources	Interties	PCE?
North Slope Borough Public Works	Diesel	No	Yes

Landfill	Class		Permitted?		Location	
		III		Yes		2 mi. southeast of the community

Water/Wastewater System

Water	Buried pipe system	
Sewer	Buried pipe system	
Notes	Lake nearby	

Homes Served		System Volume
		N/A
Water/Wastewater Energy Audit?	No	

Access

Road	No				
Air Access	Point Lay LRRS Airport	**Runway 1**	4,500' x 100'	**Runway 2**	N/A
		Runway 3	N/A	**Runway 4**	N/A
Dock/Port	No	**Barge Access?**	No	**Ferry Service?**	No
Notes					

Energy Profile: Point Lay

Power House

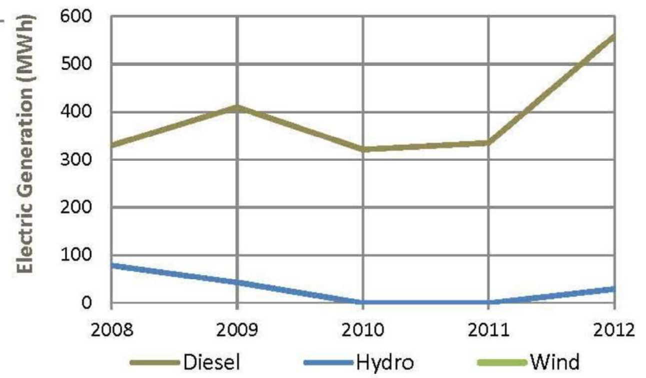
Utility	NSB Public Works, Utilities Division		
Generators	**Make/Model**	**Rated Capacity**	**Year**
Unit 1	Caterpillar 3508C	680 kW	2013
Unit 2	Caterpillar 3508C	680 kW	2013
Unit 3	Caterpillar 3508C	680 kW	2013
Unit 4	Caterpillar 3508C	680 kW	2013
Line Loss			
Heat Recovery?			
Upgrades?			
Outage History/Known Issues			

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

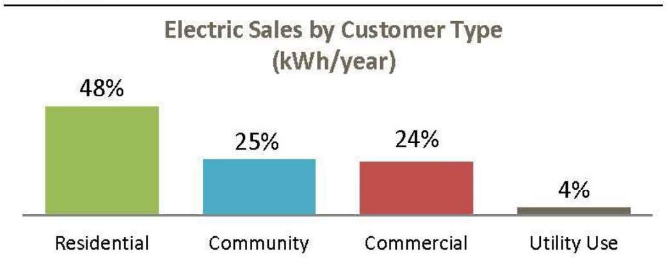
Maintenance Planning (RPSU)

Power Production

Diesel (kWh/yr)	3,365,761	**Avg. Load (kW)**	
Wind (kWh/yr)		**Peak Load (kW)**	576
Hydro (kWh/yr)		**Efficiency (kWh/gal)**	
Total (kWh/yr)		**Diesel Used (gals/yr)**	



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



Electric Rates ($/kWh)		**Cost per kWh Sold ($/kWh)**	
Rate with PCE	0.15	**Fuel Cost**	
Residential Rate	0.15	**Non-fuel Cost**	
Commercial Rat	0.03	**Total Cost**	0.88

Fuel Prices ($)	**Utility/Wholesale**	**Retail**	**Senior**
Diesel (1 gal)	4.25	1.45	1
Other Fuel? (1 gal)			
Gasoline (1 gal)	3.52	3.52	3.52
Propane (100#)			
Wood (1 cord)			
Pellets			
Discounts?			

Alternative Energy	**Potential**	**Projects**	**Status**
Hydroelectric	Unknown		
Wind Diesel	High	Class 5 wind, CDR 2014 (AEA) Design funded (AEA) 2014	
Biomass	Unknown		
Solar	High		
Geothermal	Unknown		
Oil and Gas			
Coal	High	Resource available	
Emerging Tech	Unknown		
Heat Recovery			
Energy Efficiency			

Bulk Fuel

Tank Owner	**Fuel Type(s)**	**Capacity**	**Age/Condition**
NSB Public Works	Gasoline	34,000 (2 tanks)	
NSB Public Works	Diesel	968,176 (35 tanks)	

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

Cooperative Purchasing Agreements

Notes

Energy Profile: Point Lay

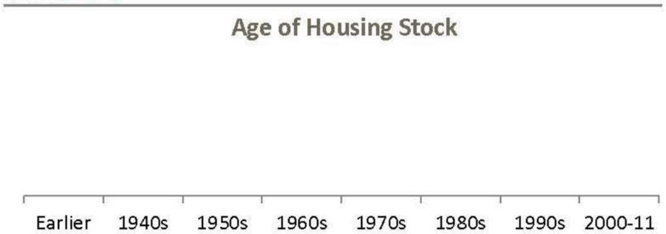
Housing Units	Occupied	Vacant	% Owner-Occup.
	60	10	38%

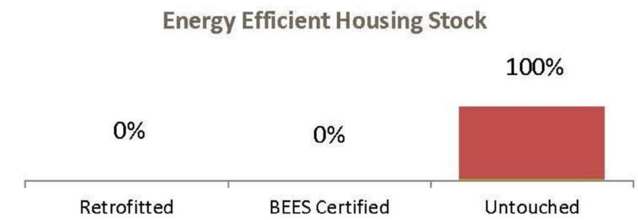
Regional Housing Authority	Weatherization Service Provider
Tagiugmiullu Nunamiullu	

Housing Need	Overcrowded	1-star

Energy Use	Average Home Energy Rating	Average Square Feet	Avg. EUI (kBTU/sf)

Data Quality





Lighting	Upgraded?	Owner	Notes

Non-residential Building Inventory

Building Name or Location	Year Built	Square Feet	Audited?	Retrofits Done?	In ARIS?
Cully Kali School			AHFC		
Fire station			AHFC		
Warm storage building			AHFC		
Tribal building					
Cully Corporation buildings (2)					
Generator building					
Old water treatment building					
Search & rescue facility					
Treatment plant					
Water treatment plant					
Water utility building					
Health clinic					
Public safety office					
Pt. Lay Baptist Church					
Pt. Lay Native Store					

ENERGY IMPROVEMENT OPPORTUNITIES/ALTERNATIVES – Pt. Lay		
Energy Opportunity	Potential	Projects
Existing Systems	High potential	E/E upgrades to systems
Interties	Low potential	Logistics
Wind	High potential	Class 5 wind resource, CDR completed 2014. Design 2014/15
Energy Efficiency (EE) program	High potential	E/E on public and community facilities audited. Residential E/E upgrades
Heat Recovery	High potential	
Hydroelectric	Unknown	
Solar	High potential	
Biomass	Unknown	
Hydrokinetic	Unknown	
Geothermal	Unknown	
Gas	Low potential	
Coal	High potential	Resource assessment needed
Emerging Technologies	Unknown	
Waste to Heat	Unknown	

PRIORITY ENERGY ACTIONS – Pt. Lay		
Timeframe	**Project Name**	**Estimated Costs in 2014**
Immediate 0-1 year	▪ Adopt an Energy element into local comprehensive plan. *Source: NSB 1981 Energy Policies*	TBD
	▪ Participate in local community outreach meetings, school presentations and energy fairs. *Source: Stakeholder Discussion, 2014*	TBD
	▪ Wind Turbine Design and Permitting *Source: AEA Renewable Energy Funds*	$146,667
Short 1-5 years	▪ Train local utility operators for new systems, including water and sewer, housing and power generation as alternative and new technologies become available. *Source: Stakeholder Discussion, 2014*	TBD
	▪ Implement Energy Audits on School and M&O Shop, *Source: Energy Audit, EECBG (AEA) , 2010, AHFC Energy Grade Audit*	$260,000
Medium 5-10 years	▪ Upgrade Electrical System. *Source: Village Distribution Systems: Report of Conditions and Proposed Power Grid Improvement Projects, NSB, 2011.*	$770,000
Long >10 years	▪ Generator upgrade to accept alternative power *Source: Alaska Energy Authority, Alaska Energy Pathways, 2010*	$175,000
	▪ Wind Turbine Construction *Source: Alaska Energy Authority, Alaska Energy Pathways, 2010*	TBD

Wainwright

Ulbuniq

Community and Energy Profile

Community Profile: Wainwright

Incorporation	2nd Class City, 1962		

Location

Along a coastal bluff on the west side of a narrow peninsula, separating Wainwright Inlet from the Chukchi Sea.

Longitude	-160.0383	**Latitude**	70.6369
ANCSA Region	Arctic Slope Regional Corporation (ASRC)		
Borough/CA	North Slope Borough		
School District	North Slope Borough School District		
AEA Region	North Slope		

Alaska Native Name (definition)

Ulbuniq

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

Historical Setting / Cultural Resources

The region around was traditionally well-populated, though the present village was not established until 1904 when the Alaska Native Service built a school there. Coal was mined at several nearby sites for village use; the closest was about 7 miles away. Today, most houses are heated by fuel oil. Ancestors of the current inhabitants were the Utukamiut (people of the Utukok River) and Kukmiut (people of the Kuk River). In early summer, the community gathers for Nalukataq, the feast after a successful whaling season. At this festival and on other occasions, villagers perform traditional Iñupiat dances. Other activities include boating, snowmobiling, hunting, camping, smelt fishing in the spring, and native arts and crafts.

Economy

Subsistence based. 40% employed in the private sector, 59% employed in the local government sector.

Climate	Avg. Temp.	Climate Zone	Heating Deg. Days
	-56/80	Arctic	18,133

Natural Hazard Plan	
Hazard Mitigation Plan (Borough-wide)	2007

Community Plans	Year
Comprehensive Plan Update	2005

Local Contacts	Email	Phone	Fax
North Slope Borough	lloyd.leavitt@north-slope.org	907-852-0200	907-852-0337
City of Wainwright	wainwrightcity@gmail.com	907-763-2815	907-763-2811
Village of Wainwright	jchildress@ain.olgoonik.com	907-763-2535	907-763-2536

Demographics	2000	2010		2013
Population	556	546	**Percent of Residents Employed**	73.70%
Median Age	25	26	**Denali Commission Distressed Community**	No
Avg. Household Size	3.5	3.5	**Percent Alaska Native/American Indian (2010)**	90.11%
Median Household Income	N/A	$66,250	**Low and Moderate Income (LMI) Percent (201x)**	44%

Electric Utility	Generation Sources	Interties	PCE?
North Slope Borough Public Works	Diesel	No	Yes

Landfill	**Class** III	**Permitted?**	Yes	**Location**	2 miles north of Wainwright

Water/Wastewater System		Homes Served		System Volume
Water	Buried pipe system			N/A
Sewer	Buried pipe system	**Water/Wastewater Energy Audit?**	No	
Notes	Merekruak Lake, three miles northeast			

Access					
Road	No				
Air Access	Wainwright Airport, gravel, good condition	**Runway 1**	4,494' x 110'	**Runway 2**	N/A
		Runway 3	N/A	**Runway 4**	N/A
Dock/Port	Yes	**Barge Access?**	Yes	**Ferry Service?**	No
Notes					

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Energy Profile: Wainwright

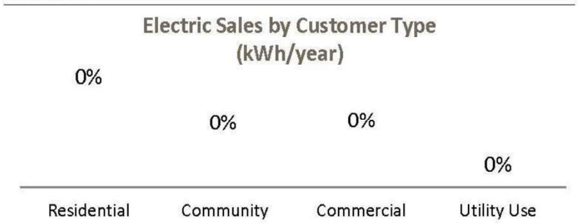
Power House

Utility	NSB Public Works, Utilities Division		
Generators	**Make/Model**	**Rated Capacity**	**Year**
Unit 1	Caterpillar 3508	430 kW	No record
Unit 2	Caterpillar 3508	430 kW	No record
Unit 3	Caterpillar 3508	430 kW	No record
Unit 4	Caterpillar 3512	950 kW	No record
Unit 5	Caterpillar 3512	950 kW	No record
Line Loss			
Heat Recovery?			
Upgrades?			
Outage History/Known Issues			

Operators	No. of Operators	Training/Certifications

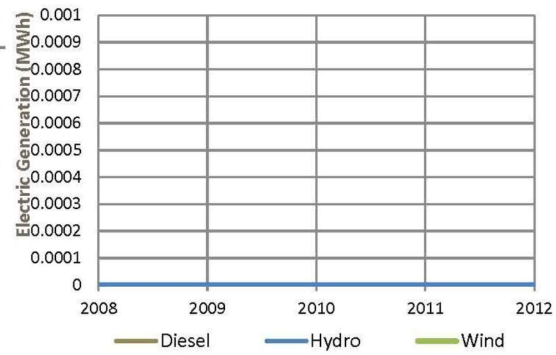
Maintenance Planning (RPSU)

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



Power Production

Diesel (kWh/yr)	5,822,711	Avg. Load (kW)	
Wind (kWh/yr)		Peak Load (kW)	
Hydro (kWh/yr)		Efficiency (kWh/gal)	
Total (kWh/yr)		Diesel Used (gals/yr)	



Electric Rates ($/kWh)		Cost per kWh Sold ($/kWh)	
Rate with PCE	0.15	Fuel Cost	
Residential Rate	0.15	Non-fuel Cost	
Commercial Rate		Total Cost	0.64

Fuel Prices ($)	Utility/Wholesale	Retail	Senior
Diesel (1 gal)	7.3	1.5	1.5
Other Fuel? (1 gal)			
Gasoline (1 gal)	6.87	6.87	6.87
Propane (100#)	468	468	468
Wood (1 cord)			
Pellets			
Discounts?			

Alternative Energy	Potential	Projects	Status
Hydroelectric	Unknown		
Wind Diesel	High	Class 4-5, CDR 2014 (AEA funded) Design 2014/15 (AEA)	
Biomass	Low		
Solar	High		
Geothermal	Unknown	Talks of hot pockets of methane	
Oil and Gas			
Coal	Unknown		
Emerging Tech	Unknown		
Heat Recovery			
Energy Efficiency			

Bulk Fuel

Tank Owner	Fuel Type(s)	Capacity	Age/Condition
NSB Public Works	154,000 (2 tanks)		
NSB Public Works	1,309,103 (39 tanks)		

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

Cooperative Purchasing Agreements

Notes

Energy Profile: Wainwright

Housing Units	Occupied	Vacant	% Owner-Occup.
	147	32	67%

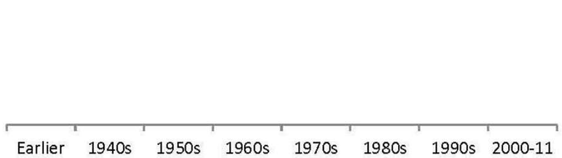
Regional Housing Authority	Weatherization Service Provider
Tagiugmiullu Nunamiullu	

Housing Need		Overcrowded	1-star

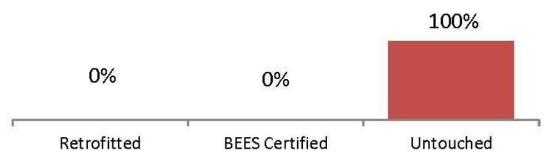
Energy Use	Average Home Energy Rating	Average Square Feet	Avg. EUI (kBTU/sf)

Data Quality

Age of Housing Stock



Energy Efficient Housing Stock



Lighting	Upgraded?	Owner	Notes

Non-residential Building Inventory

Building Name or Location	Year Built	Square Feet	Audited?	Retrofits Done?	In ARIS?
Alak School			AHFC		
Fire station			AHFC		
Olgoonik Corporation					
B&C Quikstop					
BIA School					
City building					
Housing maintenance					
School maintenance building					
Treatment plant					
Vehicle maintenance shop					
Health clinic					
Public safety office					
Olgoonik Store					
Olgoonik Hotel					
Wainwright Co-op Store					
US Post Office					
Tom&Jerrys Store					
Presbyterian Church					
Baptist Church					
NSB PW DMS Bldg					
NSB Teleconf. Bldg					
Traditional Office					

ENERGY IMPROVEMENT OPPORTUNITIES/ALTERNATIVES – Wainwright		
Energy Opportunity	**Potential**	**Projects**
Existing Systems	High potential	E/E upgrades to systems
Interties	Low potential	Logistics
Wind	High potential	Class 4-5 wind resource, CDR completed 2014. Design 2014/15
Energy Efficiency (EE) program	High potential	E/E on public and community facilities audited. Residential E/E upgrades
Heat Recovery	High potential	
Hydroelectric	Unknown	
Solar	High potential	
Biomass	Low potential	
Hydrokinetic	Unknown	
Geothermal	Unknown	
Gas	Low potential	
Coal	Unknown potential	Resource assessment needed
Emerging Technologies	Unknown	
Waste to Heat	Unknown	

PRIORITY ENERGY ACTIONS – Wainwright		
Timeframe	**Project Name**	**Estimated Costs in 2014**
Immediate 0-1 year	Adopt an Energy element into local comprehensive plan. *Source: NSB 1981 Energy Policies*	TBD
	Participate in local community outreach meetings, school presentations and energy fairs. *Source: Stakeholder Discussion, 2014*	TBD
	Wind Turbine Design and Permitting *Source: AEA Renewable Energy Funds*	$146,667
Short 1-5 years	Train local utility operators for new systems, including water and sewer, housing and power generation as alternative and new technologies become available. *Source: Stakeholder Discussion, 2014*	TBD
	Upgrade Electrical System. *Source: Village Distribution Systems: Report of Conditions and Proposed Power Grid Improvement Projects, NSB, 2011.*	$770,000
	Implement Energy Audits on School and Fire Station, *Source: 2010, AHFC Energy Grade Audit Source: AHFC 2011*	$175,000
	Electrical System Upgrades. *Source: Village Distribution Systems: Report of Conditions and Proposed Power Grid Improvement Projects, NSB, 2011.*	$1,465,598
Medium 5-10 years	Wind Turbine Construction *Source: Alaska Energy Authority, Alaska Energy Pathways, 2010*	TBD
Long >10 years	Replace power plant with more energy efficient upgrade, accommodate alternatives. *Source: Section 13 - Light, Power, and Heating Systems, Alaska Energy Authority, Alaska Energy Pathways, 2010*	$22,000,000

Chapter 5

Community Outreach

Community Outreach

This chapter community comments collected at outreach meetings held in all North Slope Borough communities.

5 COMMUNITY OUTREACH

5.1 COMMUNITY COMMENTS

Community meetings were held throughout the North Slope Borough to engage local leadership in the planning process prior to data collection and outreach. This allowed for guidance in the grassroots approach to the energy planning process. The chart below shows the dates of the Leadership meetings and Community Outreach meetings, as well as engaged agencies and entities which participated in this process.

Table 15: Community and Leadership Meetings and Participants

COMMUNITY	LEADERSHIP MEETING	COMMUNITY OUTREACH MEETING	ORGANIZATIONS ATTENDED
Anaktuvuk Pass	2/18/2014	3/3/2015	City of Anaktuvuk Pass, Nunamuit Corp., Native Village of AKP, NSB Liaison
Atqasuk	2/19/2014	2/19/2015	City of Atqasuk, NSB Public Works, Native Village of Atqasuk
Barrow	6/27/2014	TBD	NSB Grants, NSB Fuel, BUECI, Umiaq, NSB Planning, NSB Admin & Finance, NSB Public Works, UIC, Native Village of Barrow, City of Barrow, ASRC
Kaktovik	3/3/2014	3/11/2015	KIC, ASRC, Native Village of Kaktovik, City of Kaktovik
Nuiqsut	3/5/2014	3/10/2015	Native Village of Nuiqsut, NSB Liaison, Kuukpik
Point Hope	2/11/2014	3/2/2015	NSB Liaison, Native Village of Pt. Hope, City of Pt. Hope, Tikigaq Corp., ASRC, AEA
Point Lay	1/28/2014	2/20/2015	NSB Liaison, Native Village of Pt. Lay, IGAP, NSB-DWM, Cully Corp., ASRC
Wainwright	3/6/2014	4/28/2015	City of Wainwright, Native Village of Wainwright, Olgoonik Corp., ASRC Energy, AEA

Residents and other stakeholders were given opportunity to voice their opinions both orally in the meetings and in writing via comment forms. Comments spanned a broad range of topics related to energy and planners used the feedback to be sure that each area of concern was addressed in the plan. The comments on the following page provide a representative sample of the feedback received from across the study area.

“Training on residential stoves (such as Toyo’s) needs to be done. Most elders can’t fix their stoves when they go out.” Anaktuvuk Pass resident

“Fuel is flown in “on demand” and we have concerns about running out.” Atqasuk resident

“There is no back up at the Power Plant and when the system shuts down we have electricity to the fuel pump. The Day Truck is sometimes buried in snow and can’t be accessed. This concerns many of us.” Atqasuk resident

“Better housing design needs to be done. Our homes are not warm enough.” Atqasuk resident

“Some new technology is simply not designed for Arctic climate and does not work. We have done feasibility studies on different incinerators and they just don’t pencil out financially.” Service Area 10 employee

“Implementation of energy-efficient programs and projects would greatly reduce the operations costs for the North Slope Borough. Educating local residents on energy in general (usage and conservation) would greatly help.” NSB employee

“The NSB is working hard to find solutions in housing. Requiring construction of only Arctic climate designed homes would help for stabilize the housing stock.” NSB employee

“Weatherization of homes is a huge concern for our community. Our water and sewer and electricity needs to be improved as well.” Kaktovik resident

“We need to continue to seek alternative energy resources, such as wind. Our community has talked about this for many years. The costs are only going up.” Kaktovik resident

“We’d like to learn more about solar for our homes.” Kaktovik resident

“When we switched to natural gas it really helped, but our heating is still very expensive.” Nuiqsut resident

“No studies have been done here for alternative energy, but we would welcome them. Not sure if any energy-efficient audits have been done.” Nuiqsut resident

“Lack of collaboration within our community has hindered progress. We need to work together to find solutions. Too many reports without implementation of projects.” Pt. Hope leader

“We’d like to see more renewable energy projects, such as solar and hydro or tidal.” Pt. Hope resident

“We love to see waste-to-heat at our landfill. It would be great to have a greenhouse run off of that.” Pt. Lay leader

“We need sustainable solutions – our homes and water and sewer system is sinking due to climate change and thawing, we need to find solutions.” Pt. Lay leader

“We need better management of projects and more effective planning.” Wainwright leader

“The energy audit recommendations need to be implemented so we can see the savings.” Wainwright resident

“Our people need to understand energy issues and we need more educational tools within the community.” Wainwright leader

Chapter 6

Implementation Plan

Implementation Plan

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

6 IMPLEMENTATION PLAN

6.1 REGIONAL PRIORITIES

Regional priority energy actions were identified from the NSB CIPM capitol project list, stakeholder interviews, input from the Energy Steering Committee and public meetings. The priorities were categorized into immediate (<1 year), 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 projects are presented in Appendix A.

The overarching energy vision for the North Slope Regional Energy Plan to serve as a clear guide for future energy actions. It is intended to be an inspiration and provide the framework for strategic planning. In our vision we can provide affordable energy, keep our people warm, and be the leaders in bringing the most economical, sustainable energy to rural Arctic communities.

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.

The following table lists planned projects and 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. Columns have been left open for future planning efforts toward implementation of the energy projects.

PROJECTS	PROJECTS STATUS	NEXT STEPS	PARTNERS	FUNDING STATUS	Estimated Costs	Community
Energy Efficiency and Education						
Conduct community outreach and educational energy fairs.	Immediate 0-1 year				TBD	All
Collaborate with TNHA, Native Village of Barrow, CCHRC and other arctic building specialists to identify energy-efficient, arctic climate appropriate structures.	Immediate 0-1 year				TBD	All
Require bidders on all new facilities to research and present at least one demonstration energy conservation feature, system or material application.	Immediate 0-1 year				TBD	All
Incorporate energy policies in the employee handbook to encourage energy efficiency practices among NSB employees.	Immediate 0-1 year				TBD	All
Identify energy conservation strategies for public and private structures and vehicles	Immediate 0-1 year				TBD	All
Implement RurAL CAP Energywise Program in each village.	Short 1-5 years				TBD	All
Integrate AKSmart Energy curriculum in schools.	Short 1-5 years				TBD	All
Install metering systems, such as TED and smart meter grids, to track and collect energy production, consumption and cost.	Short 1-5 years				TBD	All

PROJECTS	PROJECTS STATUS	NEXT STEPS	PARTNERS	FUNDING STATUS	Estimated Costs	Community
Develop and maintain matrix showing current cost of energy.	Short 1-5 years				TBD	All
Conduct study to determine actual heating costs.	Short 1-5 years				TBD	All
Calculate life-cycle energy costs for all proposed new Borough facilities.	Short 1-5 years				TBD	All
Create a building code that emphasizes sound energy efficient arctic construction.	Short 1-5 years				TBD	All
Design and construct energy-efficient, arctic climate appropriate structures	Short 1-5 years				TBD	All
Complete energy audits on public buildings and implement recommendations.	Short 1-5 years				TBD	All
Energy Infrastructure						
Reassess current failing systems – such as water and sewer and redesign for environment and energy efficiency as needed.	Short 1-5 years				TBD	All
Reevaluate current design of systems and incorporate emerging energy technologies as appropriate.	Short 1-5 years				TBD	All
Dispose of hazardous materials related to energy production throughout the NSB.	Short 1-5 years				$5,000,000	All
Perform upgrades to power generation systems throughout the NSB.	Short 1-5 years				$5,500,000	All

PROJECTS	PROJECTS STATUS	NEXT STEPS	PARTNERS	FUNDING STATUS	Estimated Costs	Community
Install generators at Walakpa Gas Field.	Short 1-5 years				$2,343,000	All
Upgrade village power distribution grids.	Short 1-5 years				$5,778,000	All
Upgrade electric metering.	Short 1-5 years				$150,000	All
Upgrade fuel heater containments.	Short 1-5 years				$300,000	All
Upgrade to more efficient street lighting across the NSB.	Short 1-5 years				$400,000	All
Upgrade trucks serving the high voltage line.	Long >10 years				$1,000,000	All
Upgrade Electrical System	Short 1-5 years				TBD	Anaktuvuk Pass, Atqasuk, Kaktovik, Pt. Hope, Pt. Lay, Wainwright
Generator upgrade to accept alternative power.	Short 1-5 years				TBD	Anaktuvuk Pass, Atqasuk, Kaktovik, Pt. Lay
Atqasuk Transmission line Preliminary Design and Permitting	Short 1-5 years				$2,220,000	Atqasuk
Atqasuk Transmission line construction.	Medium 5-10 years				TBD	Atqasuk

PROJECTS	PROJECTS STATUS	NEXT STEPS	PARTNERS	FUNDING STATUS	Estimated Costs	Community
Power Plant Upgrade NSB – CIP requested upgrade.	Long >10 years				TBD	Atqasuk
Marine header and pipeline relocation.	Long >10 years				TBD	Barrow
Replace power plant with more energy efficient upgrade, accommodate alternatives.	Long >10 years				$22,000,000	Wainwright
Planning						
Adopt an energy element into the local and regional comprehensive plans.	Immediate 0-1 year				TBD	All
Refer to energy plan during the CIP review process.	Immediate 0-1 year				TBD	All
Update the North Slope Regional Energy Plan on a regular basis.	Short 1-5 years				TBD	All
Update NSB Comprehensive Plan to include the North Slope Regional Energy Plan.	Short 1-5 years				TBD	All
Energy Financing						
Analyze current electrical costs, NSB electrical rates and consider ways to increase PCE subsidy.	Short 1-5 years				TBD	All
Provide incentives for bill payment through education and energy efficiency measures that reduce monthly bills.	Short 1-5 years				TBD	All
Maintenance						

PROJECTS	PROJECTS STATUS	NEXT STEPS	PARTNERS	FUNDING STATUS	Estimated Costs	Community
Train employees for new systems, including water and sewer, housing and power generation.	Immediate 0-1 year				TBD	All
Communication						
Provide means to assist with communication between departments and energy plan implementation.	Immediate 0-1 year				TBD	All
Conduct community outreach meetings, school presentations and energy fairs in each village.	Immediate 0-1 year				TBD	All
Geothermal						
Prepare Geothermal Feasibility Study.	Short 1-5 years				$200,000	Anaktuvuk Pass
Develop Geothermal Resource if determined feasible.	Medium 5-10 years				TBD	Anaktuvuk Pass
Heat Recovery						
Install heat recovery systems.	Short 1-5 years				$1,438,356	Anaktuvuk Pass
Hydroelectric						
Conduct Hydroelectric Feasibility Study on Contact Creek.	Medium 5-10 years				$200,000	Anaktuvuk Pass
Develop Hydroelectric Resource if determined feasible.	Long >10 years				TBD	Anaktuvuk Pass,
Oil and Gas						

PROJECTS	PROJECTS STATUS	NEXT STEPS	PARTNERS	FUNDING STATUS	Estimated Costs	Community
Upgrade fuel tanks for safety and capacity.	Short 1-5 years				$100,000	All
Demolish, remove, and clean up out of service fuel tanks.	Short 1-5 years				$1,230,000	All
Install system to electronically manage fuel tanks most efficiently.	Short 1-5 years				$1,500,000	All
Install and upgrade fuel truck loading racks.	Short 1-5 years				TBD	All
Fuel delivery vehicles region wide.	Short 1-5 years				$900,000	All
Replace fuel pump house with more energy efficient upgrade.	Long >10 years				$1,411,000	Pt. Hope
Wind						
Wind Turbine Design and Permitting.	Short 1-5 years				TBD	Kaktovik, Pt. Hope, Pt. Lay, Wainwright
Construct Wind Turbine	Long >10 years				TBD	Kaktovik, Pt. Hope, Pt. Lay, Wainwright
Invest in wind generation throughout the NSB wherever feasible.	Short 1-5 years				TBD	All

The table below shows the possible savings over time for the Alaska Housing Finance Corporation energy audits done throughout the North Slope Borough.

Table 16: Example of Cost Evaluation for Energy Efficiency Projects

Energy Efficiency Projects
AHFC Energy Audit Recoomendations

Community	Facility	Energy Efficiency Improvement Installed cost	Annual Savings	Payback (in years)
Anaktuvuk Pass	Fire Station	$9,600	$3,200	3
	M&O Building	$76,281	$8,146	9.4
	School	$198,662	$63,490	3.1
Atqasuk	Fire Station	$22,215	$10,524	2.1
	USDW Building	$122,004	$41,995	2.9
	School	$315,462	$142,920	2.2
Wainwright	3425 C Street Shops 3A	$17,450	$1,402	12.4
	3427 C Street Shops 3B	$71,980	$8,082	8.9
	3429 C Street Shops 3	$9,110	$3,470	2.6
	Fire Station	$48,560	$7,872	8.8
	School	$118,286	$102,904	1.1
Barrow	Fire Station # 1	$31,811	$6,327	5
	Municipal Bus Barn	$52,629	$9,254	5.7
	Sanitation Building	$35,901	$12,585	2.9
	Search and Rescue Hangar	$22,107	$12,268	1.8
	Shipping and Receiving	$43,335	$6,550	6.8
	Browerville Fire Station	$36,156	$8,380	4.3
	Dlt Duty	$80,337	$22,105	3.6
	Herigage Center	$10,486	$9,951	0.9
	SD Bus Barn	$95,422	$5,435	17.4
	Public Works	$14,354	$10,940	1.3
Kaktovik	Warm Storage Facility	$46,085	$12,094	3.8
	Police	$56,970	$10,401	5.5
	School	$182,398	$82,710	2.2
Nuiqsut	O&M shop	$122,210	$6,100	20
	School	$52,864	$112,590	2.1
Point Hope	Public Works	$55,687	$338,197	1.4
	Fire Station	$21,015	$12,808	1.6
Point Lay	Fire Station	$21,337	$12,911	1.7
	Warm Storage Facility	$29,932	$13,631	0.5
	School	$29,560	$17,325	1.7
	AVERAGE	$66,136	$36,018	5

Note: Cost savings are calculated based on the historical energy costs for the building. Installation costs include labor and equipment but design and construction management costs are excluded.

7 GLOSSARY

AkWarm: AHFC released AkWarm in 1996 as a software tool for builders, designers, energy raters, lenders, and homeowners. The software can be used for energy design, retrofit, or to determine an energy rating.

Alaska Energy Authority (AEA): A public corporation of the state with a separate and independent legal existence with the mission to construct, finance, and operate power projects and facilities that utilize Alaska's natural resources to produce electricity and heat. Website: http://www.akenergyauthority.org/

Alaska Retrofit Information System (ARIS): ARIS is a project funded by the Alaska Housing Finance Corporation (AHFC). The project goal is to create a means by which to collect, manage, access, and report on information relating to AHFC's rebate and weatherization programs, as well as other official uses of AkWarm.

Alaska Rural Utility Collaborative (ARUC): ARUC is a program managed by the Alaska Native Tribal Health Consortium. ARUC manages water and sewer systems in partnership with rural Alaska communities. ARUC management is intended to result in more cost-effective operations and maintenance.

ARUC sets rates with community council input. Each community's rates are set to be self-supporting, so rates will vary per community and hires a local water plant operator (and backup) in each community at good wages and retirement benefits. They purchase all fuel, parts, electricity, etc. for water/sewer system with money collected from water/sewer customer and often can find grant money to purchase fuel, supplies, and needed parts and repairs for ARUC communities in the first year of membership.

Auxiliary Generator: A generator at the electric plant site that provides power for the operation of the electrical generating equipment itself, including related demands such as plant lighting, during periods when the electric plant is not operating and power is unavailable from the grid. A black start generator used to start main central station generators is considered to be an auxiliary generator.

Backup (Standby) Generator: A generator that is used only for test purposes, or in the event of an emergency, such as a shortage of power needed to meet customer load requirements.

Barrel (bbl.): A unit of volume equal to 42 U.S. gallons.

Benchmarking: Benchmarking is the preliminary data collection and analysis that takes place before the audit. Typical benchmark data consists of building age, square footage, occupancy, building drawings (original and additions), historical energy use including a minimum of two years of fuel and electrical bills, etc. It can be used to determine the level of audit needed or if retro-commissioning should be undertaken.

Bituminous coal: A dense coal, usually black, sometimes dark brown, often with well-defined bands of bright and dull material, used primarily as fuel in steam-electric power generation, with substantial quantities also used for heat and power applications in manufacturing and to make coke. Bituminous coal is the most abundant coal in active U.S. mining regions. Its moisture content usually is less than 20%. The heat content of bituminous coal ranges from 21 to 30 million BTU per ton on a moist, mineral-matter-free basis. The heat content of bituminous coal consumed in the United States averages 24 million BTU per ton, on the as-received basis (i.e. containing both inherent moisture and mineral matter).

British Thermal Unit: The British thermal unit (BTU or Btu) is a traditional unit of energy equal to about 1.06 kilojoules. It is approximately the amount of energy needed to heat one pound (0.454 kg) of water 1 °F (0.556 °C).

It is used in the power, steam generation, heating and air conditioning industries. In North America, the term "BTU" is used to describe the heat value (energy content) of fuels, and also to describe the power of heating and cooling systems. When used as a unit of power, BTU per hour (BTU/h) is the correct unit, though this is often abbreviated to just "BTU."

Capital Cost: The cost of field development, plant construction, and the equipment required for industry operations.

Climate Change: A term used to refer to all forms of climatic inconsistency, but especially to significant change from one prevailing climatic condition to another. In some cases, "climate 20 change" has been used synonymously with the term "global warming;" scientists, however, tend to use the term in a wider sense inclusive of natural changes in climate, including climatic cooling.

Coal: A readily combustible black or brownish-black rock whose composition, including inherent moisture, consists of more than 50% by weight and more than 70% by volume of carbonaceous material. It is formed from plant remains that have been compacted, hardened, chemically altered, and metamorphosed by heat and pressure over geologic time. It is estimated that Alaska holds about 15% of the world's coal resources, amounting to 170 billion identified short tons. Major coal provinces include Northern Alaska, the Nenana area, Cook Inlet – Matanuska Valley, the Alaska Peninsula, and in the Gulf of Alaska and the Bering River. Alaska coals exhibit low metallic trace elements, good ash-fusion characteristics, and low nitrogen content making them favorable for meeting environmental constraints on combustion in power plants.

Cogeneration System: A system using a common energy source to produce both electricity and thermal energy for other uses, resulting in increased fuel efficiency.

Combined Cycle: An electric generating technology in which electricity is produced from otherwise lost waste heat exiting from one or more gas (combustion) turbines. The exiting heat is routed to a conventional boiler or to a heat recovery steam generator for utilization by a steam turbine in the production of electricity. This process increases the efficiency of the electric generating unit.

Combustion: Chemical oxidation accompanied by the generation of light and heat.

Commercial Sector: An energy-consuming sector that consists of service-providing facilities and equipment of businesses; Federal, State, and local governments; and other private and public organizations, such as religious, social, or fraternal groups. The commercial sector includes institutional living quarters. It also includes sewage treatment facilities. Common uses of energy associated with this sector include space heating, water heating, air conditioning, lighting, refrigeration, cooking, and running a wide variety of other equipment. Note: This sector includes generators that produce electricity and/or useful thermal output primarily to support the activities of the above-mentioned commercial establishments.

Consumer (energy): Any individually metered dwelling, building, establishment, or location.

Diesel #1: Also known as DF1 or Jet A. Diesel #1 is commonly used as heating fuel throughout most of northern rural AK. Diesel #1 has a lower gel temperature than Diesel #2 which is sold for heating fuel in warmer climates. Diesel #1 is same fuel the refineries sell as Jet fuel (Jet A), and in many tank farms it is stored as Jet A until sold as DF1.

Diesel #2: Is commonly used throughout the US. In Alaska, it is used for marine and highway diesel as well as heating fuel in warmer regions. Diesel #2 is preferred over #1 where it is warm enough as it has higher energy content.

Diesel Fuel: A fuel composed of distillates obtained in petroleum refining operation or blends of such distillates with residual oil used in motor vehicles. The boiling point and specific gravity are higher for diesel fuels than for gasoline.

Distillate Fuel Oil: A generic name for a refined petroleum product. It can refer to diesel, heating fuel or jet fuel.

Electric Meter, or Watt-hour Meter: Electric Meter, or Watt-hour Meter (also known as The Energy Detective or TED meters) is an instrument that measures the amount of electric energy used by a consumer. The meter is calibrated in kilowatt-hours.

Electricity: A form of energy characterized by the presence and motion of elementary charged particles generated by friction, induction, or chemical change.

Energy Balance: The difference between the total incoming and total outgoing energy. When the energy budget is balanced, the system neither gains nor loses energy.

Energy Information Agency (EIA): An independent agency within the U.S. Department of Energy that develops surveys, collects energy data, and analyzes and models energy issues. Website: http://www.eia.doe.gov/

Fuel: Any material substance that can be consumed to supply heat, power, or mechanical energy. Included are petroleum, coal, and natural gas (the fossil fuels), and other consumable materials such as biomass.

Biodiesel (Fish Oil)	121,000 BTU/Gal
Coal (Healy)	7,900 Btu/lb
Crude Oil	138,000 Btu/gal
Diesel #1	132,000 Btu/gal
Diesel #2	138,000 Btu/gal
Electricity	3,412 Btu/k/Wh
Garbage	4,800 Btu/lb.
Gasoline	124,000 Btu/gal
Natural Gas	1,000 Btu/cf
Paper	7,500 Btu/lb
Propane	92,000Btu/gal
Wood (Birch)	24.2 MMBtu/cord
Wood (Birch))	8,300 Btu/dry lb.
Wood (Spruce)	15.9 MMBtu/cord
Wood (Spruce)	8,100 Btu/dry lb.

Gallon: A volumetric measure equal to four quarts (231 cubic inches) used to measure fuel oil.

Gas: A non-solid, non-liquid combustible energy source that includes natural gas, coke-oven gas, blast-furnace gas, and refinery gas.

Grid: The layout of an electrical distribution system.

Heating Degree Days (HDD): A measure of how cold a location is over a period of time relative to a base temperature, most commonly specified as 65 degrees Fahrenheit. The measure is computed for each day by subtracting the average of the day's high and low temperatures from the base temperature (65 degrees), with negative values set equal to zero. Each day's heating degree days are summed to create a heating degree day measure for a specified reference period. Heating degree days are used in energy analysis as an indicator of space heating energy requirements or use.

Hydroelectric Power: The use of flowing water to produce electrical energy.

Installed Capacity: The maximum theoretical production output of a plant, based either on nameplate capacity or actual (practically determined) capacity.

Kilowatt-Hour (kWh): A unit of energy equal to one kW applied for one hour; running a one kW hair dryer for one hour would dissipate one kWh of electrical energy as heat. Also, one kWh is equivalent to one thousand watt hours.

Kilowatt (kW): One thousand watts of electricity (See Watt).

Load (Electric): Amount of electricity required to meet customer demand at any given time.

MCF: One thousand cubic feet.

Megawatt (MW): One million watts of electricity (See Watt).

Microgrid: A microgrid is a small-scale power grid that can operate independently or in conjunction with the area's main electrical grid.

Microturbines: Microturbines combine heat and power (CHP), or cogeneration, for an efficient and clean approach to generating electric power and useful thermal energy from a single fuel source. CHP is used to replace or supplement conventional separate heat and power (i.e., central station electricity available via the grid and an onsite boiler or heater). Every CHP application involves the generation of electricity and the recovery of otherwise wasted thermal energy. Therefore, CHP provides greater energy efficiency and environmental benefits than separate heat and power. CHP systems achieve fuel use efficiencies of 60 to 90 percent, compared to a typical separate heat and power efficiency range of 45 to 55 percent. This improvement in efficiency translates to energy cost savings from reduced fuel used, reduced emissions of greenhouse gases and other regulated air pollutants, increased electricity-supply reliability and power quality, and reduced grid congestion and transmission and distribution losses.

In addition to burning liquid fuels such as diesel, kerosene, jet fuel, and liquid biofuels, microturbines can burn almost any carbon-based gaseous fuel: natural gas, propane, sour gas, sweet gas, well casing gas, flare gas, methane and other waste gases to create renewable power and heat. Waste material buried in landfills biodegrades over time to produce methane, carbon dioxide, and other gases. Treatment of domestic wastewater, agricultural waste and food processing waste using anaerobic digestion also produces methane and other gases. Many sites flare these waste gases; or worse yet vent them directly into the atmosphere. Methane has a greenhouse gas impact on the atmosphere that is 21 times that of carbon dioxide, and burning methane in a flare completely wastes its energy value.

Natural Gas: Gas in place at the time that a reservoir was converted to use as an underground storage reservoir in contrast to injected gas volumes.

O&M: Operations and maintenance

Peak: The amount of electricity required to meet customer demand at its highest. The summer peak period begins June 1st and ends September 30th, and the winter peak period begins December 1st and ends March 31st.

Petroleum: A broadly defined class of liquid hydrocarbon mixtures. Included are crude oil, lease condensate, unfinished oils, refined products obtained from the processing of crude oil,.and natural gas plant liquids. Note: volumes of finished petroleum products include non-hydrocarbon compounds, such as additives and detergents, after they have been blended into the products.

Power: The rate of producing, transferring, or using energy that is capable of doing work, most commonly associated with electricity. Power is measured in watts and often expressed in kilowatts (kW) or megawatts (MW).

Power Cost Equalization Program (PCE): Participating utilities receive state funding to reduce the charge to consumers in rural areas where prices can be three to five times higher than prices in urban areas.

Rankine Cycle: Converts heat into power, the heat is supplied in a closed loop of water. Organic Rankine Cycle uses a liquid with lower boiling temperature.

Refinery: An installation that manufactures finished petroleum products from crude oil, unfinished oils, natural gas liquids, other hydrocarbons, and oxygenates.

Renewable Energy Fund (REF): Established by the Alaska State Legislature and administered by the Alaska Energy Authority to competitively award grants to qualified applicants for renewable energy projects.

Renewable Energy Resources: Energy resources that are naturally replenishing but flow-limited. They are virtually inexhaustible in duration but limited in the amount of energy that is available per unit of time. Renewable energy resources include biomass, hydro, geothermal, solar, wind, ocean thermal, wave action, and tidal action.

Rural Utility Business Advisor (RUBA) Program: - The goal of the RUBA program is to increase the managerial and financial capacity of rural water and wastewater utility providers. The program is advisory only; travel and assistance is at the request of local utility staff. The program offers capacity building assistance to rural utilities throughout all regions of the state. One-on-one or small group training in the community is provided by RUBA staff for the local utility staff. http://commerce.alaska.gov/dnn/dcra/RuralUtilityBusinessAdvisorProgramRUBA.aspx

Smart Grid: A smart grid is a modernized electrical grid that uses analog or digital information and communications technology to gather and act on information, such as information about the behaviors of suppliers and consumers, in an automated fashion to improve the efficiency, reliability, economics, and sustainability of the production and distribution of electricity. It also allows utility operators to shut off power to portions of the grid while making repairs.

Smart Meters: Smart meters are meters that identify energy consumption in more detail than a conventional electric or Watt Hour meter). They have the ability to communicate information via a secured network back and forth between the end user and the utility provider. This allows the utility to close portions of grid as needed for repairs or maintenance without shutting off the entire system.

Space Heating: The use of energy to generate heat for warmth in housing units using space-heating equipment. It does not include the use of energy to operate appliances (such as lights, televisions, and refrigerators) that give off heat as a byproduct.

Transmission System (Electric): An interconnected group of electric transmission lines and associated equipment for moving or transferring electric energy in bulk between points of supply and points at which it is transformed for delivery over the distribution system lines to consumers, or is delivered to other electric systems.

Turbine: A machine for generating rotary mechanical power from the energy of a moving force (such as water, hot gas, wind, or steam). Turbines convert the kinetic energy to mechanical energy through the principles of impulse and reaction, or a mixture of the two.

U.S. Department of Energy (DOE): Oversees programs, such as Wind Powering America, with the mission to advance national, economic, and energy security; promote innovation; and ensure environmental responsibility. Website: http://www.energy.gov/

Waste to Energy or Energy from Waste: Waste-to-energy (WtE) or energy-from-waste 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.

Watt (Electric): The electrical unit of power. The rate of energy transfer equivalent to one ampere of electric current flowing under a pressure of one volt at unity power factor.

Watt (Thermal): A unit of power in the metric system, expressed in terms of energy per second, equal to the work done at a rate of one joule per second.

Watt hour (Wh): The electrical energy unit of measure equal to one watt of power supplied to, or taken from, an electric circuit steadily for one hour.

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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 their home heating and electric bills, and save money.	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, locally hired crew; household

Program	Funding Agency	Description of Funding Opportunity	Restrictions for Eligibility	Comments
				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.		
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

Program	Funding Agency	Description of Funding Opportunity	Restrictions for Eligibility	Comments
				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.		