Alaska Energy Pathway

Toward energy independence

A guide for Alaskan communities to utilize local energy resources

July 2010

ALASKA ENERGY AUTHORITY

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Wind turbines in Kotzebue

See photo credits page 44.

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Message from the Governor

Access to energy is critical for Alaska. We create economic opportunity, heat our homes, and derive significant state revenue from energy resources.

Alaskans and our country depend on conventional and renewable energy sources, and Alaska natural gas is the next logical bridge to a cleaner energy future.

Production of North Slope natural gas is within reach where two pipeline open seasons vie for gas shippers this summer. Although an overland route to North American markets dominates headlines, the Alaska Pipeline Project includes a design that can take up to three billion cubic feet of gas per day to Valdez where an LNG plant can serve Pacific Rim markets. Having multiple options for gas projects is good for Alaska – it gives more opportunities for investment, jobs, and Alaska gas for Alaskans.

In addition to the work being done on a large diameter gas pipeline, my administration has a team of pipeline engineers determining the cost of constructing a smaller diameter bullet line. Funds have also been secured to continue this work in conjunction with a new development team created by legislation passed this year. By assuring that one of these projects advance, Alaskans will secure access to this energy source for personal and industrial use.

We still have a lot of oil to produce, but history is defined by generations – not just a few years. Our generation will experience a transition on the North Slope to gas production and around the state to more renewable energy. Along the way, we plan to invest oil revenue in long-term infrastructure projects to provide energy price stability and affordable energy long into the future.

This Alaska Energy Pathway reaffirms our goal to generate 50% of our electric needs from renewable and alternative energy sources by the year 2025. I support transitioning in greater measure to renewable energy sources, but we can be more aggressive. In this document, we set targets for increasing energy efficiency statewide by 15% by 2020. We also present a long-term vision for achieving the greatest degree of energy independence possible from a combination of in-state renewables and fossil energy resources.

These are aggressive targets – indeed, some of the most aggressive in the nation. And yet, I know Alaskans are up to the challenge. We can blaze a path to energy independence and be an example to the world in this achievement.

Hundreds of Alaskans took the first step in this challenge by contributing to this Alaska Energy Pathway which lays out a general strategy that can be applied by individual communities. The next step for successful implementation of any of the suggested strategies requires even more local participation and passion.

While the Alaska Energy Pathway provides information and guidance, it will take action at the local level to develop individual community plans to lower energy costs. As your Governor, I will work with you to remove roadblocks and provide resources to facilitate this journey to a more secure energy future.

Governor Sean Parnell

Introduction from the AEA Executive Director

The people of Alaska are truly fortunate to have an abundance of natural resources. These natural resources promise a robust economy, and the incredible innate beauty of Alaska enriches our lives. At the heart of this abundance are the communities that lie scattered among the expanse of raw wilderness storing our resource riches. It is the people of Alaska, the real fuel of progress, that give us reason to ponder how we might better use our vast wealth to improve quality of life in our great state. In terms of energy, Alaska has been both blessed… and challenged. The long distances separating communities and relatively low community energy use levels challenge the economics of deliverability despite the diversity and abundance of our energy resource wealth. Determining a best-use scenario for each community within the context of their unique needs and potential is the key to ensuring a sustainable future for Alaska's people.

Alaska Energy

In January 2009, the Alaska Energy Authority (AEA) published a report titled "Alaska Energy - A first step toward energy independence." This guide is now being used by communities to review available resources and help determine least-cost energy options. The complete guide is available on the AEA website, www.akenergyauthority.org, in a Wiki format at www.energy-alaska.com and on the enclosed DVD.

The 2009 database provides a technology-screening tool that was developed to allow each community to review locally available resources and determine the most cost-efficient energy options based on delivered cost of energy to residents. For the first time, energy use in each community was determined for three major components: electricity, space heating, and transportation.

The net result of the 2009 database was a focusing tool that provides each community with least-cost options for their electricity, space heating, and transportation. Prices are based on a delivered cost that includes capital cost for infrastructure and alternative infrastructure that may be required for alternative fuel options. Operations and Maintenance (O&M) costs and fixed energy costs were included to determine the delivered cost of energy to the community. The delivered cost number is intended to identify the real cost of current and alternative energy sources.

Developing an Alaska Energy Pathway

A resource map was constructed that indicates the available resources for each community; it can be viewed in Appendix 5. As would be expected, every resource is not available in each community. It was a surprise, however, that even with all the resources in Alaska, there are regions that have only one viable local resource for fuel. For example, western Alaska communities may only have wind or the Upper Yukon may only have wood.

Costs for wind energy are included in the report, but in the electric wind-diesel systems, wind energy is limited to 20 to 30% due to control complexity and system operations. Another observation was that, even with 30% wind penetration, the remaining 70% of the electrical energy would come from diesel. Diesel can be extremely expensive in rural Alaska, so we searched for solutions that maximize wind for both electricity and heat.

Community Plans

AEA has developed information on options that each community can use to achieve energy savings within the following time frames:

- Current resource usage levels;
- Immediate start of conservation and efficiency measures over a 10-year period;
- Short-term (1–3 years);
- Mid-term (2–10 years);
- Long-term (5–15 years); and
- A stretch goal or aiming stake for the long term.

Introduction from the AEA Executive Director

We developed these community plan components in response to the commonly heard and pressing Alaskan question, "What can I do now?" In the immediate time frame, conservation and efficiency increases are key. Appendix 6 includes a copy of "Energy Savers Tips for Rural Alaskans," which shares helpful hints to achieve the Governor's vision of increasing energy efficiency by 20% by 2020. Achieving this target will take a group effort, but AEA is committed to promoting smart programs that will help achieve the targets. On the supply side, Rounds I and II of Alaska's Renewable Energy Fund are providing $125 million to approximately 100 renewable energy projects with utilities, native corporations, and municipalities across Alaska.

Short-term and mid-term solutions are achieved by using technologies that have short construction times, for example, wind-diesel systems for electricity, wind-thermal systems, or highly efficient clean burning wood stoves for heat.

Long-term solutions are achieved by using mature technologies, such as hydroelectric, alone or with emerging technologies. Hydroelectric has an extended time frame for permitting and construction, and emerging technologies require additional information before recommending commercial application. It is important to begin evaluating emerging technologies today in order that we understand the application when our decision to deploy is made.

AEA has prepared generic resource deployment scenarios for communities based on their available resources, and has been sharing the plans with utilities, native corporations, and municipalities. Alaskans have expressed great interest in participating in their community pathway development. Local participation is critical to the success of energy planning and development. Communities and regions will identify their preferences and ultimately make the community scenarios their own.

Reality of Renewables

As would be expected, there are some communities that are too small for certain technologies to be practical. In addition there are resources that are very expensive for the energy produced. During the model trials, options that increased the cost of energy were removed for the specific community. If sufficient energy was not available, that community would continue the use of diesel fuel.

Putting It All Together

The Alaska Energy Pathway will provide direction and focus to the goal that all Alaskans should have access to affordable power. By making energy from locally available resources to meet local energy needs, Alaskans will change the curses of long distance and low usage into an expansion of our good fortune. In addition to the vision or deployment strategy, AEA has recommended several existing financial tools to fund the new projects, such as use of the Power Project Revolving Loan Fund, capital debt reduction, traditional market financing, and available state and federal loan and loan guarantee programs.

The target approach coupled with financial and decision tools will allow Alaskans to create a blended energy source portfolio on our own time frame as economic conditions allow. The journey to energy independence will require Alaskans to pull together and will require focus, determination, passion, courage, innovation, risk taking, and persistence. If Alaska gets even halfway to this stretch goal, we will be well ahead of most states and nations. Then, much like the North Star, we can serve as a steady, shining guide to others undertaking the path to energy independence.

AEA Executive Director
Steve Haagenson
Statewide Energy Coordinator

Executive Summary

Over the past two years, the Alaska Energy Authority has been involved in developing a long-term energy strategy for the State of Alaska. As part of this process, we have engaged Alaskans from around the state and with very diverse backgrounds to find out how energy supply and cost impacts their lives, and to get input on what resources should be developed to meet future energy needs for electricity, heating, and transportation.

The first step in this process resulted in the 2009 publication of 'Alaska Energy – A first step toward energy independence.' This document is available for download at www.akenergyauthority.org, and contains information on all critical energy technologies, as well as a database of community energy resources compiled from a variety of sources, including conversations with ordinary Alaskans during our visits around the state.

This new report – which we are calling the 'Alaska Energy Pathway,' goes one step further. The Pathway starts with addressing the 'big picture' by beginning to set an overall policy direction for the State, including aggressive targets for energy efficiency and conservation as well as renewable energy development. The Pathway also identifies critical priority areas for Alaska that are closely related to energy supply and demand, including economic development, climate change, energy security, and education and workforce development. Finally, it includes much more detailed information on an energy path forward for each community and region in the State.

We have structured this Pathway to begin with a discussion of the 'big picture' to set the context for energy planning for the State, but ultimately action must occur at the regional and community levels. To address energy issues at this level, we divided our focus into two regions and used different approaches for each. The first is the Railbelt region that extends from Homer to Fairbanks and includes the major metropolitan areas such as Anchorage and the Mat-Su Valley. The second region encompasses the rest of state, including rural Alaska, the southeast region, and communities located on the road system that have their own, isolated electric grid. While very different approaches were taken in analyzing these distinct regions, the end results were surprisingly similar. Both methods incorporated conservation and efficiency measures, renewable targets that would reduce the reliance on fossil fuels to lower greenhouse gas emissions, a goal of stable affordable rates for residents and businesses, and increased energy security. The results of this process are summarized on pages 27-33 of this document using the community of Kipnuk as an example. The DVD inserted in the back of this publication contains detailed information for each community and region of the state.

The planning method for the Railbelt region extending from Fairbanks to Homer used a traditional utility planning approach called an Integrated Resource Plan (IRP). This Railbelt IRP looked at all the resources along this interconnected system to determine the least cost option for the entire region. Based on the results of the IRP, fossil fuel usage for electric generation in the Railbelt can be reduced from the current 95% to 50% through the development of large hydroelectric, geothermal and wind projects. The resulting capital cost for the Railbelt electric generation and transmission infrastructure additions total $7,290,000,000 over the next 20 years. The full report of the Railbelt IRP is included in the attached DVD as Appendix 12.

The remaining areas of the state have limited, if any, interconnections which led to a focus on the use of locally available fuels wherever possible to meet energy needs for heat and electricity. An assessment of possible options for each community was completed, yielding a potential pathway for each community outside the Railbelt. The initial deployment was unrestrained in the total amount of renewable energy resource usage. During a second phase, projects which increased the cost of energy were removed, resulting in a recommended community resource development strategy that would deploy renewables where economically feasible but continue using diesel as a major fuel source for both electricity and heating.

Executive Summary

Based on the results of the community deployment model (included in the attached DVD as Appendix 2), the renewable percentage for electric generation for non-Railbelt regions could be increased from the current 63% to 91% through the deployment of locally available renewable resources. Similarly, the non-fossil fuel percentage for space heating for non-Railbelt regions could be increased from the current 10% to 45%. This increase in non-fossil fuel sources will yield a corresponding reduction in carbon dioxide emissions by 77% for electric generation and 39% for space heating. Capital cost estimates were developed for the regions outside the Railbelt to construct both electrical and space heating infrastructure. The resulting capital cost for the non-Railbelt electric and space heat infrastructure additions total $2,846,000,000 over the next 20 years. A full listing of the capital costs by region and community is provided on the attached DVD in Appendix 3.

While these numbers are staggering, the cost of inaction is also significant. For example, assuming a fuel demand at current levels for the 176 largest communities in rural Alaska with a combined population of 74,500 residents, these communities are on track to spend over $5 billion over the next 20 years on diesel fuel alone[1]. During the same time period, the Railbelt will spend over $60 billion on fossil fuels for electricity generation, transportation and heat if current Railbelt fossil fuel demand is assumed[2].

The largest identified challenge is how to finance projects that have been identified as economic. There is a financial gap between the projected capital expenditures and the debt capacity of the Railbelt utilities. This gap is apparent in Figure 1, excerpted from the Railbelt IRP document. The debt capacity curve indicates in 2031 a low capacity of $1 billion and a high capacity of $2.5 billion. These debt

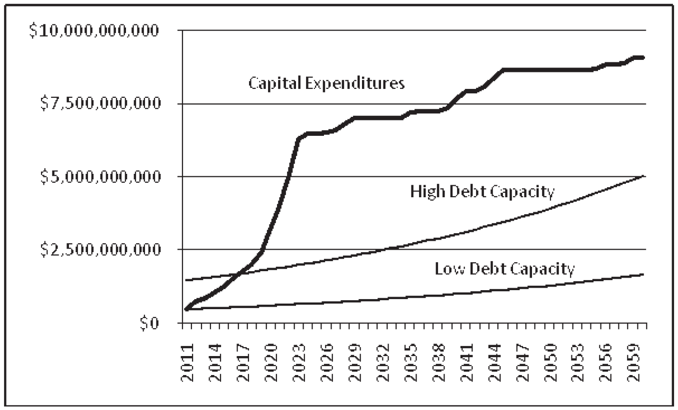


Figure 1 taken from the Railbelt Integrated Resource Plan.

capacities leave a Financing Gap from $4.5 billion to $6.5 billion for the Railbelt electric infrastructure alone. There are three options to close the financial gap:

1) Reduce capital expenditures by reducing the number and size of projects.
2) Increase debt capacity by building a healthy economic base, obtaining favorable financing terms such as loan guarantees, low interest rates or grant assistance.
3) Obtain grant funding from state, federal or other outside sources.

In actuality, all three of these options will be pursued to close the financial gap and allow for the construction of the energy infrastructure in Alaska.

In addition to community and regional planning, this Pathway recommends a number of actions to move Alaska toward greater energy independence. It begins with a reaffirmation to meet 50% of Alaska's electric energy needs through renewable energy resources by 2025. However, it also goes one step further: to achieve a 20% increase in energy efficiency and conservation by 2020. Neither of these will be easy to achieve, and both will require immediate and decisive action by the elected leaders and ordinary Alaskans around the state.

Footnotes:

1. *based on ISER Community Diesel Price Projections (medium price scenario), Energy Pathway database current fuel use, 3% interest rate, in 2007 dollars*
2. *based on Alaska Electric Power Statistics November 2003, REGA and RIRP fossil fuel price forecasts, Alaska Energy Flow 2006, Transportation Energy Consumption by Energy Source without jet fuel 2007, 3% interest rate*

Specific actions identified in this plan include:

20% Energy Efficiency and Conservation Improvements by 2020

For meeting the goal of achieving 20% Energy Efficiency and Conservation Improvements by 2020:

- ☼ Continue the public education and outreach program to help Alaskans improve energy efficiency and conservation at home and at work.
- ☼ Continue to develop an electrical efficiency program for residential buildings.
- ☼ Develop a pilot program for energy audits on all commercial and public buildings.
- ☼ Develop a pilot program for a small industrial facility energy audit program.
- ☼ Continue the Village Energy Efficiency Program to provide technical assistance and retrofits to villages and small cities.
- ☼ Support a loan guarantee fund to provide security and encourage private sector lending for energy efficiency retrofits.
- ☼ Establish baseline data for residential and commercial thermal and electrical energy use and create a database to track progress toward the 15% goal using the AKEnergyInventory.org GIS-based energy database.
- ☼ Support retrofitting of public buildings through performance contracting or other means.
- ☼ Develop and test innovative approaches to improving energy efficiency in cold climates.

50% Renewable Energy for Electric Power by 2025

For meeting the goal of achieving 50% Renewable Energy by 2025:

- ☼ Continue to fund the Alaska Renewable Energy Fund.
- ☼ Expand the Power Project Loan Fund administered by the Alaska Energy Authority to provide low-interest loans to economically viable energy projects throughout the state.
- ☼ Analyze the benefits and costs of a state corporate tax credit for renewable energy production.
- ☼ Develop an Emerging Energy Technology Grant Fund to invest in applied energy research and pilot projects of emerging technologies with near-term potential for Alaska.
- ☼ Continue to support the creation of a Railbelt electric corporation that will provide collaboration to plan, finance and construct future energy infrastructure.
- ☼ Conduct an Integrated Resource Plan for Southeast Alaska to determine least cost options for generation and interconnections to provide electric and heating needs.

Addressing Climate Change

Climate change is another topic that is closely related to energy production and use. Under the direction of the Department of Environmental Conservation, the State of Alaska is preparing a strategy for mitigating emissions of greenhouse gases and for adapting to the impacts of climate change. Approximately 15% of Alaska's greenhouse gases are estimated to be generated by electrical and heating energy production. The remaining greenhouse gases are generated by other energy sectors, including air and ground transportation and oil and gas production.

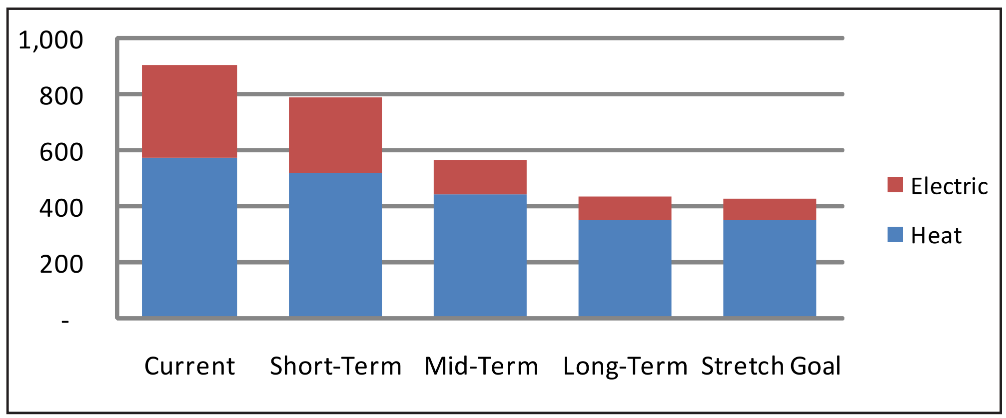


Figure 2. Greenhouse Gas Production from Non-Railbelt Electric and Heat (1,000's of Tons)

Executive Summary

Renewable energy and energy efficiency deployment measures recommended in the Alaska Energy Pathway will reduce greenhouse gas emissions while achieving other goals such as reduced reliance on fossil fuels, cost stabilization and economic development opportunities.

Energy Security

Energy security today and in the future is a significant concern for Alaska. Our state is vulnerable to disruptions in its supply chain for supplies and fuel, and increasing energy independence helps reduce those vulnerabilities. Recommended actions to improve our energy security include:

- Expand efforts to increase renewable energy production in Alaska, in order to meet the 50% by 2025 objective.
- Expand efforts to increase energy efficiency to meet the 20% by 2020 objective.
- Promote environmentally responsible development and delivery of non-renewable resources for in-state use (oil, gas, and coal exploration).
- Create incentives for oil and gas exploration to increase throughput and extend the life of the Trans-Alaska Pipeline.
- Support expansion of electrical interties where economically feasible.
- Promote the use of local energy to support instate food production.

Economic Development

Economic development is a key consideration when implementing future energy projects and building new infrastructure. Priority should be placed on infrastructure that will support economic development in Alaska, particularly related to industries that can supply high-paying jobs to residents and encourage public/private partnerships. There are several ongoing initiatives focused on addressing long-term economic development for Alaska, and their findings will be critical to long-term implementation of this Alaska Energy Pathway.

Recommended strategies related to energy and economic development include:

- Reduce imports to Alaska for energy, food, technology, and labor by increasing energy efficiency and the production of local renewable energy.
- Develop state infrastructure using life cycle cost evaluation that accounts for the construction, replacements, and operating costs including the cost of energy.
- Determine the "highest and best" use of resources to benefit Alaskans.
- Use the state as an economic development facilitator that leverages Alaska's wealth.

Investing in Innovation

Alaska faces very different conditions compared to elsewhere in the U.S. in terms of environment, population density, and the isolated nature of our electric generation and transmission system. One key component to achieving the goals laid out in this Pathway is to invest in near-term emerging energy technologies that can help meet our short-term objectives for renewable energy and energy efficiency. Specific recommended actions include:

- Support a state Emerging Technologies Grant Fund to invest in applied energy research and pilot projects of emerging technologies with near-term potential for Alaska.
- Support applied energy research at the University of Alaska.
- Create a mechanism to capture "lessons learned" from research and demonstration projects, making them available to the public and industry.
- Develop and maintain effective data collection tools and networks, increasing energy information for use in assessing energy projects, policy, and research.

Education and Workforce Development

In order to maximize our economic development potential, we must invest in education and workforce development. Public education will be critical to meeting the cornerstone objectives of 20% energy efficiency and conservation improvements by 2020, and 50% renewable energy for power generation by 2025. Specific recommended actions for education and workforce development include:

- ☼ Initiate a statewide education campaign geared toward meeting the statewide target of 15% energy efficiency improvements by 2020.
- ☼ Encourage the integration of energy, energy efficiency and renewable energy curricula at all levels of education including K-12, tech training programs, university and college, and continuing adult education.
- ☼ Complete an analysis of existing state job training and education programs and identify gaps in the energy workforce including technical training, engineering, managerial, education, and community leadership.

Alaska's Fossil Energy Future

Alaska's oil and gas development for instate and export industries has been the economic engine that has driven our economy over the past several decades. Today, the State of Alaska receives almost 90% of its general fund revenues from petroleum (royalties, production taxes, property taxes, and corporate income taxes) and will remain heavily dependent on these revenues for the foreseeable future. In order to meet the objectives laid out in this Pathway for developing Alaska's renewable resources, we must continue to chart a course toward development of our fossil energy resources. This is necessary both to meet the immediate energy needs of Alaskans and to pay for the infrastructure that will be part of a sustainable energy future for the state. This includes supporting development of our oil, gas, and coal resources. The following recommendations are related to continued development of Alaska's fossil energy resources:

- ☼ Continue to work with Southcentral producers and utilities to implement a strategy to increase natural gas supply for Southcentral Alaska.
- ☼ Continue to follow state law regarding advancement of a large diameter natural gas pipeline effort.
- ☼ Continue the Governor's effort to design and permit a small diameter natural gas pipeline that could assure access to natural gas resources.
- ☼ Encourage development of heavy oil and other technologies that will maintain Trans Alaska Pipeline System (TAPS) throughput and extend its operating lifetime.

Alaska is a large state. The disparity between energy costs in various regions is enormous, far higher than that seen in any other U.S. state and approaching levels more commonly seen in the Third World. When this fact is put in context with our patchwork of isolated grids and general lack of infrastructure, Alaska is clearly in a unique position, in that energy policy successfully enacted in other places may not apply to our state. In our dispersed population and limited infrastructure, we represent Second and Third World countries, but in our energy use we are rivaled by no one in the developed world. Our situation is unique, and as such the solutions we seek must be unique, as well.

This Pathway does not present a single solution, but rather presents a roadmap which, if followed, can result in a partial solution. Alternative energy is not an easy solution. It is not a cheap solution. But where practicable, it is a sustainable solution. The purpose of this report is to empower Alaskans at the community and regional levels to participate in finding the solutions that are right for themselves and their neighbors, and provide them with the tools to make smart choices about the direction their community heads. Energy is a larger issue than the cost of electricity or heating oil; it is intricately tied to Alaska's various economies, and those economies are tied to the social health of a community and the state.

Executive Summary

This document sets the framework for local action and develops an overall state strategy. It will be up to all Alaskans to work toward implementing these actions.

Unalakleet wind turbines installed as part of the Renewable Energy Fund.

20% Energy Efficiency and Conservation Improvements by 2020

The Alaska Energy Pathway highlights the need for investment in energy efficiency and conservation, which is the fastest, least expensive way to reduce energy cost. Improving energy efficiency will allow communities to save money, be better positioned for renewable energy generation, and be more sustainable in the future. A multitude of mature and proven efficiency technologies are available but little used across Alaska, even though Alaska has some of the highest energy prices in the nation.

This suite of programs fills the major gaps in service delivery and augments existing programs. For example, the Alaska Housing Finance Corporation manages the successful Weatherization and Home Energy Rebate Programs that focus on energy efficient building envelopes and heating systems. To complete residential sector efficiency, an electrical efficiency program is proposed to significantly reduce electrical loads in homes in a cost-effective manner.

The two largest remaining gaps in energy efficiency and conservation service delivery are 1) efficiency in workplaces, and 2) a multi-disciplinary public education and outreach campaign.

Energy Efficiency and Conservation in Workplace Buildings

Alaska workplaces, including public buildings, commercial buildings, and small industrial buildings, collectively use more energy than all the residential buildings in Alaska and have many opportunities to use energy more efficiently. With federal stimulus funds, AEA is designing and piloting a commercial and public building energy audit program in 2010. This program is designed to overcome the primary hurdle to action: educating building owners and managers about the specific efficiency opportunities that exist within their buildings and the return on investment that could be achieved if the measures were implemented. In addition to the audit, low interest loans, rebates, and incentives would encourage investment in energy efficiency and conservation.

Energy efficiency and conservation outreach and education

There are a large and growing number of viable energy efficiency technologies available today. A comprehensive public education campaign and easy access to good information is essential for assisting Alaskans to make educated choices that increase efficiency and conservation. The AEA and more than a dozen partnering agencies and organizations have formed an Energy Efficiency and Conservation Working Group to design this outreach and public education program. At its center is a new website www.akenergyefficiency.org that will serve as a single one-stop-shopping reference for energy efficiency information. The site will direct visitors to resources available for energy efficiency in Alaska, from both state and non-state entities alike. Alaska's energy efficiency initiatives will be symbolized by the new graphic image, below. This symbol will be used by all the efficiency stakeholder groups to demonstrate a consolidated effort toward improving energy efficiency and conservation efforts statewide, and to direct people to the website, which will act as the effort's hub.

akenergyefficiency.org

20% Energy Efficiency and Conservation Improvements by 2020

Left: Caulking the Nightmute Community Hall. Right: Insulation being installed into a roof space of a residence in Fairbanks.

Recommended Actions – 20% Energy Efficiency and Conservation Improvements by 2020

- Continue the public education and outreach program to help Alaskans improve energy efficiency and conservation at home and at work.
- Continue to develop an electrical efficiency program for residential buildings.
- Develop a pilot program for energy audits on all commercial and public buildings.
- Develop a pilot program for a small industrial facility energy audit program.
- Continue the Village Energy Efficiency Program to provide technical assistance and retrofits to villages and small cities.
- Support a loan guarantee fund to provide security and encourage private sector lending for energy efficiency retrofits.
- Establish baseline data for residential and commercial thermal and electrical energy use and create a database to track progress toward the 15% goal using the AKEnergyInventory.org GIS-based energy database.
- Support retrofitting of public buildings through performance contracting or other means.
- Develop and test innovative approaches to improving energy efficiency in cold climates.

50% Renewable Energy by 2025

A renewable energy goal was established in 2009, of meeting 50% of Alaska's electrical energy needs from renewable sources. This document describes policies and community-by-community scenarios that could move the state to this goal and beyond.

Alaska is already meeting 24% of its electric power generation from renewable resources, almost all of which is from hydropower installations across the state.

The Railbelt region of the state currently generates about 11% of its electric energy needs from renewable sources. This renewable energy is mainly derived from the Bradley Lake, Cooper Lake and Eklutna hydroelectric projects. The Railbelt Integrated Resource Plan deployed large hydroelectric, wind and geothermal resources to obtain the 50% renewable energy scenario. The complete Railbelt Integrated Resource Plan (IRP) is included in Appendix 12 and is summarized on page 32 of this report. The Railbelt IRP uses a classical electrical system approach to derive the least cost option for the electric needs, and no analysis was conducted on the heating needs of the Railbelt. It is assumed that due to the extensive infrastructure for natural gas delivery in Anchorage that natural gas will continue to be the main source of space heating energy for South Central Alaska for the long-term future. Interior Alaska is heavily dependent on liquid fossil fuels for space heating. The Interior will likely shift to natural gas use once gas is made available and the necessary infrastructure is developed. Biomass and coal are expected to continue to be a part of the Interior's space heating portfolio into the long-term future.

The regions outside the Railbelt currently exceed the renewable target with 63% of their electric energy being created from renewable sources. Again, the current renewable energy sources are mainly hydroelectric facilities in Southeast Alaska, but also include wind and biomass in many areas across Alaska.

The Community-by-Community Deployment model, included in Appendix 2, suggests a pathway for each of the 227 non-Railbelt communities to use renewable resources. The results of this model indicate that in the long-term, renewable resources will account for 91% of electrical needs in non-Railbelt Communities. The reduction in gallons of diesel fuel electricity in the non-Railbelt regions (Figure 2) from the current 35 million gallons per year to the long-term 7.5 million gallons is graphically shown.

The possible reduction of diesel fuel for space heating in non-Railbelt areas is shown in Figure 3 which suggests that consumption can be reduced from the current 60 million gallons per year to 35 million gallons. The model shows that, currently, renewable resources account for 10% of the energy needed for space heating in non-Railbelt communities. It predicts that in the long term this will increase to 45%. The inclusion of space heating adds a whole new dimension to a Renewable Portfolio Standard (RPS), as current RPS targets that have become popular in the U.S. are only for electric energy production.

With some of the best renewable resources in the world, Alaska is better prepared than most places to meet this challenge. The renewable technology deployments in the model are based on proven technologies, such as hydropower, wind, biomass and geothermal power. Emerging technologies that will likely become commercially viable in the next decades could use previously untapped resources such as tidal, wave and in-river hydro energy.

50% Renewable Energy by 2025

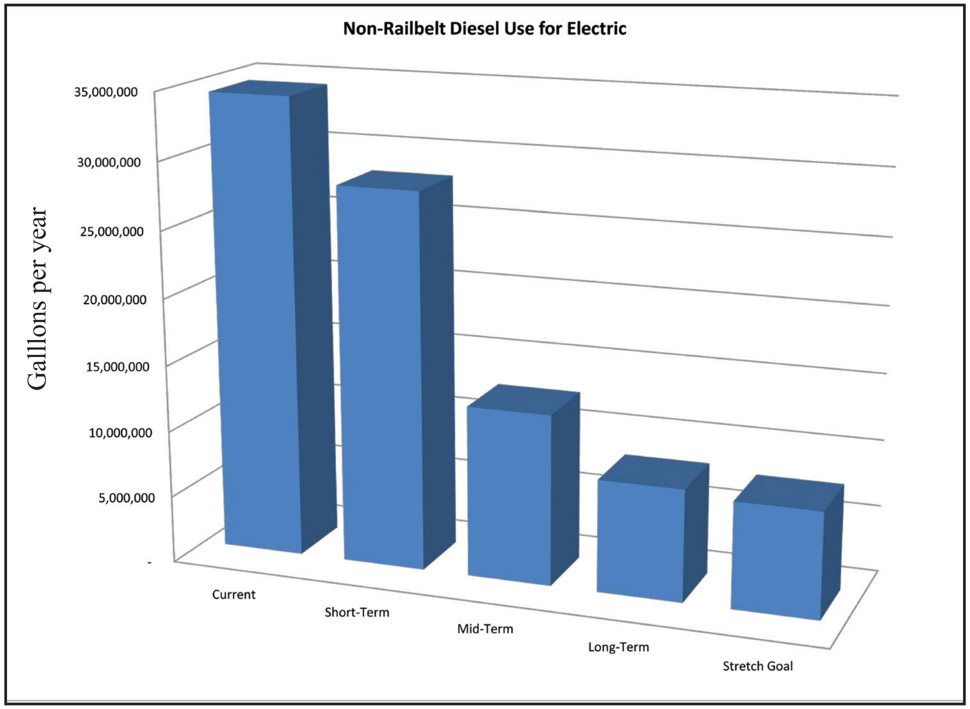


Figure 2. Non-Railbelt Diesel Use for Electric (gallons per year)

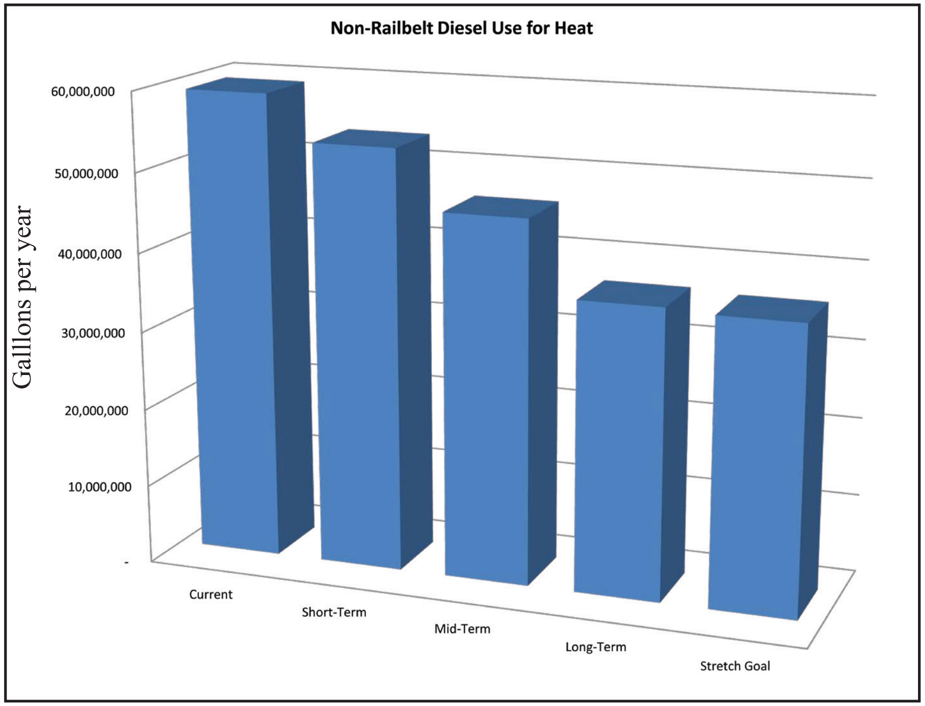


Figure 3. Non-Railbelt Diesel Use for Heat (gallons per year)

Recommended Actions – Roadmap to 50% Renewable Energy by 2025

- Continue to fund the Alaska Renewable Energy Fund.
- Expand the Power Project Loan Fund administered by the Alaska Energy Authority to provide low-interest loans to economically viable energy projects throughout the state.
- Analyze the benefits and costs of a state corporate tax credit for renewable energy production.
- Develop an Emerging Energy Technology Grant Fund to invest in applied energy research and pilot projects of emerging technologies with near-term potential for Alaska.
- Continue to support the creation of a Railbelt electric corporation that will provide collaboration to plan, finance and construct future energy infrastructure.
- Conduct an Integrated Resource Plan for Southeast Alaska to determine least cost options for generation and interconnections to provide both electric and heating needs.

Energy Security and Its Implications For Alaskans

Greater energy independence for Alaska is more than an economic issue. It is an issue of state energy security. Energy security ensures that energy needs will be met in a reliable and affordable manner in the decades to come. This energy is used to heat our homes, produce electricity, and fuel our vehicles. But we also need energy to manufacture, grow, and produce all the goods and services essential to maintaining our quality of life. The geographic positioning of Alaska creates extended distances from current manufacturing or production facilities. These long distances increase our vulnerability to disruptions in supply chains of energy and non-energy related imported goods.

Alaska's renewable energy resources provide a local source of predictably priced energy that is less susceptible to fluctuations in fuel price and reduces the exposure to potential future carbon dioxide regulation. Increased certainty in energy prices helps to attract investors to the state and can make the state more competitive in the global economy. By using local natural resources, renewable energy systems often keep more dollars circulating within the local economy - a key advantage especially for rural communities.

Trans-Alaska Pipeline at Fox, Alaska

Energy

A secure and reliable delivery system for fossil fuel energy to Alaska can be a challenge for both imports and in-state utilization of fossil fuels. The key to a secure supply chain is redundancy in infrastructure. In-state refiners rely on pipeline or tanker delivery systems to provide the necessary crude oil. Long-term disruptions in the supply systems can create energy shortages unless adequate storage alternative delivery systems are available for the crude oil and the refined product.

Many parts of rural Alaska have limited seasonal access and must rely on one or two fuel deliveries each year and storage of the fuel between deliveries. Alternative deliveries may become necessary if inclement weather impedes delivery or stored fuel is destroyed.

ALASKAN ENERGY USE

Alaskans used 363 TrillionBTUs of energy in 2006. Only 7 TrillionBTUs (~2%) came from renewable energy sources. Of this amount, 70 TrillionBTUs, (~20%) was imported as a combination of petroleum products for transportation, heating, and power generation. These imported fuels were disproportionately used in rural Alaska, with 100% imports in many communities.

Food

The majority of food Alaskans eat comes from outside the state. It typically travels many thousands of miles, with fossil fuels providing the energy for delivery. If national energy sources are disrupted by war, terrorism, natural disaster, or other events, these important food supplies would also be disrupted. Fortunately, there is a basic level of storage capacity, so if a supply chain is interrupted, alternative means such as planes or vessels could be utilized to reestablish the food delivery prior to a shortfall.

Tomatoes grown using geothermal energy at Chena Hot Springs, outside of Fairbanks, Alaska

Recommended Actions – Energy Security

- Expand efforts to increase renewable energy production in Alaska, in order to meet the 50% by 2025 objective.
- Expand efforts to increase energy efficiency to meet the 20% by 2020 objective.
- Promote environmentally responsible development and delivery of non-renewable resources for in-state use (oil, gas, and coal exploration).
- Create incentives for oil and gas exploration to increase throughput and extend the life of the Trans-Alaska Pipeline.
- Support expansion of electrical interties where economically feasible.
- Promote the use of local energy to support in-state food production.

Economic Development

What is Important for Economic Development

Reduction of the cost of energy is one of the main drivers for this Energy Pathway document. Many Alaskans are struggling to make ends meet, so simply reducing the cost of energy would appear to be an acceptable result. Unfortunately, this Alaskan dilemma is intertwined with several other issues that are directly related to income, opportunity, wealth retention, geographic location, economies of scale, and the collective community vision of Alaska.

Historically, Alaska is viewed as the Last Frontier and a land of opportunity. People will continue to come to Alaska, its regions and communities as long as opportunities exist and as long as optimism prevails. When opportunities cease, people will look for opportunity elsewhere.

The state must strive to create opportunities whenever Alaska's money is spent. Expenditures of state funds should create opportunities that will:

- Share Alaska's wealth with Alaskans
- Retain wealth in Alaska
- Retain Alaskans for generations
- Build Alaskan careers (with an adaptable, trained workforce that can adjust to labor market changes)
- Diversify our economy
- Export value-added products
- Provide environmentally responsible development
- Provide fiscal predictability
- Provide measurable results and benchmarks

Six Economic Development Strategies

1. Reducing Imports

One strategy to retain money is to substitute imports with locally derived alternatives or reduce imports for our energy, food, technology, labor, or services when it makes economic sense. The concept of import substitution with locally derived, value added goods and services is a fundamental strategy for economic development.

2. Sustainable Economy

Development of a diversified economy is critical for a stable sustainable future for Alaska. A sustainable economy requires labor, energy, infrastructure, financing, management, and a market. Sustainable economic development can be achieved when there is an increase in the amount of money flowing into an area versus a negative net outflow of money out of the same area.

3. Infrastructure Development

Projects must be critically analyzed using life-cycle costing to identify the source of funds needed to cover the ongoing expense and to assure replacement at the end of its useful life. The useful life of infrastructure can last decades - so this analysis must reflect the impact that this infrastructure will have on future generations. When capital funds are plentiful, the selection and evaluation process may be less critical. Conversely, when capital funds are limited, care must be taken to select projects that provide the largest benefit for the dollars spent and to select projects with affordable costs of ongoing operations.

4. Highest and Best Use of a Resource

Communities should participate in forums to determine the highest and best use of Alaskan resources to maximize opportunities in the long-term for themselves, their children, and their grandchildren. The communities should also determine and select industries that will develop opportunities for their citizens. These forums could incorporate the various planning processes that a community undertakes, such as energy, comprehensive, land-use, or other forms of planning.

5. Public/Private Partnerships

Find ways to promote the strengths of both the public sector and the private sector. Develop a culture of balancing risk with rewards and opportunities to share calculated risks. Build on the strengths of all parties to ensure the best performance from all. We should identify ways to reward Alaskan-based companies that provide Alaskan opportunities and proactively address a regional or community-based economic development approach.

6. State as an Economic Facilitator

The state can play a key role in the evaluation and facilitation of technologies, community discussions, and vision development.

Economic Development

The Rain Barrel

Due to its geographic isolation, Alaska is dependent upon outside suppliers for many goods and services associated with its economy. Basic goods, such as food, electronics, clothing and other consumer goods are derived primarily from outside of Alaska, with a shortage of locally available goods and products.

Due to its dependence on external goods, Alaska's economy can be likened to a rain barrel. Money flows into the barrel as value-added products or services are sold to others outside the economic zone, or money is provided from governmental sources. Money that is used to purchase goods and services from outside the economic zone will drain the dollars from the Alaskan economy.

Due to our heavy reliance on imports, we know the money expended in Alaska leaves in a short time frame. Every time consumers or local firms buy goods or services from outside the state, the money leaves Alaska. Local wages stay around a little longer, until they purchase items from outside Alaska. Alaska's import purchases can be for energy, resources, food, technology, labor, leadership, or services.

Money flows into the barrel in two ways:

- ☼ When a product is sold to an outside customer.
- ☼ When dollars are brought in from outside sources.

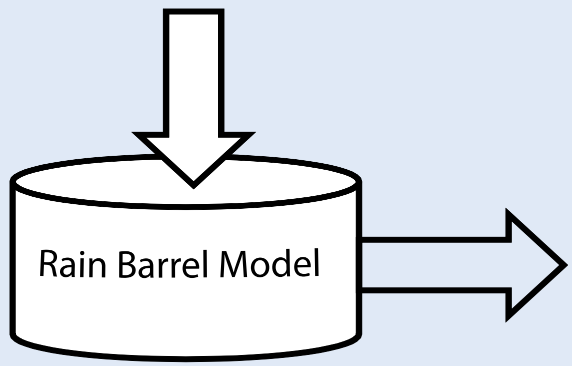
Money flows out of the barrel in five ways:

- ☼ Local firms buy their goods from outside sources.
- ☼ Local households go out of town to buy goods and services.
- ☼ Local employees pay taxes and social security to higher government units.
- ☼ Community citizens, local firms, and local investors spend local resources on ventures that don't pay off.
- ☼ Community citizens invest their dollars in outside ventures instead of local business opportunities.

Using the Rain Barrel

For example, money would flow into the rain barrel if the federal government provided a funding source for a wind turbine to be installed in Alaska. Purchasing a wind turbine from a source outside of Alaska would import the wind technology, intellectual capital, and manufacturing labor. Alternatively, a locally manufactured wind turbine would eliminate import substitution and create opportunities for a value added, export product. Admittedly, we cannot instantly create a self-reliant Alaska, but we could start with a development model to first operate and maintain; then assemble and construct; with the ultimate goal of being a net exporter.

Determine ways to increase dollars into the economy.



Determine ways to retain dollars in the economy by reducing the dollars leaving the economic Rain Barrel.

Figure 4. Rain Barrel Model[1.]

1. *Publication 1646. Extension Service of Mississippi State University, cooperating with U.S. Department of Agriculture. Published in furtherance of Acts of Congress, May 8 and June 30, 1914. Ronald A. Brown, Director*

Economic Development

"On economic policy, I will not be constrained by a short-term view of our economy, but instead will focus on Alaska's future. We will build a legacy economy, for this generation and the next. Ten years from now, I want it said that Alaska inspires and grows dreams. I want it said that in Alaska our young people can see and seize opportunity for themselves. I want Alaska to be a place where owning a small business leads to greater financial security, and where larger businesses look at us as a great place to invest and create jobs."

Governor Sean Parnell

Recommended Actions – Economic Development Strategies

- ☼ Reduce imports to Alaska for energy, food, technology, and labor by increasing energy efficiency and the production of local renewable energy.
- ☼ Develop state infrastructure using life cycle cost evaluation that accounts for the construction, replacements, and operating costs including the cost of energy.
- ☼ Determine the "highest and best" use of resources to benefit Alaskans.
- ☼ Use the state as an economic development facilitator that leverages Alaska's wealth.

Investing in Innovation

Alaska faces very different conditions compared with elsewhere in the U.S. in terms of the environment, population density, and isolated nature of electrical generation and transmission systems. One critical step to utilizing our resources, overcoming our unique challenges, and implementing energy solutions for Alaskans is to invest in applied energy research.

Applied research is aimed at developing technologies for immediate use, centering on producing innovative, cost-effective, reliable, and locally appropriate technologies. To date, energy funding opportunities in Alaska, such as the Renewable Energy Fund, focus on "off-the-shelf" technologies that have already been developed and demonstrated in Alaska or elsewhere, and are not designed to invest in the next generation of energy technologies.

Many of the best energy solutions come from Alaskans, who are in the best position to understand the available resources as well as the specific issues related to energy production and use in their communities. However, to move these ideas from the drawing board into practical application requires funding, and money for non-commercial technologies is often not readily available. The strength of innovation is demonstrating a new way of doing things, a way that challenges current trends and institutional thinking. However, these types of projects require taking risks – risks that traditional funding sources are often unwilling to accept because the rate of failure is higher than more traditional, off-the-shelf commercial technologies. One current state proposal would create an Emerging Energy Technology Fund (EETF), providing grant opportunities for both fossil energy and emerging renewable energy projects. Alaska is an ideal test bed for emerging energy technology. Given our abundant energy resources, the high cost of energy, and the variation in climate and landscape, projects can prove financially viable, even in the research and demonstration phases. An EETF would link technology developers with potential end-users to seek specific solutions to Alaska's energy challenges.

This type of support for applied energy research in Alaska would assist in:

- Addressing specific Alaskan energy issues.
- Supporting pre-commercial energy technologies, or commercial technologies that have not been demonstrated in Alaska.
- Demonstrating commercial success of new energy technologies.
- Showcasing technologies that have the potential for developing export markets for Alaskan products, ideas, and expertise.

There are other opportunities for investment as well, such as expanding funding for existing energy research programs in the state, including the University of Alaska, as well as private non-profit organizations such as the Cold Climate Housing Research Center. Job training, education, and governance can also benefit from targeted investment and support.

By funding applied energy research as part of the state's overall investment in energy projects, Alaska has the opportunity to truly become a leader on the world stage in energy development in a manner that can provide stable, affordable energy throughout the state while simultaneously developing economic opportunities for its residents and its industries.

Recommended Actions – Investing in Innovation

- Support a state Emerging Energy Technologies Grant Fund to invest in applied energy research and pilot projects of emerging energy technologies with near-term potential for Alaska.
- Support applied energy research at the University of Alaska.
- Create a mechanism to capture "lessons learned" from research and demonstration projects, making them available to the public and industry.
- Develop and maintain effective data collection tools and networks, increasing energy information for use in assessing energy projects, policy, and research.

Investing in Education and Workforce Development

Job creation and workforce development drive sustainable economic growth, especially in a world where technology and industry advance at lightning speed. As the pathway is put into effect, many of the future energy industry jobs will be in the renewable energy sector.

In order to achieve the goals laid out in this document, we will need to educate all Alaskans. The state must make the investment in educating its citizens, energy industry professionals, and community leaders for their respective roles in Alaska's energy future. By educating today's youth about strategies and behaviors to both conserve and use energy efficiently, we can have an immediate impact on our energy consumption. The state must cultivate its youth as skilled laborers, engineers, economists, or educators for tomorrow's energy economy.

In the near term, the state needs to continue support for energy-related training programs, such as AVTEC and the various University of Alaska critical energy-related skilled-labor education programs. But to achieve our vision of a more energy-independent Alaska, we must have other energy industry professionals to design, fund, manage, and execute the plan. We must educate that future workforce to ensure that those energy-related jobs are held by Alaskans and that career opportunities will exist to sustain our communities. To develop an export market for Alaskan products, ideas, and expertise, we must have an educated workforce and a strong university system and research programs to foster innovation.

In the end, implementation of this plan will occur at the local level. To move economically viable projects from the drawing board to completion, local project champions are needed – people who are committed to taking the time to work toward developing energy solutions for their community. These community leaders exist throughout the state in the Native leaders, utility leaders, and local governments. It will be necessary to provide these key individuals with the tools and know-how to transform their enthusiasm and hard work into economically successful energy projects for their communities.

Students training to be mechanics.

Recommended Actions – Education and Workforce Development

- ☼ Initiate a statewide education campaign geared toward meeting the statewide target of 15% energy efficiency improvements by 2020.
- ☼ Encourage the integration of energy, energy efficiency and renewable energy curricula at all levels of education including K-12, tech training programs, university and college, and continuing adult education.
- ☼ Complete an analysis of existing state job training and education programs and identify gaps in the energy workforce including technical training, engineering, managerial, education, and community leadership.

Children playing in Nightmute. Nightmute is a recipient of the pilot program 'Whole Village Energy Efficiency Retrofit,' administered by the Alaska Energy Authority.

Alaska's Fossil Energy Future

Alaska holds about half of America's remaining proven oil reserves, almost a quarter of its traditional natural gas reserves, and over half of its coal resources. When unconventional oil and gas resources such as viscous oil, coal bed methane, and methane hydrates are factored in, the potential energy resources of Alaska dwarf the combined resources of all of the other 49 states. Development of these resources to meet the near-term needs of Alaskans, and delivering these resources to market is critical to accomplishing the goals laid out in this plan.

Access to our natural gas resources

Alaska is on track to finally access the natural gas resources of the North Slope. Right now, Governor Parnell has a team of engineers performing preliminary design work to advance a bullet line with the potential to provide natural gas to thousands of homes and businesses. We are also making historic progress on a large diameter pipeline to be constructed under the Alaska Gasline Inducement Act that can serve these in-state needs and underpin our economy for the next 50 years. By remaining focused on these two equally important projects, our chance of achieving success that creates jobs for our families and serves the energy needs for the majority of Alaskans will be greatly increased.

Access to the abundant natural gas reserves of the North Slope will not only help to meet the state's energy needs and fuel the state treasury, it would also provide the raw material for potential value added industries.

While on the decline, state geologists believe Cook Inlet natural gas fields contain sufficient volumes to meet the near-term needs of Southcentral Alaska. Companies are investigating incentives that may assist the economics of exploring for more natural gas in the basin. Use of recent directional drilling techniques and the possibility of a new jack-up drill rig in the basin are under consideration. In addition, gas storage for the basin will be developed to smooth out seasonal demand swings.

Trans-Alaska Pipeline System

The declining oil production from the North Slope oil fields is also of concern, as state revenues are directly tied to this flow. The Trans-Alaska Pipeline System (TAPS) needs a minimum flow of about 300,000 barrels per day to remain viable, so encouraging additional exploration, development of new fields and techniques, and production of heavy oil remain a priority.

Outer Continental Shelf (OCS) development and conversion of natural gas or coal to liquid fuels for transportation have also been suggested as a way of providing additional product flow for the TAPS system. Gas-to-liquid (GTL) and coal-to-liquid (CTL) production is a way of converting relatively low-value feedstocks into high-value liquid petroleum products. However, high capital costs and concern over possible greenhouse gas restrictions have prevented any of these projects from moving past the conceptual stage.

Other Opportunities to Develop our Fossil Energy Resources

Other smaller scale projects have been proposed to deal with local energy issues, including developing propane as a fuel to replace diesel in remote villages, and shipping liquefied natural gas (LNG) from the North Slope to Fairbanks, as well as for export. In addition, at least 35 towns and villages have been identified that are close to coal seams that could potentially benefit from coal or coal bed natural gas for local or regional energy needs. Lack of economies of scale for power plants and transmission options prevents development of these localized resources at this time. However, continued improvements in technology could lead to small-scale coal utilization, including underground coal gasification, development of coal bed methane, barge-mounted coal-fired power plants, and above-ground coal gasification that might economically compete with diesel-fired generation in the not-too-distant future.

Funds have been secured to perform a feasibility study to site a gas to liquids plant somewhere in the Railbelt to possibly produce ultra clean diesel and aviation fuel. It may also be possible to supply such a plant with gas derived from Alaska's abundant coal reserves. Technology has been developed that allows coal to be gasified in place, underground, producing a resource called synthesis gas, or syngas.

Recommended Actions – Fossil Energy

- ☼ Continue Governor Parnell's effort to design and permit a small diameter natural gas pipeline that could assure access to natural gas resources.
- ☼ Continue to work with Southcentral producers and utilities to implement a strategy to increase natural gas supply for Southcentral Alaska.
- ☼ Continue to follow state law regarding advancement of a large diameter natural gas pipeline effort.
- ☼ Encourage development of heavy oil and other technologies that will maintain Trans-Alaska Pipeline System (TAPS) throughput and extend its operating lifetime.
- ☼ Work to develop state fossil energy resources away from current field areas by facilitation of new infrastructure, streamlined regulation and incentives, and working with our federal colleagues to maximize responsible resource developement in NPR-A and the federal OCS.
- ☼ Continue to develop a surface transportation plan that will improve the economics of finding and producing oil and gas from the Foothills Region of the North Slope.
- ☼ Support efforts to permit oil and gas exploration and development from the Outer Continental Shelf of Alaska.
- ☼ Aggressively advocate for sensible federal permitting of development of oil and gas from the National Petroleum Reserve – Alaska.

Regional Approach

Alaska is a large state, with diverse resources and energy needs. For this reason, we felt it was necessary to consider a potential future pathway to meet the immediate and long-term energy needs of each individual community in the state separately before considering the bigger picture. This approach not only allows residents of individual communities to get a sense for how development of projects in their community can influence long-term energy costs for residents, but it also allows us to calculate the total investment needed statewide to develop all energy projects that have been identified as economically viable. This number totals almost $7.3 billion for the Railbelt region, and $2.9 billion for the rest of the state. If all of these proposed projects were constructed, it would increase renewable energy as a percentage of overall power generation for the non-Railbelt regions of the state to 91% from the current level of 63%, and increase use of renewables on the Railbelt to over 50% from a current level of less than 10%. These results are includes in Table 1 below, and broken out into regions as defined by existing regional native corporations.

Table 1. Capital Cost Rollup.

Capital Cost Rollup							
Native Corporation	Immediate (0-10 Years)	Short-Term (1 - 3 Years)	Mid-Term (2-10 years)	Long-Term (5 -15 Years)	Stretch-Goal (15+ years)	Capital Cost per Region	Capital Cost per Capita
Ahtna, Incorporated	$9,883,000	$18,961,000	$41,925,000	$18,456,000	$14,698,000	$103,923,000	$34,710
Aleut Corporation	$24,104,000	$34,481,000	$359,690,000	$20,209,300	$0	$438,484,300	$59,918
Arctic Slope Regional Corp.	$22,252,000	$29,020,000	$0	$47,349,461	$0	$98,621,461	$14,636
Bering Straits Native Corp.	$30,862,000	$49,560,000	$158,950,000	$41,132,382	$0	$280,504,382	$29,952
Bristol Bay Native Corporation	$24,011,000	$65,871,000	$220,744,000	$63,078,468	$1,467,000	$375,171,468	$51,569
Calista Corporation	$81,189,800	$65,708,000	$160,031,000	$116,208,706	$1,277,000	$424,414,506	$17,263
Chugach Alaska Corporation	$23,126,000	$41,150,000	$37,617,000	$23,741,592	$0	$125,634,592	$17,894
Doyon, Limited	$23,079,600	$50,777,000	$104,062,500	$30,258,596	$18,142,447	$226,320,143	$32,349
Koniag, Incorporated	$30,266,100	$28,451,000	$63,861,000	$902,449	$3,068,760	$126,549,309	$13,789
NANA Regional Corporation	$23,487,000	$29,195,000	$46,339,847	$53,286,779	$3,607,000	$155,915,626	$21,858
Sealaska Corporation	$222,371,300	$98,123,000	$162,172,408	$57,809,096	$2,505,248	$542,981,052	$8,040
Rural Region Totals	$514,631,800	$511,297,000	$1,355,392,755	$472,432,829	$44,765,455	$2,898,519,839	$27,453
Railbelt Region	$1,485,000,000	$940,000,000	$2,631,000,000	$2,959,000,000	$760,000,000	$7,290,000,000	$16,200
Statewide Totals	$1,999,631,800	$1,451,297,000	$3,986,392,755	$3,431,432,829	$804,765,455	$10,188,519,839	$43,653

Regional Energy Planning

Regional Methodology

In order to develop the numbers included in Table 1, we divided the state into two regions, and used slightly different approaches for each. For the Railbelt region, extending from Homer to Fairbanks and including the major metropolitan areas such as Anchorage and the Mat-Su Valley, we used a traditional Integrated Resource Plan that is detailed on page 32, with the full plan included on the DVD accompanying this publication.

The second region encompasses the rest of state, including rural Alaska, the southeast region, and communities located on the road system that have their own, isolated electric grid. This process included 227 communities that were treated on an individual basis, and then grouped into geographic regions based on native corporation regions as shown in Table 1. The end result includes a deployment pathway extending from today into the future for each community, which could not be included as a printed version as the final results would encompass many hundreds of pages. Instead, they are included on the DVD accompanying this publication, and are also available on the AEA website at www.akenergyauthority.org. To provide a sample of the output, we have included the results for Kipnuk, which is included on the following pages and provides a sample of information included on the DVD for each non-Railbelt community in the state.

Community Deployment Pathway

The community deployment pathway is summarized for each community in Appendix 1. Appendix 4 includes the generic deployment strategy for available resources and includes the definitions and conditions for each deployed technology. The community deployment summary shows the percentage of energy for each term, the capital investments to achieve that energy mix for that term, and the resulting cost of energy after deployment. A more detailed energy summary and deployment pathway for each non-Railbelt community is provided in the expanded community-by-community assessment in Appendix 2. The cost of energy numbers indicate the ability of renewable energy resources to compete in the long-term, as they are based on the provisional crude oil cost of $107.50/barrel.

The detailed community report has four sections as shown in Appendix 12:

☼ Community Information
☼ Deployment Summary
☼ Current Energy Status
☼ Specific Technology Details

The first section includes basic information about the community. The second section, shows deployment summary for that community. The third section shows current energy status, the cost of electricity, heat, and transportation diesel fuel based on the provisional cost of $107.50/barrel of crude oil, priced as a delivered cost of diesel fuel to each community. The fourth section contains detailed costing and sizing information for deployed technologies for the terms from immediate to stretch goal. The estimates are considered high level and will need to be refined for each community in advance of budgeting or construction.

Regional Energy Planning

The decision to determine when to go down the pathway can be based on several factors, such as economics, climate change, community desires to reduce emissions, or an economic development strategy. We will be focusing on the economics of projects compared to a 20-year average projected fuel price of $107.50/barrel equivalent. For our analysis, we used the 20-year average (2010-2030) of the 2009 Energy Information Administration (EIA) projection, or $107.50 per barrel. The final section of the community detailed report compares the cost of deployed technology to the cost of energy based on the average projected fuel cost equivalent. If the cost of energy is lower for a deployed technology when compared to the cost of energy at that time, it would indicate an economic opportunity for deployment.

The cost estimates contained in this report were conducted at the conceptual level with no site-specific design or scope development. Cost estimates were based on similar historical energy projects constructed in Alaska, vendor estimates, and historical reports and studies for specific applications. These high-level conceptual design cost estimates are based on the best data currently available. Detailed site-specific cost estimates must be completed prior to project selection to determine more accurate values.

It must be emphasized that the energy deployment scenario for each community is not a definite plan set forth by AEA, but a general proposed pathway based on the best information available to AEA's program managers. The intent is to stimulate discussion on community energy planning, and provide rough cost estimates of community-scale projects. Individual communities must decide for themselves what their energy development strategy should be, and how best to use local renewable energy resources for their community's benefit.

Kipnuk — Wind Only

	Current		Immediate (0-10 Years)		Short-Term (1-3 Years)		Mid-Term (2-10 Years)		Long-Term (5-15 Years)		Stretch Goal (15+ Years)		
Electric	100%	Diesel	-5%	Conserve	70%	Diesel	60%	Diesel	35%	Diesel	35%	Diesel	
			-15%	Efficiency	30%	Wind/Diesel	40%	Wind/Diesel	65%	Wind/Diesel	65%	Wind/Diesel	
				$531,000		$1,400,000		$3,910,000		$1,830,000		$0	[1]
		$0.51 [4]				$0.49		$0.41		$0.40		$0.40	[2]
Heat	100%	Diesel	-5%	Conserve	100%	Diesel	100%	Diesel	73%	Wind/Storage	73%	Wind/Storage	
			-15%	Efficiency					27%	Diesel	27%	Diesel	
				$1,660,000		$0		$0		$1,827,759		$0	[1]
		$48.06				$48.06		$48.06		$53.50		$53.50	[3]
				$2,190,000		$1,400,000		$3,910,000		$3,660,000		$0	[5]

[1] Subtotal Term Capital Cost ($) [2] Cost of Electricity ($/kWh) [3] Cost of Heat ($/mmBTU) [4] Current Utility Cost ($/kWh) [5] Term Capital Cost

Explanatory Notes:

Shown here is an example of the deployment pathway for Kipnuk, which for the purpose of this document has been designated a "Wind Only" community.

The amount of wind energy that can be produced at any time versus the total amount of energy produced is called penetration. Penetration is a limiting factor to every wind energy system and depends on the local wind resource. Our community model takes this dependency into account and limits the wind energy production. The wind energy production is based on the community's designated wind class.

Community Information Summary

Community: Kipnuk

Bethel	Year 2000 Census Area
Census Population:	664
Census Per Capita Income:	$8,589
Utility Company:	Kipnuk Light Plant
Regional Corporation:	Calista Corporation
State House Seat:	5
State Senate Seat:	S
Borough:	Unorganized
Incorporation Type:	Unincorporated
Latitude:	59d 56m N
Longitude:	164d 03m W
AEA Comm ID:	99
PCE ID No:	332080

Location: Kipnuk is located on the west bank of the Kugkaktlik River in the Yukon-Kuskokwim Delta, 85 air miles southwest of Bethel. It lies four miles inland from the Bering Sea coast.

Climate: The community is located in a marine climate. Precipitation averages 22 inches, with 43 inches of snowfall annually. Summer temperatures range from 41 to 57, winter temperatures are 6 to 24.

Economy: Most employment in Kipnuk is in seasonal activities such as commercial fishing and construction. Subsistence activities are a major component of the Kipnuk lifestyle. 97 residents hold commercial fishing permits. Coastal Villages Seafood, Inc., processes halibut and salmon in Kipnuk. Income is also obtained by trapping. The community is also interested in an arts and crafts marketing cooperative.

Facilities: A 210,000 gal. water storage tank is filled from a reservoir on a nearby lake; residents haul treated water from several watering points. Honeybuckets are hauled by the village to a sewage lagoon. Homes are not plumbed. The Village Council collects refuse and maintains the Class III permitted landfill.

Transportation: Kipnuk offers a State-owned 2,120' long by 35' wide gravel airstrip, with scheduled air taxi service five times each day. Charter services are also available. A seaplane base is also available. Boats and skiffs are used by residents for local travel during the summer, with snowmachines in the winter. Winter trails exist to Tuntutuliak (77 mi.), Chefornak (20 mi.) and Kwigillingok (35 mi.) Although there is no dock, barges from Bethel deliver cargo each summer. It is a local priority to construct docking facilities.

Regional Energy Planning

Kipnuk **Wind Only**

		Current	Immediate (0-10 Years)	Short-Term (1-3 Years)	Mid-Term (2-10 Years)	Long-Term (5-15 Years)	Stretch Goal (15+ Years)
Electric		100% Diesel	-5% Conserve	70% Diesel	60% Diesel	35% Diesel	35% Diesel
			-15% Efficiency	30% Wind/Diesel	40% Wind/Diesel	65% Wind/Diesel	65% Wind/Diesel
	[1]		$531,000	$1,400,000	$3,910,000	$1,830,000	$0
	[2]	$0.51		$0.49	$0.41	$0.40	$0.29
Heat		100% Diesel	-5% Conserve	100% Diesel	100% Diesel	73% Wind/Storage	73% Wind/Storage
			-15% Efficiency			27% Diesel	27% Diesel
	[1]		$1,660,000	$0	$0	$1,827,759	$0
	[3]	$48.06		$48.06	$48.06	$53.50	$53.50
	[5]		$2,190,000	$1,400,000	$3,910,000	$3,660,000	$0

[1] Subtotal Term Capital Cost ($) [2] Cost of Electricity ($/kWh) [3] Cost of Heat ($/mmBTU) [4] Current Utility Cost ($/kWh) [5] Term Capital Cost

% mix for electricity (kWh) used in the community based on resources, technology, and economics.

Capital expenditure for electric plants.

$/kWh resulting cost of electricity (not including subsidy) based on provisional $107.50/bbl equivalent fuel prices delivered to specific community.

% energy mix for heat based on resources, technology, and economics.

Capital expenditure for heat plants.

Resulting cost of heat per mmBTU based on provisional $107.50/bbl equivalent fuel prices delivered to specific community.

Current Energy Status

Electric Utility (Estimated)

Cost of Electricity (Residential)	0.51 kWh	Annual Community Energy Sales	1,566,436 kWh/Year
Average Community Load	179 kW	Annual Diesel Electricity Generated	1,674,646 kWh/Year
Estimated Peak Load	397 kW	Wind Turbine Electricity Generated	0 kWh/Year
Electrical Intertie?	N	Hydroelectric Electricity Generated	0 kWh/Year
Primary Diesel Power Locations(s):		Natural Gas Electricity Generated	0 kWh/Year
Hydroelectric Plant Location(s):		Annual Electricity Purchased	0 kWh/Year
Communities on the Intertie:		Source Data Note:	5 yrs:FY04-08

Note: Power plant (station service), transmission, and distribution losses account for the difference between power generation and sales.

Diesel Power Generation (Estimated)

Annual Diesel Electricity Generated	1,674,646 kWh/year			Estimated Local Fuel Cost @ $107.50/bbl	$4.31
Annual Diesel Fuel Consumption	136,720 gal/year	Fuel Cost	$0.35 /kWh	Projected Fuel Cost /year	$589,263
Average Diesel Efficiency	12.25 kWh/gal	Non-Fuel Cost	$0.15 /kWh	Non-Fuel Costs /year	$249,567
		Diesel COE	$0.50 /kWh	**Total Electric**	**$839,000**

Space Heating (Estimated)

2000 Census Data		Estimated Heating Fuel Used	180,174 gallons/year
Fuel Oil	99%	Estimated Heating Fuel Cost	$5.31 $/gallon
Wood	0%	Delivered Heating Fuel Cost	$48.06 $/mmBTU
Electricity	0%	Annual Community Heat Requirements	23,423 mmBTU
Note: Residential data only.		**Total Heating Oil**	**$957,000**

Transportation (Estimated)

Estimated Diesel Used 67,720 gallons Estimated cost $5.31 gallon **Total Transportation** **$360,000**

Total Energy Cost $2,200,000

Current community electricity demand information estimated from both recent utility-reported and historical data. Current space-heating energy demand information estimated from several variables, including communtiy-specific population and climate information.

All diesel fuel costs are based on the 20-year Department of Energy, Energy Information Administration average price of crude oil of $107.50 per barrel, converted to diesel fuel and delivered to the specific community.

Kipnuk **Wind Only**

Demand-Side Electric Efficiency and Conservation

Deployment Term	**Immediate**	Electricity Saved	**313,287**	kWh		Capital Cost	**$531,200**
Technology	**Electric Usage**	Fuel Saved	**25,577**	Gallons		Annual Capital Cost	**$75,631**
						Fuel Savings	**$110,237**

15% Electricity Reduction from Efficiency
5% Electricity Reduction from Conservation

Note: Fuel Saving Base on 100% Diesel

Yearly Savings **$34,600**

Demand-Side Heat Efficiency and Conservation

Deployment Term	**Immediate**	Heat Saved	**4,685**	mmBTU		Capital Cost	**$1,660,000**
Technology	**Space Heating**	Fuel Saved	**36,035**	Gallons		Annual Capital Cost	**$236,347**
						Fuel Savings	**$191,345**

15% Heat Reduction from Efficiency
5% Heat Reduction from Conservation

Note: Fuel Saving Base on 100% Diesel

Yearly Savings **($45,000)**

Current Power Plant: Upgrade Potential

Deployment Term **Short**
Technology **Diesel**
Utility Company **Kipnuk Light Plant**
Technical Assistance or Upgrade Required
Complete Powerhouse
Status or Note **Pending**
Potential Efficiency **14.00** kWh/Gal
New Fuel Used **119,618** Gallons

		$/kWh
Capital Cost	**$2,800,000**	
Annual Capital P/I	**$307,425**	**$0.184**
New Fuel Cost	**$515,552**	**$0.308**
Non-Fuel Cost	**$233,441**	**$0.139**
New cost of electricity		**$0.640**

Note: Performance Improvement to Higher Efficiency

Yearly Savings **($220,000)**

Deployment Term **Short**
Technology **Diesel Engine Heat Recovery**
Utility Company **Kipnuk Light Plant**
Heat Recovery System Installed? **Y**
Heat Recovery System Operational? **Y**
Buildings Connected and Working:
Powerhouse, City Council Office
Water Jacket **2,666** mmBTU
Stack Heat **0** mmBTU

		$/mmBTU
Capital Cost	**$535,275**	
Annual Capital P/I	**$58,770**	**$22.04**
Annual O/M	**$16,058**	**$6.02**
Total Annual Cost	**$74,829**	**$28.07**

Yearly Savings **$468,000**

Consumer efficiency and conservation.

The cost for efficiency increases and conservation measures for electricity is $800 per capita and $2,500 per capita for heat. The amount of cost reduction is based on a 20% reduction in fuel usage. A positive savings indicates the per capita investment is appropriate for the resulting cost savings. A negative number indicates the per capita amount should be reduced and focused on the most cost effective efficiency and conservation measures.

Power plant upgrades.

Power plant upgrades can range from low cost remedial actions through the technical assistance program, to complete power plant replacement. The projects are shown with loans for all capital costs. If grants are obtained the cost per kilowatt hour for annual costs can be reduced by the percentage of grant as a method to rapidly determine the resulting energy cost.

Power plant heat recovery.

Heat recovery can provide community cost savings through the use of heat that would be rejected from a diesel electric generating power plant. The value of the recovered heat is set at approximately half the cost of the diesel equivalent. The savings are determined through subtraction of the annual cost to recover the heat from the annual value of the heat.

Kipnuk — Wind Only

> Short, Mid-term, and Long-term Options.
>
> Options are presented in resulting dollars and per unit of energy being produced. The annual capital costs assume loans have been obtained for project funding. A loss indicates a community may delay this investment loan funded project until higher fuel costs have developed, or obtain grants to reduce the debt component of the resulting energy costs.

Deployment Term **Short-Term**
Technology **Wind/Diesel**

Percent of Community Electrical Energy Consumption **30%**

Meteorological Tower Present?	No	
Wind Class	6	
Capacity Factor	0.34	
Installed Capacity	155	kW
Annual Electricity Production	469,931	kWh
Electric Energy Available (Heat, etc.)	0	kWh
Thermal Energy Available	0	mmBTU

Note
Electric dump load included in capital cost.
Siting Note
Last year of FAA/NWS data. Class 6 at airport.

		Electric Cost $/kWh	Heat Cost $/MMBtu
Capital Cost	$1,404,599		
Annual Capital Cost	$132,584	$0.282	$0.00
Annual OM Cost	$22,040	$0.047	$0.00
Fuel Cost:	$0	$0.000	$0.00
Total Annual Cost	$154,624	$0.329	$0.00
Non-Fuel Costs		$0.129	
Alternative COE:		$0.458	

Annual Electric Savings **$20,100**
Annual Heat Savings **$0**

Deployment Term **Mid-Term**
Technology **Wind/Diesel**

Percent of Community Electrical Energy Consumption **40%**

Meteorological Tower Present?	No	
Wind Class	6	
Capacity Factor	0.34	
Installed Capacity	207	kW
Annual Electricity Production	626,574	kWh
Electric Energy Available (Heat, etc.)	0	kWh
Thermal Energy Available	0	mmBTU

Note
Electric dump load included in capital cost.
Siting Note
Last year of FAA/NWS data. Class 6 at airport.

		Electric Cost $/kWh	Heat Cost $/MMBtu
Capital Cost	$578,147		
Annual Capital Cost	$54,573	$0.087	$0.00
Annual OM Cost	$29,386	$0.047	$0.00
Fuel Cost:	$0	$0.000	$0.00
Total Annual Cost	$83,959	$0.134	$0.00
Non-Fuel Costs		$0.129	
Alternative COE:		$0.263	

Annual Electric Savings **$149,000**
Annual Heat Savings **$0**

Deployment Term **Long-Term**
Technology **Wind/Diesel**

Percent of Community Electrical Energy Consumption **65%**

Meteorological Tower Present?	No	
Wind Class	6	
Capacity Factor	0.34	
Installed Capacity	715	kW
Annual Electricity Production	1,018,183	kWh
Electric Energy Available (Heat, etc.)	1,143,498	kWh
Thermal Energy Available	335,045,049	mmBTU

Note
Capital Cost allocation of 50% between electric and heat used. Capital cost shown is 50% of total.
Siting Note
Last year of FAA/NWS data. Class 6 at airport.

		Electric Cost $/kWh	Heat Cost $/MMBtu
Capital Cost	$1,827,759		
Annual Capital Cost	$172,528	$0.169	$49.65
Annual OM Cost	$47,753	$0.047	$5.86
Fuel Cost:	$0	$0.000	$0.00
Total Annual Cost	$220,280	$0.216	$55.51
Non-Fuel Costs		$0.129	
Alternative COE:		$0.345	

Annual Electric Savings **$158,000**
Annual Heat Savings **($170,000)**

Railbelt Integrated Resource Plan

The Railbelt electric grid, which runs between Homer and Fairbanks, was evaluated using a traditional approach for interconnected systems called an Integrated Resource Plan (IRP). A summary of results from the study is shown in Table 1, and a full copy of the report is included in the Appendices.

The Railbelt IRP was developed in 2009 for AEA by Black and Veatch Consultants. The goal was to address several current and anticipated issues related to power supply and demand for the Railbelt electric grid, including:

- Assessing the demand for electricity projected for the Railbelt over the next 50 years.
- Potential future generation resources and their related capital, fuel, and operating costs. The Railbelt's existing electrical generation fleet is aging, and many plants are approaching the end of their design lifetime, and will need to be replaced over the next 20 years.
- How the Railbelt can best meet the goal of producing half of its electrical energy from renewable resources by 2025.
- The declining availability of inexpensive natural gas that has been historically used to generate electrical power, especially in the south-central region.
- The limited ability of Alaska's existing small utilities to invest in large scale projects due to the capital requirements of these projects compared to the size and financial capabilities of existing utilities, and whether a transition plan from a decentralized model to a unified Generation and Transmission (G&T) organization would resolve this issue.

In order to address these issues, a model was developed to evaluate the addition of new generation capacity for the Alaska Railbelt energy system. This model was then used to evaluate issues including:

- The role that conservation by end users (demand side management) can play in meeting future needs by reducing the overall demand.
- The integration of a large scale hydropower project, such as the Susitna Dam, onto the Railbelt grid to meet future electric power needs.
- The addition of other renewable resources such as geothermal, wind, and use of municipal solid waste.
- The effect that a possible tax on carbon emissions might have on the economics of each of the alternatives.
- The possible financial strategies that might be used for large scale energy projects.
- The fragility of the transmission network that connects the communities along the Alaska Railbelt, and the costs of upgrades to this system to make it more robust.

Recommended Actions – Railbelt

- Continue to support the creation of a Railbelt electric corporation that will provide collaboration to plan, finance and construct future energy infrastructure.
- Encourage Railbelt utilities to implement recommendations from the regional IRP.

Summary of Results from the Railbelt IRP

The Railbelt IRP was first released to the public in November 2009, and included estimates of the cost of electricity under the various scenarios modeled, indicating that the wholesale cost of power under these scenarios would vary between 17 and 20¢ per kW-hr. This cost is consistent with the large capital requirements of a large hydro project (between $4.1 and $10 billion dollars), but are above the current average cost of power in Alaska, given by the U.S. EIA at 13.88¢ per kW-hr (retail).

Table 2 summarizes the economic results of the Railbelt IRP study, based on 4 scenarios:

- Scenario 1A – Base Caseload Forecast – Least-Cost Plan
- Scenario 1B – Base Caseload Forecast – Force 50% Renewables
- Scenario 2A – Large Growth Load Forecast – Least-Cost Plan
- Scenario 2B – Large Growth Load Forecast – Force 50% Renewables

All scenarios include the cost of CO2 Cap and Trade programs. The predicted charges are based on the EIA and EPA version of the Cap and Trade bill that passed the U.S. House of Representatives.

Table 2. Summary of Economic Results of Four Basic Scenarios.

Case	Cumulative Present Value Cost ($000,000)	Average Wholesale Power Cost (¢ per kWh)	Renewable Energy in 2025 (%)	Total Capital Investment ($000,000)
Scenarios				
Scenario 1A	$13,625	17.26	62.32%	$9,087
Scenario 1B	$13,625	17.26	62.32%	$9,087
Scenario 2A	$20,162	19.75	42.64%	$14,111
Scenario 2B	$21,109	20.68	65.83%	$18,805
Sensitivities				
1A/1B Without DSM/EE Measures	$14,507	17.40	67.10%	$8,603
1A/1B With Double DSM	$12,546	15.89	65.15%	$8,861
1A/1B With Committed Units Included	$14,109	17.87	46.84%	$8,090
1A/1B Without CO2 Costs	$11,206	14.20	49.07%	$8,381
1A/1B With Higher Gas Prices	$14,064	17.82	61.95%	$9,248
1A/1B Without Chakachamna	$14,332	18.16	38.06%	$7,719
1A/1B With Chakachamna Capital Costs Increased by 75%	$14,332	18.16	38.06%	$7,719
1A/1B With Susitna (Lower Low Watana Non-Expandable Option) Forced	$15,228	19.29	61.01%	$12,421
1A/1B With Susitna (Low Watana Non-Expandable Option) Forced	$15,040	19.05	63.01%	$15,057
1A/1B With Susitna (Low Watana Expandable Option) Forced	$15,346	19.44	63.01%	$15,588
1A/1B With Susitna (Low Watana Expansion Option) Forced	$14,854	18.82	66.90%	$14,069
1A/1B With Susitna (Watana Option) Forced	$15,683	19.87	70.97%	$13,211
1A/1B With Susitna (High Devil Canyon Option) Forced	$14,795	18.74	66.92%	$11,633
1A/1B With Modular Nuclear	$13,841	17.53	60.51%	$9,105
1A/1B With Tidal	$13,712	17.37	65.52%	$9,679
1A/1B With Lower Coal Fuel and Lower Coal Capital Costs	$13,625	17.26	62.32%	$9,087
1A/1B With Tax Credits for Renewables	$12,954	16.41	67.56%	$9,256


Long Lake, Snettisham Hydroelectric Project.

Financing Gap

Figure 1-9, from the Railbelt IRP, helps put into context the scope of the Railbelt capital investments relative to the estimated combined-debt capacity of the Railbelt utilities. The curves at the bottom of the graph represent Seattle Northwest's estimate of the bracketed range of additional debt capacity collectively for the Railbelt utilities, adjusted for inflation over time. The upper curve shows the Capital Expenditures required for the projects listed in the Railbelt IRP. The difference between the top and two lower curves is the financial gap that represents the capital deficiency.

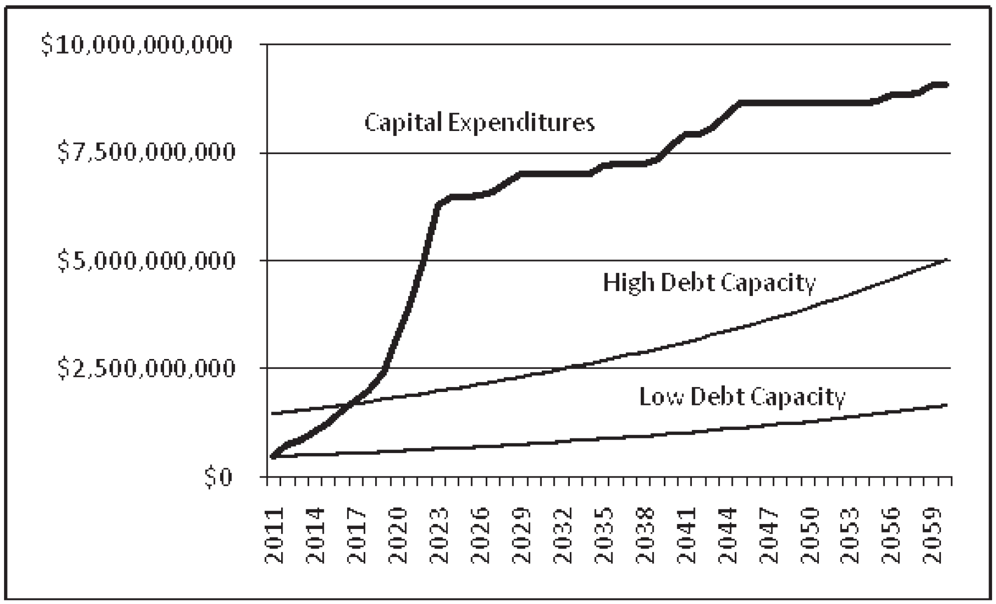


Figure 1. (from page 3) From the Railbelt Integrated Resource Plan.

There are several ways to close the financial gap:

1) Reduce the capital expenditures by reducing the number and size of projects.
2) Increase the debt capacity by building a healthy economic base, obtaining favorable financing terms such as loan guarantees, low interest rates or grant assistance.
3) Obtain grant funding from state, federal, or other outside sources.

Reducing Capital Expenditures

The key to reducing capital expenditures is to develop criteria for project selection, to identify, evaluate and compare each project for the desired results. Project estimates can be refined for minor cost reductions, but in the end, construction of all projects may still not be affordable. There are governmental loan enhancement programs such as loan guarantees, discounted interest rates, tax credits or tax exempt financing options that can reduce the resulting project cost.

Increasing Debt Capacity

The most direct method of increasing debt capacity is through association or partnering with an entity that possesses a high credit rating. The arrangement could be through direct participation in a project or through an agreement to guarantee project bonds or commit to pay for future funds, such as a take-or-pay contract.

Enhancing the economic base can provide additional funds to pay for infrastructure while increasing the debt capacity. Increasing debt capacity through economic development is expected to take several years and will require a concerted focused vision and effort. Several simple but effective strategies are discussed in the Economic Development section on page 23 of this document that could be used to increase debt capacity through increasing the economic base in Alaska. A robust economic base will support an increased debt capacity that can weather national and global economic variations.

Existing Debt Capacity

Debt capacities are a function of the borrower's ability to repay the loans and are directly linked to the local ability to raise cash, either through an economic base or assistance. One way to quantify debt capacity in a community is to look at the funds that are currently being spent for energy. There are three major components to consider when looking at energy costs; fuel, operations and maintenance, and existing debt payments. Existing debt payments are assumed to continue through the life of the asset, so they are considered sunk cost. Operations and Maintenance (O&M) costs of existing systems are expected to be similar to the O&M costs of an alternative system. The remaining cost of fuel provides an approximation of the annual payment towards a loan at the debt capacity limit that would be available for the construction of a renewable energy project.

The community detailed reports use the reduction in diesel fuel costs less the increased annual debt payments to determine the savings. If the fuel reduction savings is equal to the annual payments for additional loan, the energy will cost the same and the savings will be zero. The fuel costs in the model have been determined for each community, based on a 20-year average price of crude oil of $107.50 per barrel. A zero savings indicates that the cost of a renewable energy project is the same as continuing to purchase fuel at an equivalent crude oil price. The loan will provide a stable energy cost to the community through level yearly loan payments. As crude oil prices increase above the equivalent crude oil price, the community will realize increased savings over continued use of diesel fuel. Conversely, if the crude oil costs remain below the projected average, the community will be required to continue to make loan payments, and not benefit from crude oil price reductions. It is important to critically analyze the current trends and the projected cost of crude oil before converting to a stable-priced renewable energy resource loan program.

Financing - A Path Forward

In order to carry out the goals outlined in this plan, a substantial investment in construction of new energy infrastructure will be required. A final financing plan for projects will be developed to include a combination of traditional funding options such as bonding, commercial loans, grants, and governmental loan guarantees. In addition, less traditional methods should be considered that may ultimately provide a better fit for the current needs of Alaskans, such as leveraging the financing resources of the State of Alaska in conjunction with existing statutory or governmental programs.

Performance Contracting of Energy Efficiency and Conservation Projects

Energy efficiency and conservation programs are expected to take advantage of a combination of performance contracting and grant programs similar to the existing Alaska Housing Finance Corporation, Home Weatherization Program. Performance contracting is a method of achieving energy efficiency savings when initial capital dollars are limited or not available. Typically, a performance contractor will assess a commercial or public building to determine the potential energy savings opportunities and offer a retrofit package to the owner. The package includes negotiating a loan to cover the capital costs for the efficiency improvements, with monthly payments equal to or less than the amount saved through reduced energy bills or other cost savings. There are several companies that specialize in performance contracting that will guarantee the actual savings in order to ensure the performance contract program provides a cost reduction to the owner.

Financing Alaskan Energy Projects

Grant Funding

Grant funding, such as through the existing Alaska Renewable Energy Fund, is one method of funding the capital costs of energy projects, but they are rarely a sustainable funding source in the long-term. When grant-funded projects reach the end of their useful life, another grant will be required to rebuild the system and maintain the same resulting energy costs. Including investment in a Repair and Replacement (R&R) fund as a portion of customer billing rates would allow the development of a sinking fund to finance the replacement plant at the end of its useful life. Electric utilities in Alaska are issued a Certificate of Public Convenience and Necessity (CPCN) after the utility is found to be fit, willing, and able to provide the service. The CPCN also obligates the utility to provide that service to the public. The R&R fund would be collected by the electric utility to pay for the energy system replacement and ensure the utility is obligated to invest in the new plant to provide ongoing service. Only utilities, which have been issued a CPCN should be allowed to collect an R&R fund to provide sustainability of grant funds. All other entities without a CPCN should be limited to participating in a revolving loan fund to finance construction, rather than being eligible for state-funded grant programs. A major advantage of revolving loan programs is that upon repayment of the loan, the principal is available to be reissued for other projects.

Loans

Financing for projects can be based on traditional market financing options such as bonding, but may not be possible due to the broad nature of the projects and the open nature of the locally controlled business model that is important to Alaskans. Less traditional methods would include the financing resources of the State of Alaska in conjunction with existing statutory programs which may provide a better fit for Alaskans. Rather than relying on grant funding for energy projects, the available funds could be used to secure financing through the use of loans from the Power Project Fund (PPF) established under AS 42.45.10.

As with all debt instruments, cash flow is important to ensure lender confidence, reduce the risk of default, and maintain reduced interest rates on loans. The cash flow that is currently expended on the immediate cost of fuel could instead be used to pay for a capital construction loan and any associated increase in operating costs. In a simple example, a small community that is currently paying $100,000 a year for diesel fuel could have equivalent renewable energy project loan payments for a $1,000,000 loan at 6% over 20 years. Assuming the construction of a renewable energy project with no fuel cost or a constant fuel cost, this trade of fuel cost for debt will stabilize the cost of energy for the life of the project.

Financing Alaskan Energy Projects

On page 39, Figure 5 forecasts crude oil prices per barrel in 2009 dollars for the next 20 years. This graph is based on projections by the U.S. Department of Energy, EIA, with original data published in 2007 dollars. For our analysis, we used the 20-year average (2010–2030) of the 2009 EIA projection, or $107.50 per barrel.

The graph also demonstrates the interrelationship of crude price per barrel and fixed loan payments that could result. If the community in the prior example purchased the $100,000 of fuel oil at $100.06 per barrel, the line labeled "Fixed Cost of Loans" would indicate the break-even point for the renewable energy project. As the price of crude oil continues to increase, the fixed loan payment would equate to an energy cost savings.

Debt reduction grants will reduce payments and the effective cost of energy as can be seen on the line labeled, "Fixed Cost of Debt after Debt Reimbursement."

All appropriations for debt reduction loans would be specified by the Alaska State Legislature for specific projects. This flexible schedule will allow for energy projects to be constructed at an earlier date, with the grant funds to be appropriated when the cost of crude oil is higher. It should be understood that stabilizing energy costs through fixed loan payments may cost more if the cost of fuel were to drop below the loan payment level. For this reason, it is imperative that a thorough analysis of fuel pricing be conducted. Funds to capitalize a revolving loan fund could be generated through the issuance of bonds or appropriated general funds. Federal loan guarantees could be effectively used to increase availability of commercial loans and decrease the effective interest rate. Construction of infrastructure for the municipalities, not-for-profit utilities, and non-profits could have tax implications on the organizations.

Each organization should identify the proper tax treatment for infrastructure grants. Additional financial benefits can be obtained through the use of Production Tax Credits, accelerated depreciation schedules, Clean Renewable Energy Bonds (CREBs), sale of Green Tags or carbon offsets, and other federal and state renewable incentive programs.

Assuming a constant fuel demand, we are on track to spend over $5 billion (est.) on diesel fuel alone in rural Alaska, and an additional $60 billion (est.) on fossil fuels in the Railbelt over 20 years.

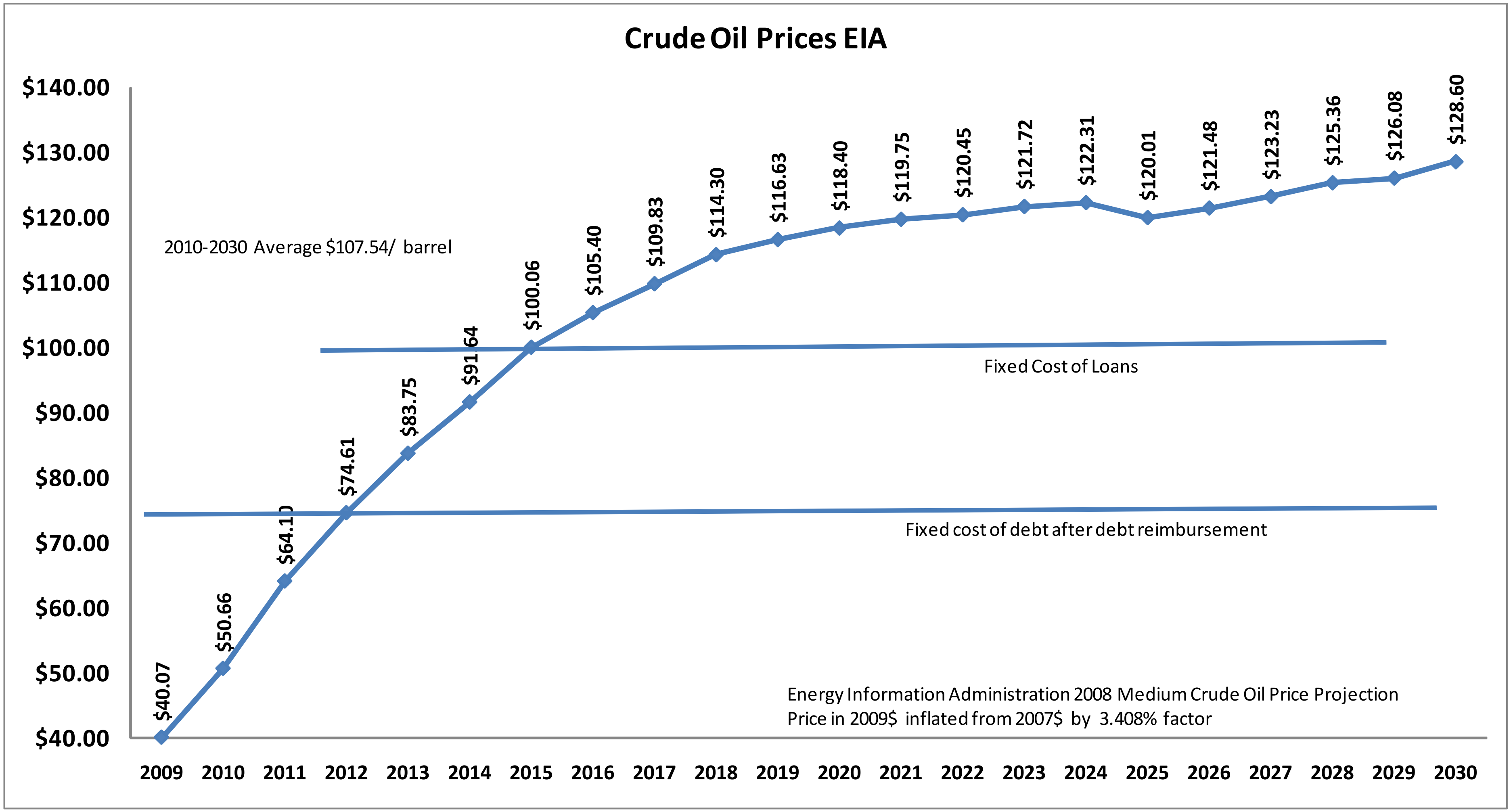


Figure 5. Energy Information Administration's 2008 Medium Crude Oil Price Projection.

Explanation of Appendices

Appendix 1: Community Deployment Summary

Renewable energy deployment scenarios are a community energy planning format that consists of a breakdown of percentages of plausible energy sources for a given community. Typically, beginning with 100% diesel for both space heating and electricity, the plan presents an option for immediate, short, medium, and long terms, while ending with a stretch-goal scenario. Presented in this appendix are the deployment scenarios of the 227 non-Railbelt communities in Alaska, grouped by regional Native corporation boundaries.

After screening out a number of different energy sources as being technically or economically unproven on a rural or village scale, AEA program managers identified community resources that are mature technologies and economically viable. Alaska communities were grouped by combinations of four available resources – wind, wood, hydro, and geothermal – resulting in 10 different "summary templates" (with each community assigned to 1 of the 10 categories). The generic deployment scenarios were created for each of the 10 summary templates. A narrative explaining the choices of percentages was developed for each of the generic deployment scenarios. These generic deployment scenarios are included in Appendix 4.

The community deployment scenario database was first uploaded with the generic summary templates, with most of the 227 non-Railbelt communities assigned to 1 of 10 templates. Communities using existing hydro and wind generation capacity (either locally or via an intertie) had their "current" energy source percentages adjusted accordingly. Also added in were estimated current energy cost information for both electricity and heat. The cost of energy calculations shown on the deployment summary are rough estimates, and are described in more detail for each community in Appendix 3.

It must be emphasized that the energy deployment scenario for each community is not a definite plan set forth by AEA, but a general proposed pathway based on the best information available to AEA's program managers. The intent is to stimulate discussion on community energy planning and provide rough cost estimates of community-scale projects. Individual communities must decide for themselves what their energy development strategy should be and how best to use local renewable energy resources.

Appendix 2: Expanded Community-by-Community Assessment

This appendix expands on the summary provided in Appendix 1, and includes more complete information on current energy usage, resources, and deployment strategies for each community outside the Railbelt.

Appendix 3: Community and Regional Capital Cost Summaries

This appendix includes the community and regional cost roll-ups.

Appendix 4: Generic Deployment Scenarios

Alaska communities were grouped by combinations of 4 chosen available resources – wind, wood, hydro, and geothermal – resulting in 10 different summary templates (with each community assigned to 1 of the 10 categories). The goal of each of the 10 scenarios is to lay out a possible pathway for the deployment of mature, reliable technologies to reduce the amount of diesel consumed. These renewable energy sources will be deployed in a phased approach over a realistic period of time. The long-range stretch goal is envisioned to be a future scenario, when up to 100% of electrical and thermal energy consumed in the community is produced from local, renewable sources.

The generic deployment scenarios were a starting point for each community deployment. The results of each community deployment were reviewed and adjusted based on community size, resource availability, community energy requirements, etc. The community deployments were again reviewed to determine if there were large increases in the cost of energy resulting from a deployment. For example, a small hydroelectric facility that had limited water resources would require a large capital expenditure, and would result in a large increase in the cost of energy for the community. Projects that had significant increases in the cost of energy were removed from the deployment scenario. Removing high-cost projects from the deployment will result in the use of diesel energy for the local load and a reduction in the percent of energy from renewable sources.

It is worth noting that almost none of the deployment scenarios of the 227 non-Railbelt communities conform exactly to any of the 10 summary template scenarios shown in this appendix. For an individual community, the timeline for deployment will be a function of several factors: cost of diesel fuel, cost of alternatives to diesel, funding resources, local enthusiasm, and applied research for presently unproven technology applications.

Appendix 5: Resource Maps

Appendix 6: Energy Savers Tips for Rural Alaska

In this appendix is a publication titled, "Energy Savers Tips for Rural Alaska" which was developed by Southwest Alaska Municipal Conference (SWAMC) and AEA. The publication provides helpful hints that can be deployed to reduce the energy consumption in your home.

Appendix 7: Transmission

This appendix expands the discussion on transmission and provides cost information that explains why, from a purely economic perspective, building additional transmission infrastructure will not help meet the objectives laid out in this plan.

Appendix 8: Research Needs Assessment

This appendix summarizes what the current state of knowledge is on a number of emerging technologies, and options to improve our existing energy infrastructure. This includes hydrokinetics, short-rotation woody biomass crops, biomass CHP systems, and energy storage. It also includes a discussion of priorities and suggestions for research funding.

Appendix 9: Study of Storage Options and Costs

Energy storage has been included in the Community-by-Community Assessment as critical to meeting the long-term and stretch-goal objectives for many communities. This is because some of the renewable energy resources, such as wind, are intermittent and not necessarily available on demand. Today, many advanced energy storage options such as batteries, flywheels, and super-capacitors are still in development. Lower tech options, such as thermal storage, are commercial but can be expensive when deployed on a large scale to meet medium and long-term needs for storage. This appendix outlines the available and expected future options for energy storage appropriate for Alaska, and costs estimates for deploying selected technologies at several different scales typical of rural communities. The cost estimates were prepared using recent (2009) quotes from energy storage technology vendors. It is hoped that the energy storage technology sector will advance significantly in the next decade in terms of improved efficiency and reliability of equipment and reduced costs.

Appendix 10: Propane Study

This appendix evaluates the concept of delivering North Slope propane to rural Alaska as a mid-term bridging fuel. Cost estimates were prepared for capital and operating costs to provide propane from the North Slope to rural Alaska. Due to the 10-year term of the capital debt, the propane alternative would provide energy to rural Alaska at about twice the cost of continuing the use of diesel fuel.

Explanation of Appendices

Appendix 11: Methodology Used in the Example Community-by-Community Plan

This appendix provides details on the methodology and assumptions used in generating the Community-by-Community database.

Appendix 12: Railbelt Integrated Resource Plan Report

2010 Alaska Energy Pathway DVD

2010 Alaska Energy Pathway

Appendix		
Appendix	1	Community Deployment Summary
	2	Expanded Community-by-Community Assessment
	3	Community and Regional Capital Cost Summaries
	4	Generic Deployment Scenarios
	5	Resource Maps
	6	Energy Savers Tips for Rural Alaska
	7	Transmission
	8	Research Needs Assessment
	9	Study of Storage Options and Costs
	10	Propane Study
	11	Methodology Used in the Example Community-by-Community Plan
	12	Railbelt Integrated Resource Plan Report

Resource Energy Plans:

Ahtna	Chugach
Aleut	Doyon - TCC
Bering Straits	Koniag
Bristol Bay	NANA
Calista	Sealaska

2009 Alaska Energy Plan: A First Step Toward Energy Independence.

Community Information by Regional Corporation

During the Alaska Rural Energy Conference held April 27-29, 2010, AEA rolled out the draft Alaska Energy Pathway. Included in this DVD are two videos from that conference which explain the Pathway in more detail:

Alaska Energy Pathway DVD

- ☼ Steve Haagenson – AEA Executive Director
- ☼ Gene Therriault – Senior In-State Energy Policy Advisor

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Alaska Energy Pathway DVD

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- Open DVD Home Page
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- Internet Explorer - Please open "Viewing Options" link from DVD Home Page.

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The links on the left-hand side of the screen have pop-up menus, which allow the user to drill down to a specific community, region or report section.

On the right-hand side of the screen, you will see the 2010 Alaska Energy Pathway Narrative and its appendices. Scroll your curser over the title of the appendix, you will see a visual cue to aid you in determining which item you'd like to review first.

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