HJR

18

<TARGET><BILL>HJR 18</BILL><SUBJECT>HJR 18</SUBJECT><COMM>HENE30</COMM></TARGET>

Representative Chris Tuck

Alaska House Majority Coalition Leader

Serving House District 23 • Dimond Estates, Foxridge, Taku, Campbell, Northwood, and Windemere

Sponsor Statement

House Joint Resolution 18

"Urging the Alaska delegation in Congress to implement a renewable energy testing program in the state; supporting the development and testing of renewable energy resources in the state; and encouraging entrepreneurs to develop renewable energy projects in the state."

HJR 18 sends a very important message to the Alaskan Congressional delegation that our great state wishes to take its rightful place as a leader in the development of emerging renewable energy and encourages our representatives to advocate for our wishes in Washington.

Over the past decade, the renewable energy sector has seen tremendous growth while the cost of production has also dropped. This has been made possible due to strides in research and timely direction of resources and funds. Alaska is uniquely qualified to contribute to the proliferation of affordable and clean energy because our demanding environment is an ideal testing ground for cutting edge technology and our fiscal climate is ripe for outside investment.

The Alaska state motto is "North to the Future"; which represents our tradition of looking forward and as a land of promise. By sending this message to our congressional delegation, we will be living up to our reputation and favorably positioning our state to enjoy the fruits of renewable energy which include not only affordability but also a much needed boost to the Alaskan economy of today and tomorrow.

HJR 18 urges Congress to take action and direct funds to our state in order to position Alaska as a leader within the burgeoning renewable energy industry while also helping Alaskan pocketbooks by driving down energy costs and bringing new jobs to our economy. HJR 18 serves as a continuing reminder to Congress that encouraging renewable energy testing is in Alaska's best interest and in the best interest of the Nation. I humbly ask for your support.

Session (January-April):
State Capitol, Room 204
Juneau, AK 99801-1182
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HOUSE JOINT RESOLUTION NO. 18

IN THE LEGISLATURE OF THE STATE OF ALASKA

THIRTIETH LEGISLATURE - FIRST SESSION

BY REPRESENTATIVES TUCK, Grenn

Introduced: 4/5/17
Referred: House Special Committee on Energy

A RESOLUTION

Urging the Alaska delegation in Congress to implement a renewable energy testing program in the state; supporting the development and testing of renewable energy resources in the state; and encouraging entrepreneurs to develop renewable energy projects in the state.

BE IT RESOLVED BY THE LEGISLATURE OF THE STATE OF ALASKA:

WHEREAS, to achieve economic security and satisfy the continuous rise in demand for energy, the United States must reduce its long-term dependence on nonrenewable energy sources; and

WHEREAS the future of the economy of the United States is dependent on access to cheap, clean energy resources; and

WHEREAS the economic value of a renewable energy industry is enormous; and

WHEREAS employment in renewable energy is exponentially increasing while other energy industries are struggling; and

WHEREAS the renewable energy industry provides employment opportunities, including employment opportunities in manufacturing, installation, operation, maintenance, research and development, construction, and transport; and

WHEREAS the state has vast renewable energy potential from resources that include wind, hydro energy, biomass, tidal energy, solar power, geothermal energy, and biofuels; and

WHEREAS the state suffers from high energy costs, particularly in communities that are not on the road system and where costs are among the highest in the nation; and

WHEREAS, along with the highest energy prices, the state also has the greatest variety and abundance of renewable energy resources in the country; and

WHEREAS investing in renewable energy development in the state would result in technology that has been demonstrated to function in the most extreme environments in the nation; and

WHEREAS the high cost of diesel electrical generation in rural areas of the state creates an opportunity for renewable energy projects that may not be economically viable elsewhere; and

WHEREAS the state has hundreds of isolated, remote microgrids that provide a unique opportunity to test integration of renewable and nonrenewable generation resources;

BE IT RESOLVED that the Alaska State Legislature supports the development and testing of renewable energy resources in the state to ensure the energy independence and security of the nation; and be it

FURTHER RESOLVED that the Alaska State Legislature calls on the state's Congressional delegation to recognize the state as the most suitable region for the testing and development of renewable energy in the nation and to direct resources to the state for these purposes; and be it

FURTHER RESOLVED that the Alaska State Legislature recognizes that the state has the opportunity to become a leader in renewable energy development and that renewable energy development could bring new revenue streams to the economy of the state; and be it

FURTHER RESOLVED that the Alaska State Legislature recognizes that the state has the opportunity to become a viable renewable energy development center that has the potential to export cutting edge technology around the world; and be it

FURTHER RESOLVED that the Alaska State Legislature supports economic development through innovation in renewable energy resources in the state and encourages entrepreneurs to develop renewable energy projects in the state.

COPIES of this resolution shall be sent to the Honorable Lisa Murkowski and the Honorable Dan Sullivan, U.S. Senators, and the Honorable Don Young, U.S. Representative, members of the Alaska delegation in Congress.

ALASKA ENERGY AUTHORITY

April 5, 2017

The Honorable Adam Wool
Alaska House of Representatives
House Energy Chair
State Capitol Room 412
Juneau, AK 99801

RE: Support of HJR 18

Dear Representative Wool and House Energy Committee Members:

The Alaska Energy Authority writes in support of House Joint Resolution 18 urging Alaska's Congressional delegation to support renewable energy in the state.

Much of Alaska's renewable energy knowledge and lessons learned about the technical and economical deployment of renewable energy, and importantly about the *integration* of renewable energy, stems from the evaluation, development, construction, operations and performance of renewable energy projects funded by Alaska's Renewable Energy Fund.

The State of Alaska has invested over a quarter billion dollars in renewable energy projects funded through the Renewable Energy Fund. This State investment has resulted in 70 projects currently in operation, displacing 30 million gallons of diesel equivalent per year and growing as more projects are completed and come online. Another 150 additional projects have received assistance in completing the higher risk early project development stages resulting in quality feasibility analyses, resource assessments and preliminary designs.

The State of Alaska, through the Renewable Energy Fund, has jumpstarted the renewable energy market in Alaska while establishing a strong vetting process for developing cost effective renewable energy projects.

Significant knowledge has also been gained on pre-commercial energy solutions through Alaska's Emerging Energy Technology Fund, which has helped spur development of new energy technologies by entrepreneurs and other private-sector developers.

There are many more good projects to be developed, and many future technologies and systems that will be part of cost effective renewable energy future for Alaska and the country. There are many communities in Alaska that could benefit from investment in renewable energy projects. In the 2016 legislative session AEA recommended 39 projects for funding, 38 of these projects are still seeking funding.

Federal funding infused into the Renewable Energy Fund could continue to provide cost-effective solutions to Alaska residents and could help Alaska continue to grow as a world leader in integrating renewable energy into small grids, a significant challenge facing many parts of the world.

The Federal tax incentives for renewable energy are not a good fit for Alaska's market and thus have rarely been used in Alaska. This results in Alaska receiving a disproportionally small share of the federal incentives that has helped so many other states significantly advance their renewable energy projects.

For reference, attached are 1) our current Renewable Energy Fund Status Report and Recommendations which outlines the performance of the program and this year's recommended projects; 2) The Renewable Energy Atlas of Alaska. Later this month AEA will be publishing to our web site an update to the Emerging Energy Technology Fund Status Report which outlines the progress on the pre-commercial technologies that are being advanced through this program.

Sincerely,

S. Skaling for M. Lamb

Michael E. Lamb, CPA, CGFM, CGMA
Executive Director

Attachments: Renewable Energy Fund Status Report and Recommendations
Renewable Energy Atlas of Alaska

cc: Representative Chris Tuck
Commissioner Chris Hladick, DCCED

Fiscal Note

State of Alaska
2017 Legislative Session

Bill Version: HJR 18
Fiscal Note Number:
() Publish Date:

Identifier: HJR18-LEG-SESS-04-05-17
Title: SUPPORT FOR RENEWABLE ENERGY TESTING
Sponsor: TUCK
Requester: HOUSE ENERGY

Department:
Appropriation:
Allocation:
OMB Component Number: 0

Expenditures/Revenues

Note: Amounts do not include inflation unless otherwise noted below. (Thousands of Dollars)

	FY2018 Appropriation Requested	Included in Governor's FY2018 Request	Out-Year Cost Estimates				
OPERATING EXPENDITURES	**FY 2018**	**FY 2018**	**FY 2019**	**FY 2020**	**FY 2021**	**FY 2022**	**FY 2023**
Personal Services							
Travel							
Services							
Commodities							
Capital Outlay							
Grants & Benefits							
Miscellaneous							
Total Operating	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**

Fund Source (Operating Only)

None							
Total	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**

Positions

Full-time							
Part-time							
Temporary							

Change in Revenues

None							
Total	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**

Estimated SUPPLEMENTAL (FY2017) cost: 0.0 *(separate supplemental appropriation required)*
(discuss reasons and fund source(s) in analysis section)

Estimated CAPITAL (FY2018) cost: 0.0 *(separate capital appropriation required)*
(discuss reasons and fund source(s) in analysis section)

ASSOCIATED REGULATIONS

Does the bill direct, or will the bill result in, regulation changes adopted by your agency?
If yes, by what date are the regulations to be adopted, amended or repealed?

Why this fiscal note differs from previous version:

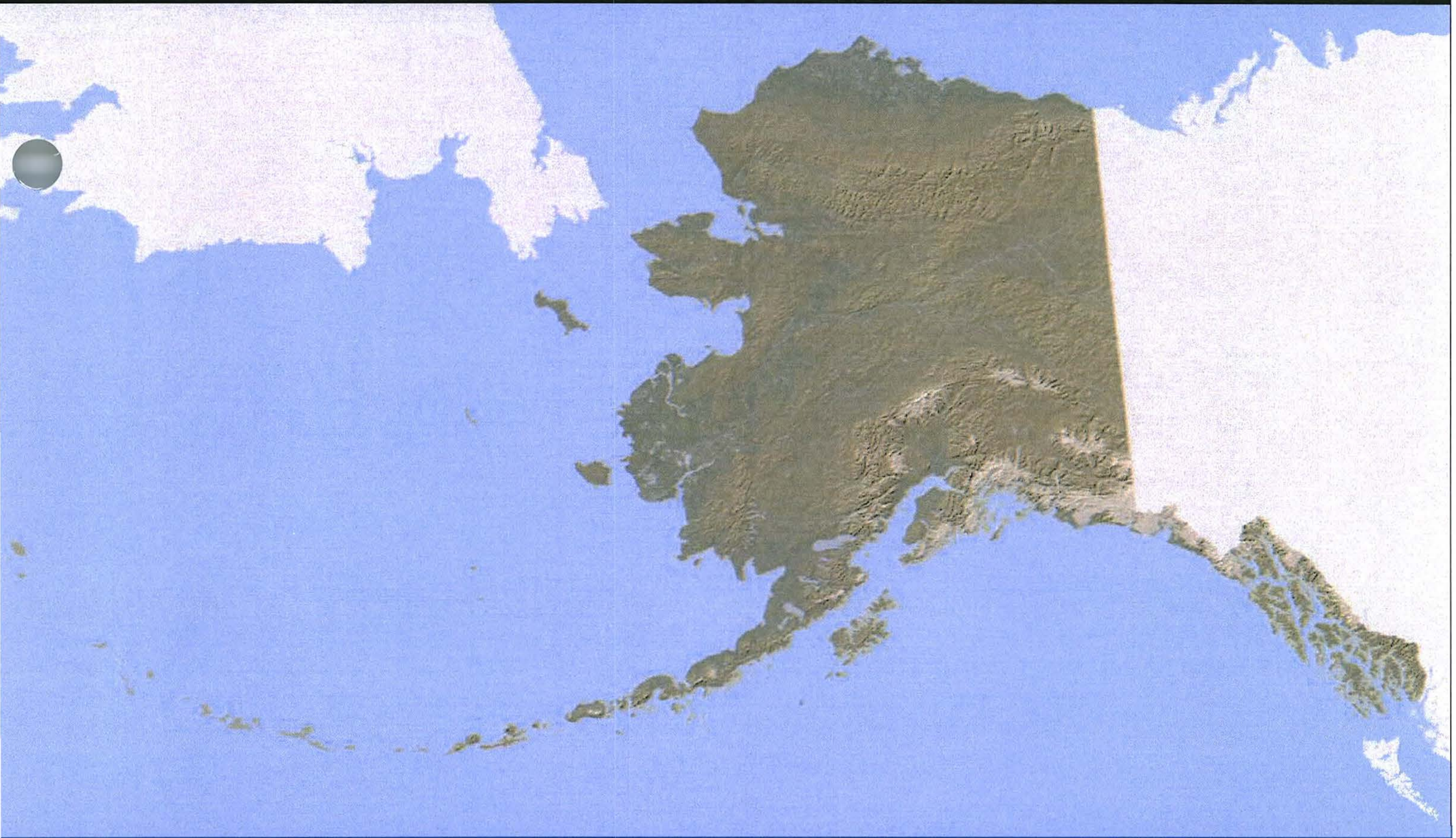
Initial version. One page. Zero note.

Prepared By: Sante Lesh, Budget Analyst — Phone: (907)465-4824
Division: Legislative Affairs Agency — Date: 04/05/2017 04:10 PM
Approved By: Pam Varni, Executive Director — Date: 04/05/2017
Agency: Legislative Affairs Agency

RENEWABLE ENERGY
ATLAS
OF ALASKA







A Guide to Alaska's Clean, Local,
and Inexhaustible Energy Resources

Renewable resources, over the long term, can provide energy at a known cost that can hedge against volatile fuel prices and dampen the effects of inflation. With some of the best renewable energy resources in the country, Alaska has an opportunity to invest locally in sustainable infrastructure, save communities millions of dollars in energy costs each year, and bring new revenue streams into the state's economy.

As concerns about volatile fossil fuel prices, energy security, and climate change increase, renewable resources play a key role in sustaining communities with local, clean, and inexhaustible energy to supply Alaska's growing demand for electricity, heat, and transportation fuel. Because there are limited fuel costs associated with generating electricity and heat from renewable sources, more Alaskans are looking to resources like hydropower, wind, biomass, geothermal, solar, tides, and waves. Alaskans are also increasingly saving heat and electricity through energy efficiency and conservation measures, keeping dollars in the state's economy, creating more stable and resilient communities, and helping to achieve the state goal of 50 percent renewable energy by 2025.

The Renewable Energy Atlas of Alaska is designed as a resource for the public, policy makers, advocates, landowners, developers, utility companies and others interested in furthering the production of electricity, heat and fuels from hydro, wind, biomass, geothermal, solar, and ocean power resources. Produced with the use of geographic information system (GIS) technology, this Atlas brings together renewable resource maps and data into a single comprehensive publicly available document. The maps contained in this Atlas do not eliminate the need for on-site resource assessment. However, they do provide an estimate of the available resources.

The Atlas is posted on the Alaska Energy Authority (AEA) website, AKenergyauthority.org, and the Renewable Energy Alaska Project (REAP) website, Alaskarenewableenergy.org. The revised map data is expected to be available by April 2016 in interactive format at the State of Alaska's energy inventory website at AKenergyinventory.org.

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Photo Credits
Below, left to right: Marsh Creek LLC, Cordova Electric Cooperative, Alaska Energy Authority, Alaska Energy Authority, Alaska Energy Authority, Chena Hot Springs Resort.

Alaska's Energy Infrastructure

With 16 percent of the country's landmass and less than 0.3 percent of its population, Alaska's unique geography has driven development of its energy supply infrastructure— power plants, power lines, natural gas pipelines, bulk fuel "tank farms" and related facilities.

Alaska has more than 150 stand-alone electrical grids serving rural villages, and larger transmission grids in Southeast Alaska and the Railbelt. The Railbelt electrical grid follows the Alaska Railroad from Fairbanks through Anchorage to the Kenai Peninsula and provides 80 percent of the state's electrical energy.

A little more than 2,000 MW of installed power generation capacity exists along the Railbelt, serving an average annual load of about 600 MW and a peak load of more than 800 MW.

Powered by wood until 1927, Fairbanks switched to coal after the Alaska Railroad provided access to the Nenana and Healy coalfields. The Anchorage area has enjoyed relatively low-cost heating and power since expansion of the Eklutna hydropower plant in 1955 and major Cook Inlet oil and gas discoveries in the 1960s.

Completed in 1986, the AEA-owned Alaska Intertie, which runs from Willow in the south to Healy in the north, now allows transfer of power from diverse energy sources to the six Railbelt electrical utilities.

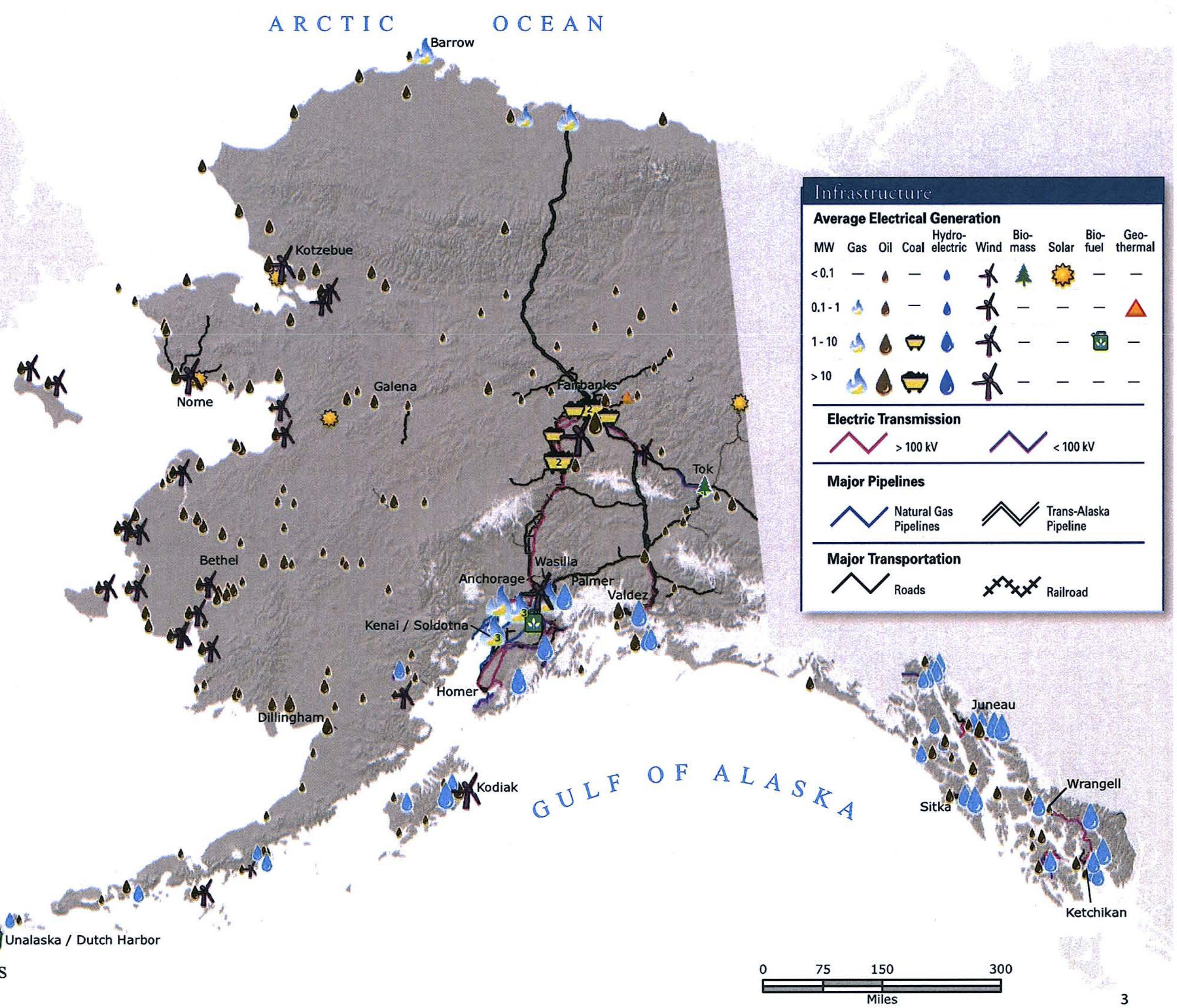
Nearly 75 percent of the Railbelt's electricity comes from natural gas. Major natural gas powered generation facilities along the Railbelt include Chugach Electric Association's (CEA) 430 MW plant west of Anchorage at Beluga and Anchorage Municipal Light and Power's (ML&P) 266 MW plant in Anchorage. ML&P is currently constructing a 120 MW powerplant in east Anchorage. CEA and ML&P also jointly own the 183 MW Southcentral Power Plant in Anchorage, commissioned in 2013. Homer Electric Association (HEA) owns the 35 MW steam turbine located in Nikiski and 50 MW plant in Soldotna. In Palmer, Matanuska Electric Association (MEA) has constructed a 171 MW dual-fuel generation station that can burn natural gas and diesel.

One other major fossil-fuel facility is located in the Railbelt is Golden Valley Electric Association's 129 MW facility near Fairbanks fueled by naphtha from the Trans-Alaska Pipeline.

The other 25 percent of the Railbelts's electric capacity comes from predominantly a mixture of hydro and wind, including 24.6 MW of wind power from the Eva Creek project located near Healy, 17.6 MW of wind power from Fire Island near Anchorage, and 126 MW from the AEA-owned Bradley Lake Hydroelectric plant near Homer. Other contributors include the Cooper Lake Hydroelectric facility, the Eklutna Lake Hydroelectric facility and the 1 MW Wind farm at Delta. The Municipality of Anchorage and Doyon Utilities commissioned a 5.6 MW methane power plant at the city's landfill.

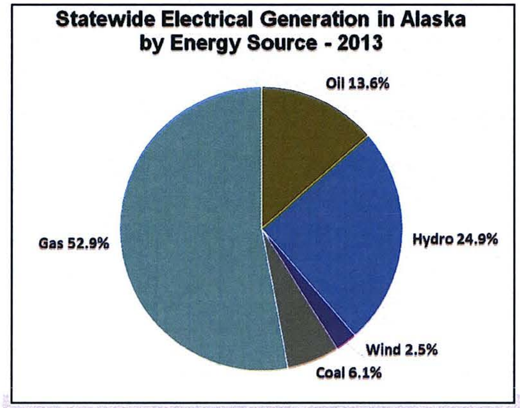
During the early 1980s, the state completed four hydropower projects to serve Ketchikan, Kodiak, Valdez and Petersburg-Wrangell. At 76 MW, the "Four Dam Pool" projects displace the equivalent of about 20 million gallons of diesel for annual power production.

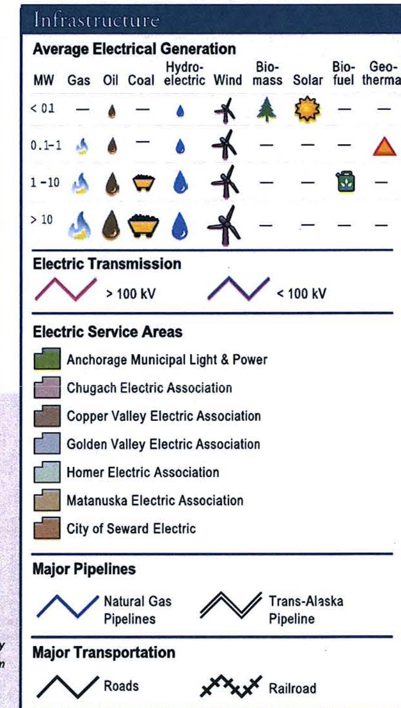
With some notable exceptions, most of Alaska's remaining power and heating needs are fueled by diesel that is barged from Lower 48 suppliers or transported from refineries in Nikiski, North Pole and Valdez. After freeze-up, many remote communities rely on fuel stored in tank farms, or pay a premium for fuel flown in by air tankers. State and federal authorities continue to support programs to repair and build code-compliant fuel tanks, improve power generation and generation efficiency, and exploit local renewable energy sources such as wind, biomass, and hydro.

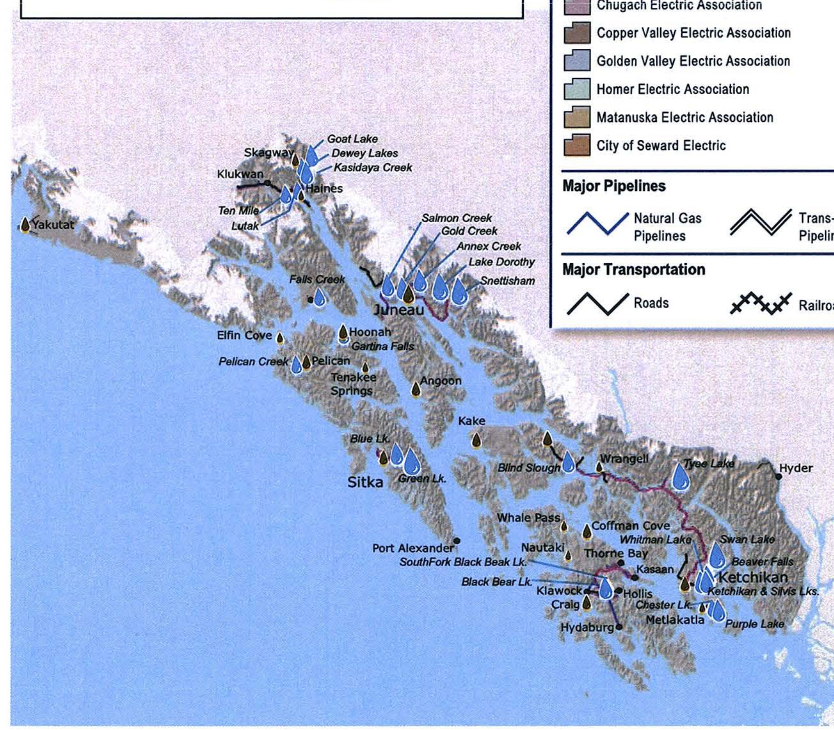


ALEUTIAN ISLANDS


Tanana
Minto
Fairbanks
Chena
North Pole
Eielson AFB
Manley
Ruby
Chicken
Clear AFB
Healy Lake
Delta Junction
Eva Creek
Fort Greely
Healy
Dot Lake
Dry Creek
Lake Minchumina
Tok
Tanacross
Tetlin
Telida
Cantwell
Paxson
Mentasta Lake
Takotna
Nikolai
McGrath
Slana
Chistochina
Lake Louise
Talkeetna
Glennallen
Skwentna
McCarthy
Chitina
Wasilla
Palmer
Eklutna Lake
Lime Village
Susitna
Valdez
Eagle River
Beluga
Anchorage
Solomon Gulch
Tyonek
Fire Island
Tatitlek
Humpback Creek
Power Creek
Whittier
Nikiski
PRINCE WILLIAM SOUND
Cordova
Kenai
Cooper Lake
Seward
Chenega Bay
Port Alsworth
Nondalton
Tazimina
Newhalen
Iliamna
Pedro Bay
COOK INLET
Bradley Lake
Homer
Seldovia
Nanwalek
GULF OF ALASKA
Kokhanok
Igiugig
SHELIKOF STRAIT
Aleneva
Port Lions
Ouzinkie
Kodiak
Terror Lake
Womens Bay
Chiniak
Karluk
Larsen Bay
Old Harbor
Akhiok


Statewide Electrical Generation in Alaska
by Energy Source - 2013
Oil 13.6%
Hydro 24.9%
Wind 2.5%
Coal 6.1%
Gas 52.9%


Infrastructure
Average Electrical Generation
MW Gas Oil Coal Hydro-electric Wind Bio-mass Solar Bio-fuel Geo-thermal
< 0.1
0.1-1
1-10
> 10
Electric Transmission
> 100 kV
< 100 kV
Electric Service Areas
Anchorage Municipal Light & Power
Chugach Electric Association
Copper Valley Electric Association
Golden Valley Electric Association
Homer Electric Association
Matanuska Electric Association
City of Seward Electric
Major Pipelines
Natural Gas Pipelines
Trans-Alaska Pipeline
Major Transportation
Roads
Railroad


Goat Lake
Dewey Lakes
Kasidaya Creek
Skagway
Klukwan
Haines
Ten Mile
Lutak
Yakutat
Salmon Creek
Gold Creek
Annex Creek
Lake Dorothy
Snettisham
Falls Creek
Juneau
Elfin Cove
Hoonah
Gartina Falls
Pelican Creek
Pelican
Tenakee Springs
Angoon
Kake
Blue Lk.
Sitka
Green Lk.
Blind Slough
Wrangell
Tyee Lake
Hyder
Whale Pass
Coffman Cove
Whitman Lake
Port Alexander
SouthFork Black Beak Lk.
Naukati
Thorne Bay
Swan Lake
Beaver Falls
Kasaan
Ketchikan
Black Bear Lk.
Klawock
Hollis
Ketchikan & Silvis Lks.
Craig
Chester Lk.
Metlakatla
Hydaburg
Purple Lake

Alaska's primary biomass fuels are wood, sawmill wastes, fish byproducts and municipal waste.

Wood remains an important renewable energy source for Alaskans. More than 100,000 cords of wood are burned in the form of cordwood, chips and pellets annually.

Closure of major pulp mills in Sitka and Ketchikan in the 1990s ended large-scale, wood-fired power generation in Alaska. However, the price of oil has raised interest in using sawdust and wood wastes for lumber drying, space heating, and small-scale power production.

In 2010 the Tok School installed a chip-fired boiler, displacing approximately 65,000 gallons of fuel oil annually. Also in 2010, Sealaska Corporation installed the state's first large-scale pellet boiler at its headquarters in Juneau.

More than 30 woody biomass heating systems are operational in Alaska, including the communities of Craig, Kasilof, Tanana, Coffman Cove, Thorne Bay, Ketchikan, and Gulkana.

In 2012, the Tok School upgraded their biomass heating system to produce electricity and heat. They are now producing about 50 kW of power in addition to heating the school, becoming the first school in the United States to operate a combined heat and power plant.

Biomass pellets, like those used to power the Sealaska Corporation headquarters in Juneau.

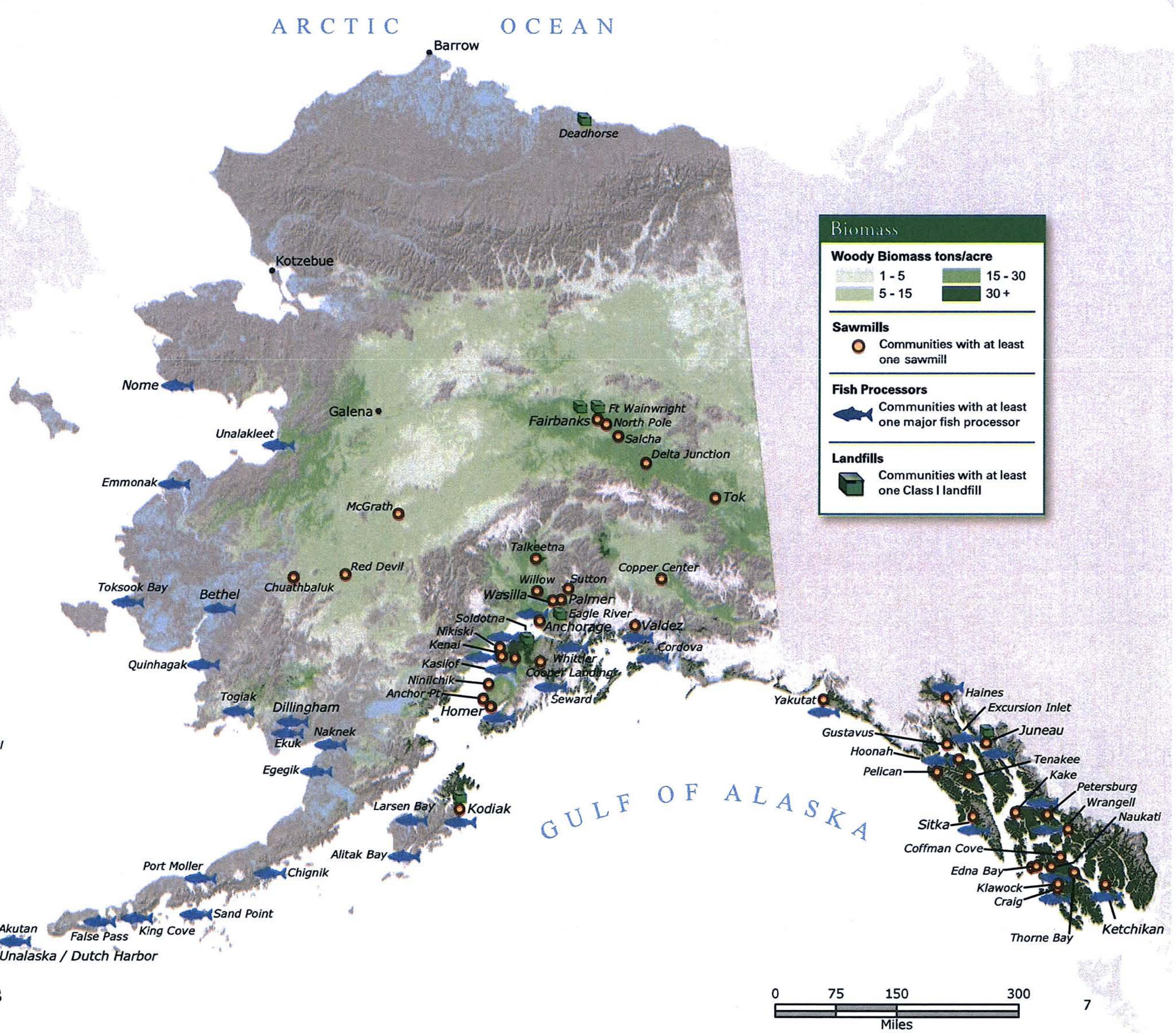
Savings in energy costs from the installation of biomass systems are having significant impact on our communities. The schools in Tok, Kaasan, and Thorne Bay have installed greenhouses to grow fresh vegetables for their cafeterias and to incorporate horticulture into their curriculum. The Tok School and Thorne Bay School have installed greenhouses heated with their biomass boilers. Students now have fresh vegetables in their cafeteria and are learning math and science with hands-on experience in the greenhouse.

There is also interest in the in-state manufacture of wood pellets. Currently, there are small and large-scale plants operating in Alaska. The largest facility, Superior Pellets, is located in North Pole and is capable of producing an estimated 30,000 tons of pellets per year. Small-scale pellet mills are operating in Dry Creek and Ketchikan.

Biodiesel refers to a vegetable-oil or animal-fat based diesel fuel. Every year groundfish processors in Unalaska, Kodiak and other locations produce approximately 8-million gallons of pollack oil as a byproduct of fishmeal plants. The oil is used as boiler fuel for drying the fishmeal or exported to Pacific Rim markets for livestock and aquaculture feed supplements and other uses.

In 2001, with assistance from the State of Alaska, processor UniSea Inc. conducted successful tests of raw fish oil/diesel blends in a 2.2 MW engine generator. Today UniSea uses about 1.5-million gallons of fish oil a year to operate their generators, boilers and fishmeal dryers.

Alaskans generate approximately 650,000 tons of garbage per year. In 2012, the Municipality of Anchorage and Doyon Utilities commissioned a 5.6 MW methane power plant at the city's landfill to provide over 25 percent of Joint Base Elmendorf Richardson's electrical load.



Geothermal

Alaska has four distinct geothermal resource regions: 1) the Interior Hot Springs, running from the Yukon Territory of Canada to the Seward Peninsula, 2) the Southeast Hot Springs, 3) the Wrangell Mountains and 4) the "Ring of Fire" volcanoes, which include the Aleutians, the Alaska Peninsula, and Mt. Edgecumbe on Kruzof Island.

Interior and Southeast Alaska have low to moderate temperature geothermal systems with surface expressions as hot springs. The Wrangell Mountains have several active volcanoes with unknown geothermal energy development potential. The Ring of Fire hosts several high-temperature hydrothermal systems, typically seen on the surface as hot springs, geysers, and fumarole fields.

Use of geothermal resources falls into two categories: direct use and electricity production. Direct use includes applications such as district heating, greenhouses, absorption chilling and swimming pool heating.

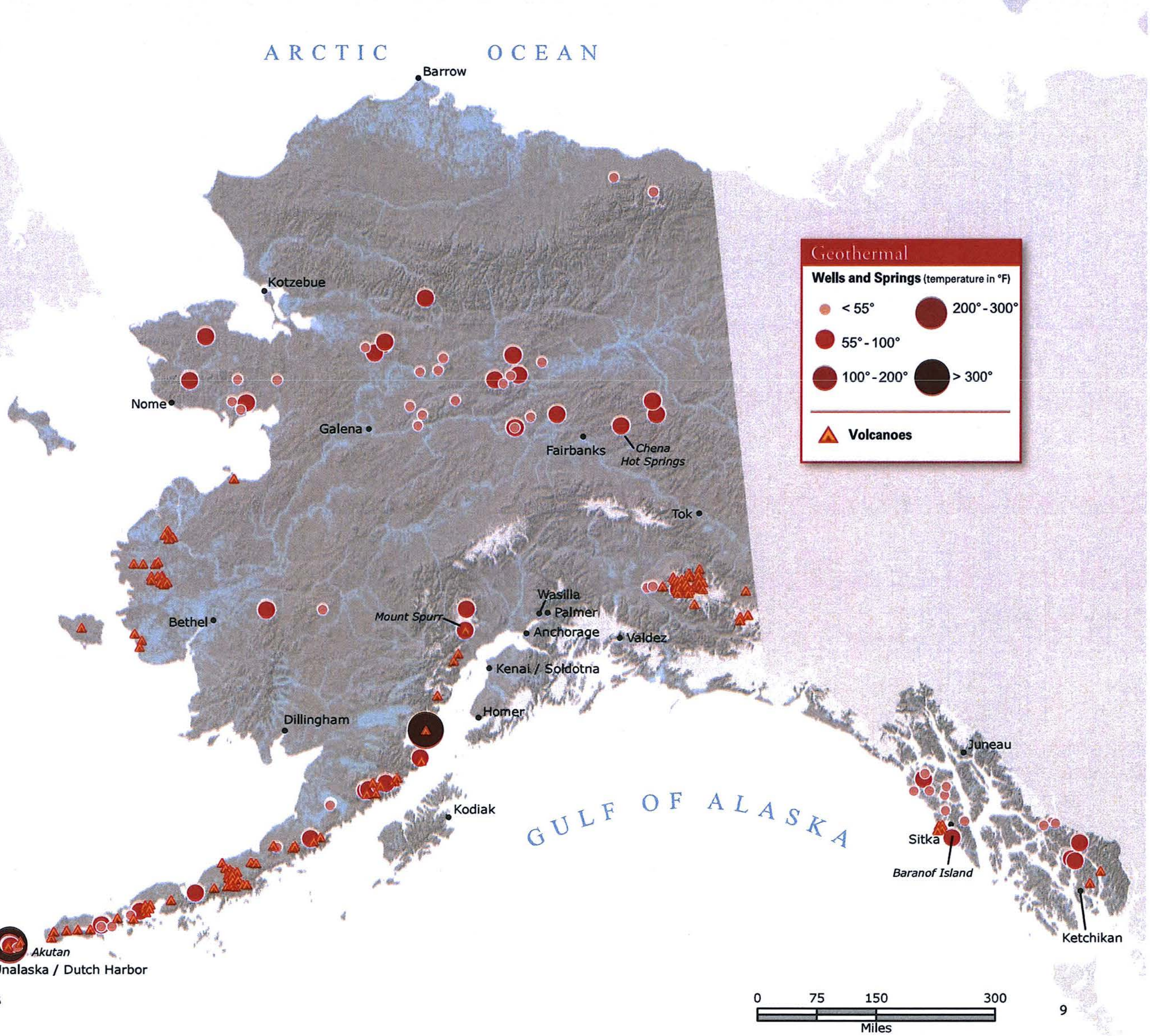
Several potential geothermal resources have been explored across Alaska, although the distance from the resources to population centers with large electrical loads combined with the high exploration costs have hampered progress towards development.

Mt. Spurr, 80 miles west of Anchorage, was investigated for its geothermal potential, including exploration drilling in 2011. The exploration did not encounter temperatures capable of supporting a power plant, and challenging project economics discouraged additional exploration within the leased areas. Akutan in the Aleutians has also been the target of geothermal exploration. In 2010, the City of Akutan drilled two exploratory wells at Hot Springs Bay Valley, encountering 359°F water at 585 feet. Additional exploration drilling is being conducted in the summer of 2016

Exploration in the 1980s near Mt. Makushin outside of Dutch Harbor indicated that tens of megawatts could be generated from geothermal resources there. In 2012 and 2013, several exploration wells were completed at Pilgrim Hot Springs on the Seward Peninsula in order to assess the region's resource potential. A 2011 reconnaissance study examined the potential geothermal resource at Tenakee Inlet Hot Springs in Southeast Alaska, although the location was deemed too remote to economically supply power to the nearest villages.

In the Interior, Chena Hot Springs Resort is an example of diverse geothermal energy use - providing heat and power to its facilities, swimming pools, and greenhouses. The resort utilizes organic rankine cycle generators that run using 165°F water, the lowest temperature for an operating geothermal power plant in the world. In 2005, the resort installed a 16-ton absorption chiller and uses geothermal energy to keep an ice museum frozen year-round.

Ground source heat pump (GSHP) systems are another use of geothermal energy. These electrically powered systems tap the relatively constant temperature of surrounding earth or water bodies to provide heating and cooling. More than 50,000 of these systems are installed in the US each year. In Alaska, heat pump systems are used for space heating homes, commercial buildings and public facilities. The Juneau Airport GSHP, in operation since 2011, has displaced significant quantities of diesel fuel and also used the system for sidewalk snowmelt. The City & Borough of Juneau also uses a GSHP system to help heat the Dimond Park Aquatic Center. In 2012, the Alaska SeaLife Center in Seward installed a system that taps heat from seawater in Resurrection Bay. GSHP systems are most applicable in areas with low electric rates and high heating fuel costs. Geotechnical conditions like permafrost are also a factor.



Hydroelectric

Hydroelectric power, Alaska's largest source of renewable energy, supplies 24.9 percent of the state's electricity in an average water year. In 2014, 45 hydro projects provided power to Alaska utility customers, including the 126 MW AEA-owned Bradley Lake project near Homer, which supplies about eight percent of the Railbelt's electricity.

Most of the state's developed hydro resources are located in Southcentral, the Alaska Peninsula, and Southeast – mountainous regions with moderate to high precipitation. Outside the Railbelt, major communities supplied with hydropower are Juneau, Ketchikan, Sitka, Wrangell, Petersburg, Haines, Skagway, Kodiak, Valdez, Akutan, Atka, Pelican, Chignik, Gustavus, Cordova and Glennallen.

In 2014, the City of Sitka increased the capacity of the Blue Lake Dam and powerhouse replacement bringing the installed capacity to 16.9 MW. Annual energy potential from the project increased by 50 percent adding another 32 GWh.

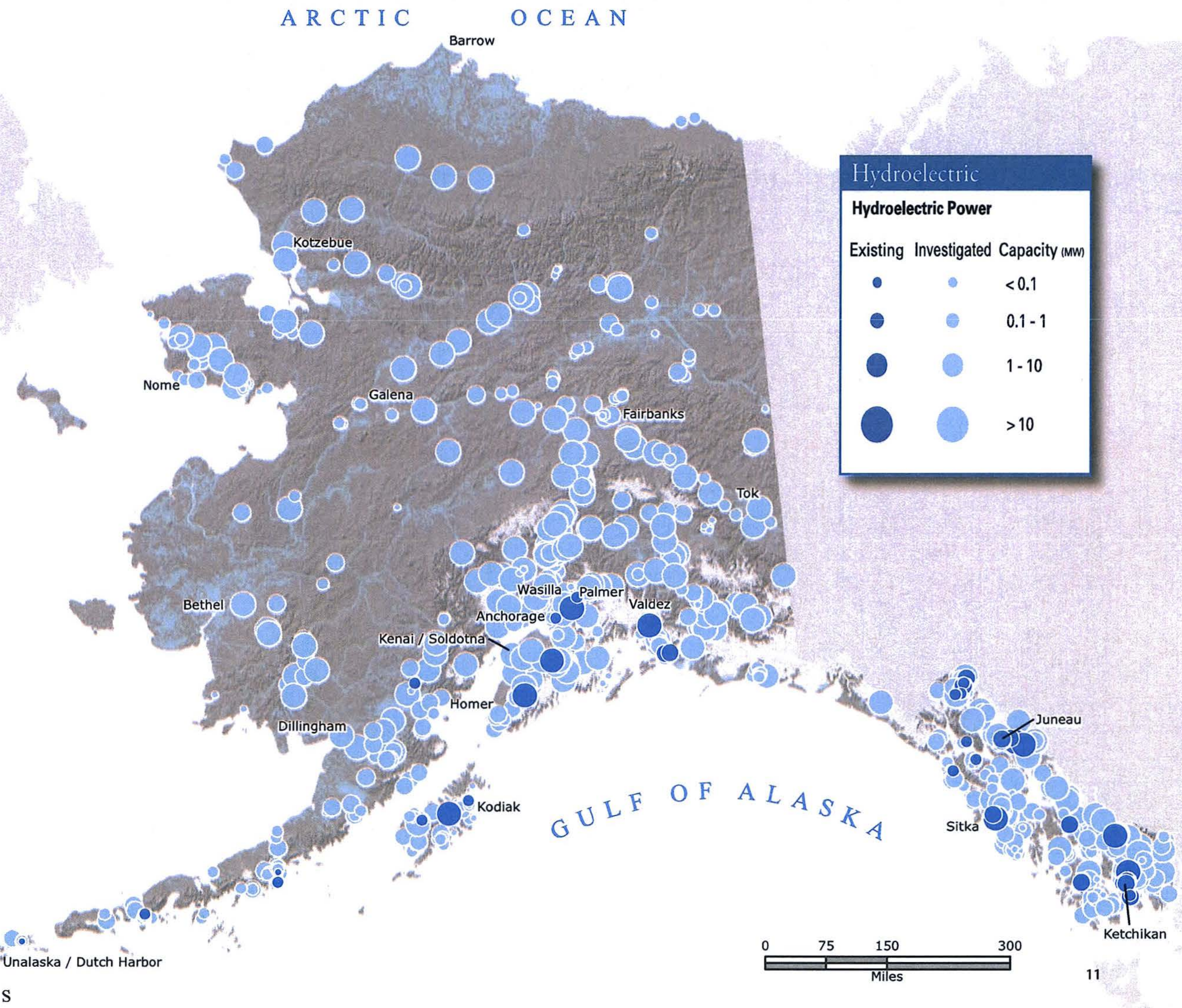
Kodiak Electric Association completed installation of the third, and final turbine at the Terror Lake powerhouse adding another 11.25 MW impulse unit bringing the total power capacity to 34 MW. This added capacity will meet peak load demands without operating diesel generators. Terror Lake also acts as an energy reservoir by collecting inflow for future hydropower generation during times when the wind farm at Pillar Mountain is actively producing power. As a result, the City of Kodiak is nearly 100 percent renewable.

Other projects provide hydro storage without dam construction through the natural impoundment of existing lakes. The 31 MW Crater Lake project, part of the AIDEA-owned Snettisham project near Juneau, includes a "lake tap" near the bottom of the lake that supplies water to a powerhouse at sea level through a 1.5-mile long tunnel. Eklutna Lake, near Anchorage, is also a lake tap system.

Still other projects increase annual energy production by diverting rivers to existing hydroelectric storage reservoirs and power plants. These projects allow more efficient use of existing infrastructure, including intake structures and dams, powerhouses and generation equipment, roads and transmission lines. The diversion of Stetson Creek to Cooper Lake near Cooper Landing was completed in 2015. A diversion of Battle Creek to Bradley Lake near Homer is in the planning stages.

Smaller "run-of-river" projects use more modest structures to divert a portion of the natural river flow through penstocks to turbines making power. The 824 kW Tazimina project near Iliamna diverts water into an intake 250 feet upstream from a 100-foot waterfall through a steel penstock to an underground powerhouse, and then releases it back into the river near the base of the falls. Other run-of-river projects include Falls Creek at Gustavus and Chuniisax Creek in Atka. Projects on Packers Creek in Chignik Lagoon and the Gartina Falls near Hoonah are recently completed run-of-river hydro projects serving small rural communities.

A major hydroelectric project first proposed in the 1980s is again under consideration. AEA is pursuing a Federal Energy Regulatory Commission (FERC) license for Susitna-Watana Hydro. The hydroelectric storage project at Mile 184 of the Susitna River would provide 2,800 GWh annually. Susitna-Watana Hydro is a proposed 705-foot dam that would provide more than half the Railbelt's average annual electric load.



Ocean and River Hydrokinetic

Alaska has thousands of miles of coastline, providing vast potential for tidal and wave energy development. Alaska rivers can also be a potential resource, using in-river hydrokinetic devices and tidal energy technologies that could supply some of Alaska's energy needs.

While there are many opportunities, significant environmental and technical challenges remain for the widespread commercial deployment of wave, tidal, and in-river devices. However, these technologies are evolving rapidly and are being demonstrated at more sites around the world each year.

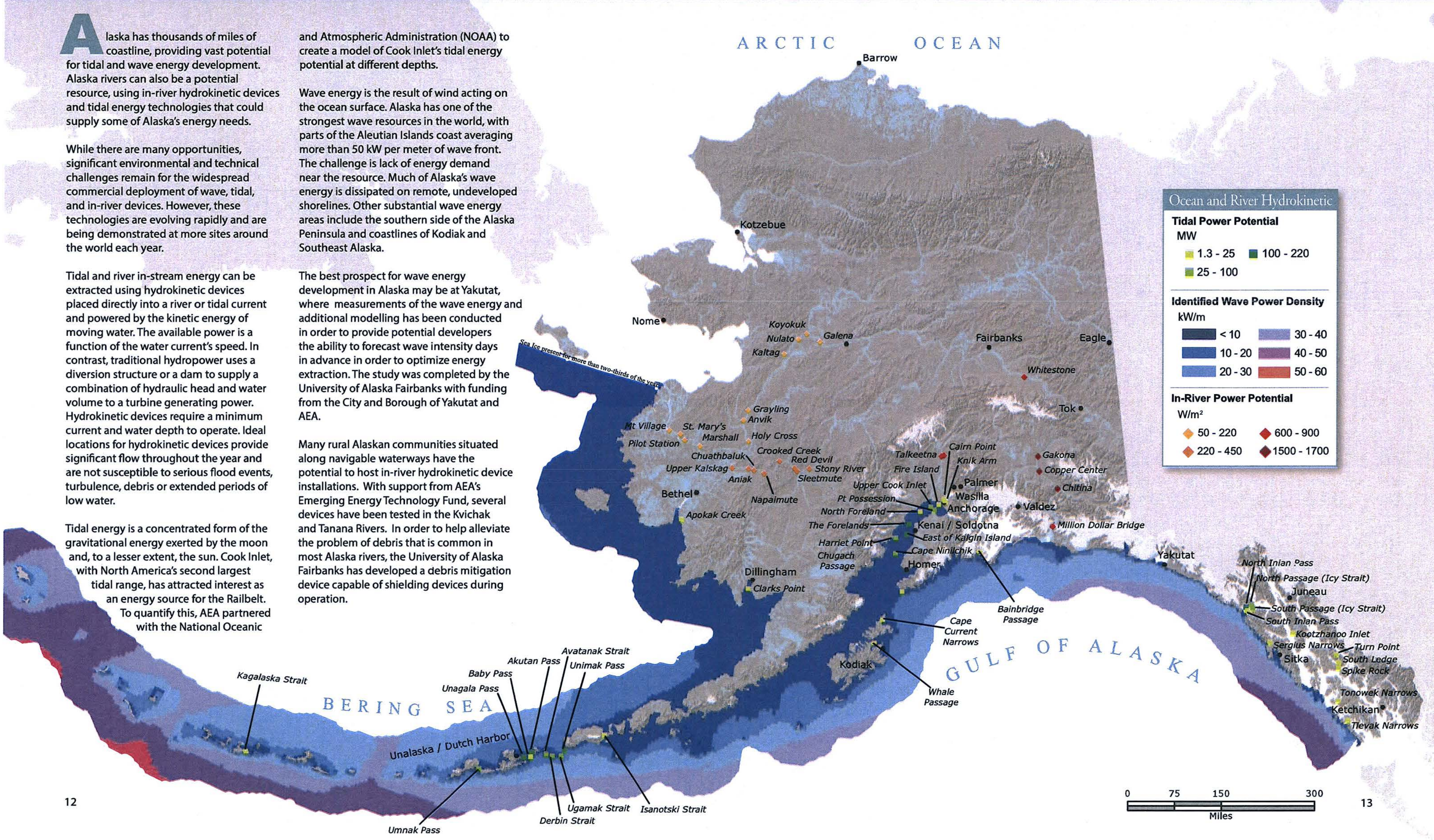
Tidal and river in-stream energy can be extracted using hydrokinetic devices placed directly into a river or tidal current and powered by the kinetic energy of moving water. The available power is a function of the water current's speed. In contrast, traditional hydropower uses a diversion structure or a dam to supply a combination of hydraulic head and water volume to a turbine generating power. Hydrokinetic devices require a minimum current and water depth to operate. Ideal locations for hydrokinetic devices provide significant flow throughout the year and are not susceptible to serious flood events, turbulence, debris or extended periods of low water.

Tidal energy is a concentrated form of the gravitational energy exerted by the moon and, to a lesser extent, the sun. Cook Inlet, with North America's second largest tidal range, has attracted interest as an energy source for the Railbelt. To quantify this, AEA partnered with the National Oceanic and Atmospheric Administration (NOAA) to create a model of Cook Inlet's tidal energy potential at different depths.

Wave energy is the result of wind acting on the ocean surface. Alaska has one of the strongest wave resources in the world, with parts of the Aleutian Islands coast averaging more than 50 kW per meter of wave front. The challenge is lack of energy demand near the resource. Much of Alaska's wave energy is dissipated on remote, undeveloped shorelines. Other substantial wave energy areas include the southern side of the Alaska Peninsula and coastlines of Kodiak and Southeast Alaska.

The best prospect for wave energy development in Alaska may be at Yakutat, where measurements of the wave energy and additional modelling has been conducted in order to provide potential developers the ability to forecast wave intensity days in advance in order to optimize energy extraction. The study was completed by the University of Alaska Fairbanks with funding from the City and Borough of Yakutat and AEA.

Many rural Alaskan communities situated along navigable waterways have the potential to host in-river hydrokinetic device installations. With support from AEA's Emerging Energy Technology Fund, several devices have been tested in the Kvichak and Tanana Rivers. In order to help alleviate the problem of debris that is common in most Alaska rivers, the University of Alaska Fairbanks has developed a debris mitigation device capable of shielding devices during operation.



Solar

Alaska's high latitude presents the challenge of having minimal solar energy during long winter months when energy demand is greatest. However, solar energy plays an important role in small, off-grid power generation and low-power applications such as remote communications sites.

In Alaska, careful building design and construction can minimize the use of heating fuel. "Passive solar" design includes proper southern orientation and the use of south-facing windows that transfer the sun's energy into the building through natural processes of conduction, convection, and radiation. Passive solar design employs windows, thermal mass and proper insulation to enable the building itself to function as a solar collector.

"Solar thermal" heating systems use pumps or fans to move energy to a point of use, such as a domestic hot water tank. Typical homes demand a large amount of fuel year-round for domestic hot water, so using the sun to heat water for even seven or eight months a year saves significant amounts of energy. A larger role for solar thermal hot water systems in Alaska is emerging as heating systems advance – allowing solar-heated fluid to supply in-floor systems currently heated by fuel boilers. Solar thermal heating demonstration projects have been completed in Nome, Kotzebue and in McKinley Village, and are providing performance and economic data.

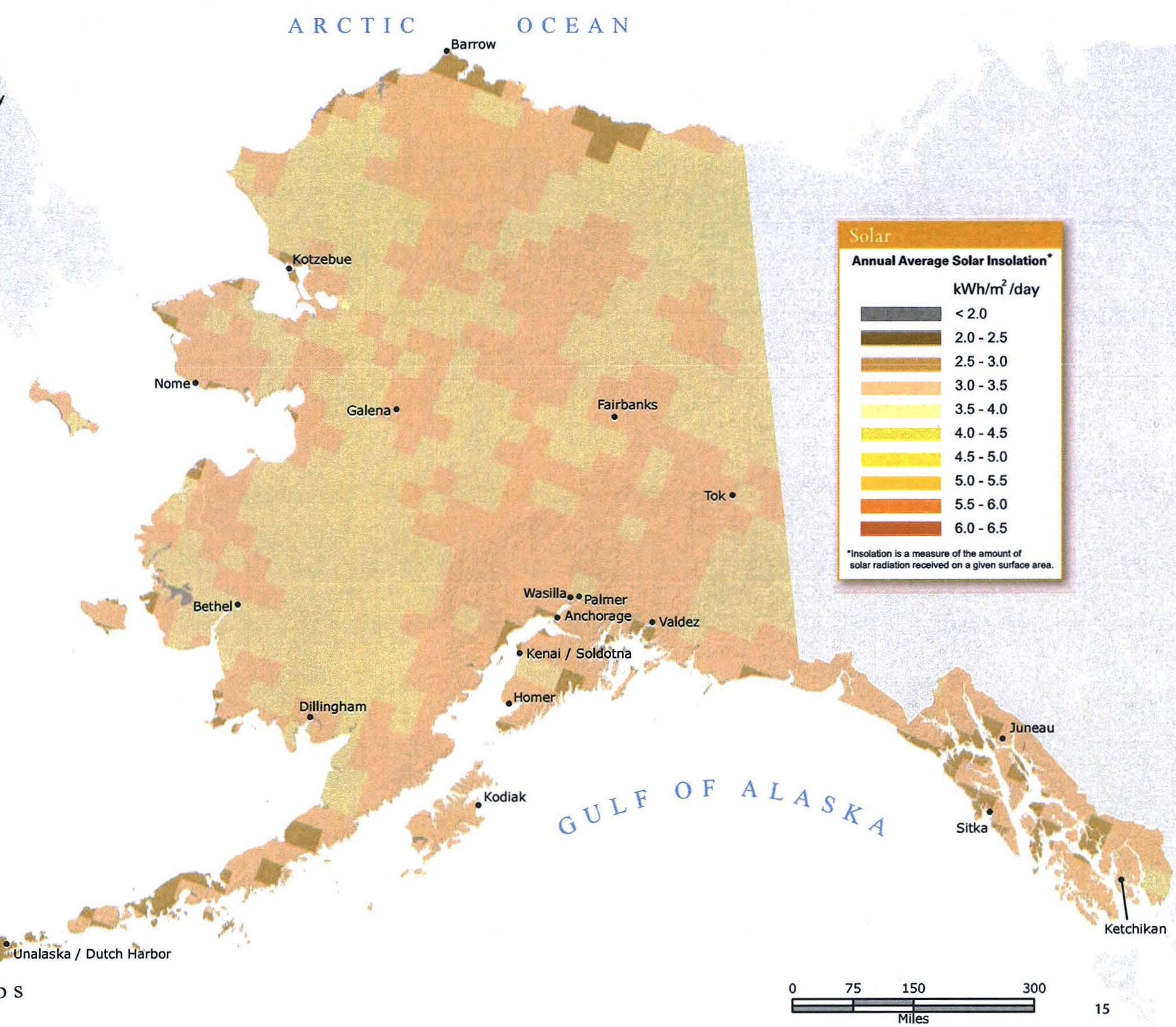
Solar photovoltaic (PV) and solar thermal renewable energy development, technology that is being rapidly developed in other parts of the world, is a fledgling industry in AK due to the lack of data on these systems and the historically poor economics. Some new commercial and utility developments are underway that indicate solar PV systems may now be economical. Many small off-grid systems continue to be sensible for remote cabins and monitoring equipment but are not a significant contributor to Alaska's energy generation.

During long summer days, photovoltaic (PV) panels can be the ideal power source for remote fish camps, lodges and cabins in stand-alone systems with relatively low power demand. Increased worldwide demand and larger scale production of panel components have cut solar panel costs significantly over the last five years.

Even though the longest day is in June, the greatest amount of solar energy that can be harnessed in Alaska is in March, April and May, when panels receive direct sunlight in addition to snow-reflected light. Coupled with cool temperatures that reduce electrical resistance, PV systems can actually exceed their rated output during this time of year.

December Average Insolation

June Average Insolation



Alaska has abundant wind resources available for energy development.

Increased costs associated with fossil fuel-based generation and improvements in wind-power technology make this clean, renewable energy resource attractive to many communities.

The wind map on these pages shows the potential for wind energy development. The colors represent the estimated Wind Power Class in each area, with Class 1 being the weakest and Class 7 the strongest. The quality of a wind resource is key to determining the feasibility of a project, but other important factors to consider include the size of a community's electrical load, the price of displaced fuels such as diesel, turbine foundation costs, the length of transmission lines and other site-specific variables.

Alaska's best wind resources are largely located in the western and coastal portions of the state. In parts of Southwest Alaska turbines may actually need to be sited away from the strongest winds to avoid extreme gusts and turbulence.

While average wind speeds tend to be much lower in the Interior, areas such as Healy and Delta Junction have strong wind resources. The quality of the wind resource is very site specific so it is critical to measure the wind resource before starting development.

Site-specific wind resource data from around the state has been collected through AEA's anemometer loan program and is available at Akenergyauthority.org.

Wind power technologies that are used in Alaska range from small systems at off-grid homes and remote camps, to medium-sized wind-diesel hybrid power systems in isolated villages, to large industrial turbines on the Railbelt and in communities like Kodiak, Kotzebue and Nome.

On the Railbelt, utilities and independent power producers have installed three wind projects to diversify the region's energy mix and provide a hedge against volatile-priced fossil fuels. Those projects are a 17.6 MW wind farm near Anchorage on Fire Island, Golden Valley Electric Association's 24.6 MW Eva Creek wind farm near Healy, and a 1.9 MW wind farm near Delta Junction. At the beginning of 2016, Alaska had a total installed wind capacity of 67 MW.

Rural Alaska, which is largely powered by expensive diesel fuel, has seen rapid development of community-scale wind-diesel systems in recent years.

In 2009, Kodiak Electric Association (KEA) installed the state's first megawatt-scale turbines and then doubled the size of its wind farm in 2012. The project's six 1.5 MW turbines supply more than 18 percent of the community's electricity. Combined with the Terror Lake hydroelectric project, KEA can now shut off their diesel generators almost all year.

Alaska Village Electric Cooperative has wind-diesel hybrid systems installed in ten of the 56 Western and Interior villages it serves, and is developing projects in at least five other communities. Unalakleet Valley Electric Cooperative added a 600 kW wind farm in 2009. Kotzebue added two 900 kW turbines in 2012, more than doubling its wind capacity.

There are now 27 wind installations operating in rural communities outside of the Railbelt

Renewable Energy Fund

Alaska's Renewable Energy Fund (REF) was created by the Alaska Legislature in 2008 with the intent to appropriate $50 million a year for five years to develop renewable energy projects across the state, particularly in areas with the highest energy costs. In 2012 the Legislature extended the program for another 10 years, until 2023.

The REF is administered by the Alaska Energy Authority (AEA) and has been a major stimulus for renewable energy projects across Alaska. Since 2008, the Legislature has appropriated $259 million for 287 qualifying projects. Grants have been awarded for reconnaissance and feasibility studies, as well as design and construction projects covering a wide range of technologies and geographic areas – from wind turbines in Quinhagak to a hydroelectric project in Gustavus to a ground source heat pump system at the Juneau airport to a heat recovery system in North Pole.

In 2016, the Alaska Energy Authority is estimating that renewable projects constructed with funding from the Renewable Energy Fund will displace 30 million gallons of diesel fuel.

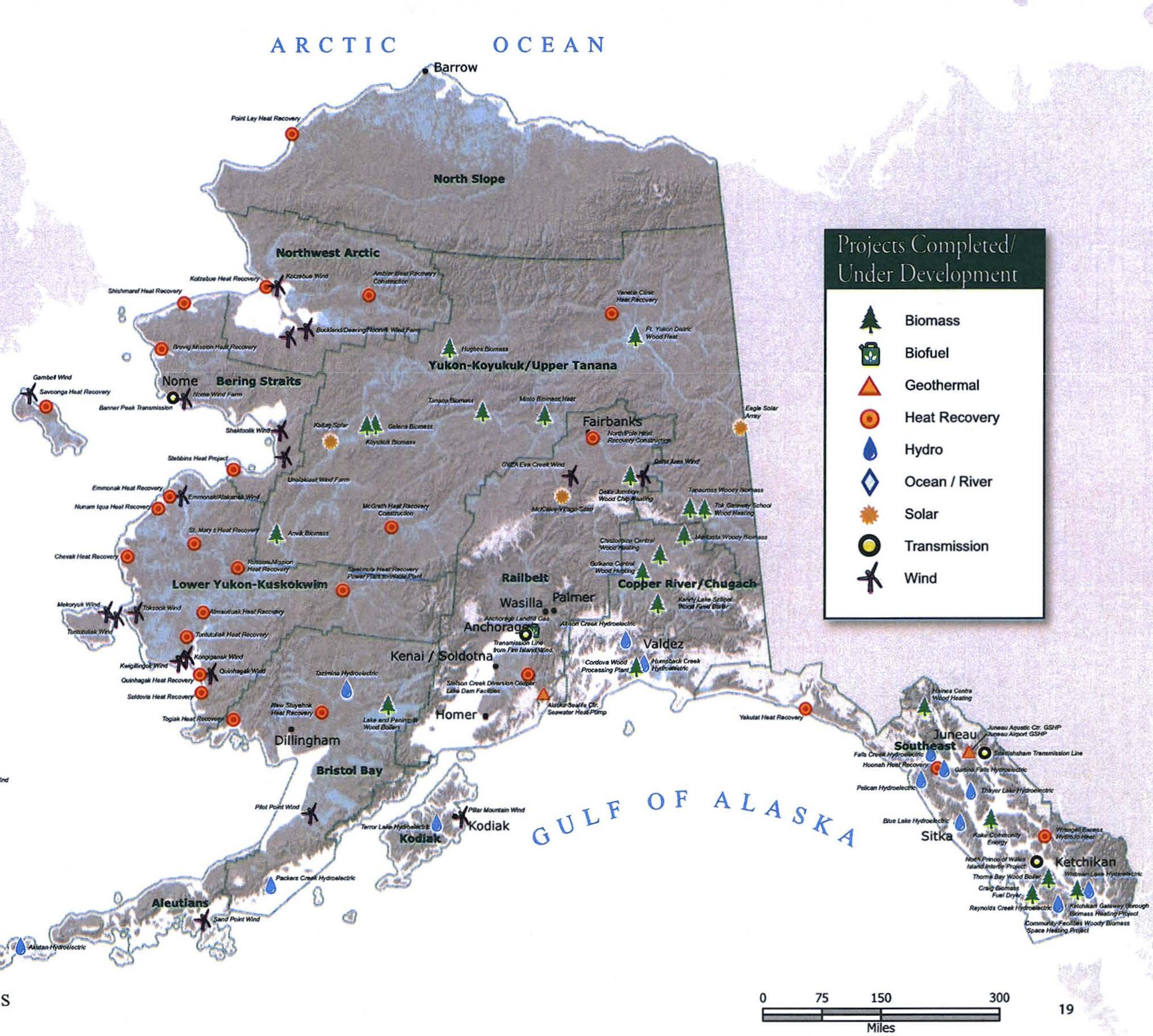
The program is helping communities stabilize energy prices by reducing their dependence on costly diesel fuel for power generation and space heating. In the 2015, 54 projects displaced an estimated 22 million gallons of diesel fuel worth nearly $61 million. These numbers are expected to increase again in 2016 as many more projects become operational. Newer projects include the construction of biomass boilers in the Lake and Peninsula Borough, the Blue Lake hydroelectric expansion in Sitka, the Saint Paul heat recovery upgrade, and the wind-to-heat project in Gambell.

The present value of the capital expenditures used to build the fist 54 generating projects is $494 million and the present value of benefits is $1.237 billion. Based on the present value of capital costs and future benefits, these project have an overall benefit-cost ratio of 2.5. The REF invested $128.3 million of total project cost to these 54 projects in order to generate the $1.237 billion of lifecycle benefits.

One completed project is Gartina Falls in Hoonah that displaces about one-third of the community's diesel used for electricity generations. Other projects completed are Chevak and Gambell surplus wind-to-heat water, wood boilers in Kokhanok, and Packers Creek Hydroelectric in Chignik Lagoon.

With low state revenues in recent years, AEA has been working with the Renewable Energy Fund Advisory Committee (REFAC) to adapt the program to changing times. Recent years have seen additional emphasis placed on funding early-stages of development that cannot easily be financed and providing assistance to applicants to find financing options to construct feasible projects.

To qualify for funding, project developers must submit applications to AEA, which ranks them based on economic and technical feasibility, local support, matching funding and the community's cost of energy. These rankings are submitted to the Legislature, which approves the projects and appropriates funding.



Chignik Lagoon Hydroelectric

Total cost: $5.5 million
REF funding: $4.5 million
Generation: 550 MWh annually
Expected life: 50 years
B/C ratio: 1.06

In 2015 Chignik Lagoon experienced a dramatic change within the community. The noise and emissions from the diesel generator plant ceased but the power was still on. The shift from powering the community with diesel to a water powered generator, a vastly simpler system, occurred with the flick of a switch. Yet the path to building the hydroelectric generation project was not so simple.

Chignik Lagoon, with a 2010 census population of 78, is one of three communities in the vicinity of the Chignik River located on the south shore of the Alaska Peninsula 450 miles southwest of Anchorage. In 1980 a regional reconnaissance study found two economical projects (Through Creek and Crazy Creek). The next known investigation was the 1995 feasibility for development on Packers Creek.

Alaska's REF grant program jump started the development and later awarded grants for final design and construction. The 167 kW project now generates about 85 percent of Chignik Lagoon's electrical needs. Construction of the project also improved other infrastructure and opportunities in the community. A new mile-long gravel road leading to the Packer Creek dam nearly doubles the total amount of road in Chignik Lagoon opening up new areas for recreation and subsistence. The project also improved electrical distribution, reduced noise and diesel emissions, and will potentially motivate new business and stimulate the local economy due to lower cost power.

Unalakleet Wind to Heat

Total cost: $4.2 million
REF funding: $4 million
Generation: 550 MWh annually
Expected life: 20 years
B/C ratio: 2.06

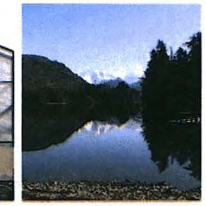
In partnership with the Alaska Energy Authority, Unalakleet Valley Electric Cooperative (UVEC) completed the design and construction of a wind to heat project in Unalakleet, Alaska. The project installed six Northern Power 100 kW wind turbines, constructed a new power plant, and installed a transmission line to connect the turbines to UVEC's electrical distribution system. Any excess energy generated by the turbines is directed from the wind farm to an electric boiler in the heat recovery loop that feeds the Unalakleet School, using "waste heat" to warm the school gym and several offices.

The project became operational in December of 2009. Since then, the turbines have generated 4,670 Megawatt hours of electricity and 552 MMBtu of thermal energy. This has allowed UVEC to displace 334,000 gallons of diesel fuel, saving the community $1,195,000 in reduced fuel costs. Over its 20-year projected lifespan, the project has a calculated benefit/cost ratio of 2.06, meaning that the project will realize a 206 percent return on investment. This wind project now provides for 35 percent of Unalakleet's electricity needs.

The Alaska Energy Authority's Renewable Energy Fund (REF) grant contributed $4,000,000 to the design and construction of the project. Local funds contributed $201,492 for the same project phases.

Throne Bay School Biomass

Total cost: $220,179
REF funding: $178,179



In Southeast Island School District's Thorne Bay School greenhouse, students are learning the science of growing food, healthy eating, and how to run a successful business. In 2013, the school self-funded and built a hydroponic greenhouse that captures excess heat generated by the school's cordwood boiler.

The boiler was purchased using a Renewable Energy Fund grant made possible through AEA and the efforts of the Alaska Wood Energy Development Task Group's (AWEDTG's) pre-feasibility and feasibility study process.

In the Thorne Bay School, in addition to displacing heating fuel, the biomass boiler and greenhouse have been incorporated into the curriculum: science, horticulture, math and business are all taught hands-on. The school's greenhouse grows fresh vegetables for the school cafeteria, improving the quality of school lunch. Excess food is sold to the community as a part of the student-led business and families can deliver wood to the boilers to help fund sports and other extracurricular activities.

Thorne Bay School is generating cheaper, more sustainable heat while championing a successful model of hands-on learning and local economic development that can be replicated around the region. This REF success story is an example of the great things that can be accomplished through collaboration and creativity.

Alaska SeaLife Center Seawater

Total cost: $830,000
REF funding: $286, 580

The City of Seward used a Round III grant from the Renewable Energy Fund (REF) to complete the installation of a seawater heat pump system to supply space heating to the Alaska SeaLife Center. This REF grant was combined with an award from the Denali Commission's Emerging Energy Technology Grant Program and local matching funds to complete the project.

The seawater heat pump system has been fully operational since late 2012, when the fuel oil boilers were shut off (one has since been removed). Since completion, the system has offset the equivalent of over 100,000 gallons of diesel fuel.

Heat pumps use a working fluid run in a refrigeration cycle to move heat from a lower temperature source to a higher temperature load. The SeaLife Center was able to take advantage of an existing seawater intake which draws water from Resurrection Bay for use in the facility's marine life tanks and exhibits. By pumping seawater—with temperatures ranging from 37 to 52 F—through a titanium heat exchanger, the heat pump system uses the 900 foot deep bay itself as a heat source. The seawater temperature is sufficient to boil the heat pump's refrigerant. The resulting vapor is then compressed, further elevating its temperature in order to supply 100 to 120 F hydronic fluid to heat the building's air handlers, domestic hot water supply, and outdoor pavement for snow and ice melt.

State and federal policies, including subsidies, play a crucial role in energy development. In 2014, International Energy Agency estimates that fossil-fuel consumption subsidies amounted to $493 billion. This is down $39 billion from 2013 "in part due to drop in international energy prices. Subsidies to oil products represent half the total. These subsidies were over four times the value of subsidies to renewable energy.

In the United States, the federal production tax credit (PTC) has been the primary incentive tool for renewable energy development. Congress passed the PTC in 1992 to even the playing field between the renewable energy industry and the fossil fuel and nuclear industries. However, since then the credit has been reauthorized just one or two years at a time, creating uncertainty in the industry about federal support of renewables. The current iteration of the credit allows the owners of qualifying wind, geothermal and biomass projects to take 2.3 cents off their tax bill for every kilowatt-hour generated during the first ten years of the project, but only if the projects were deemed eligible as of December 31, 2014. Other qualifying renewable energy technologies are allowed a 1.1 cent/kWh tax reduction. All solar technologies can take advantage of a 30% federal investment tax credit (ITC) or grant for facilities placed in service by the end of 2019. Between 2020 and 2022 the credit is phased down. By 2022, commercial solar systems will receive a 10% credit, while residential solar tax credits are phased out.

Because of the uncertainty surrounding federal policy, state policies have historically been the primary drivers of renewable energy development in the United States. Four important policy mechanisms used across the country are renewable portfolio standards, clean energy funds, feed-in tariffs and net metering. In addition, there are a variety of other state and federal grant, loan and rebate programs designed to promote renewable energy development.

Emily Binnian

This home in Kasilof is one of the early members of Homer Electric Association net metering program.

Renewable Portfolio Standards

Twenty-nine states, Washington DC and three U.S. territories have adopted policies known as a renewable portfolio standards, or RPS. An additional eight states and one territory have renewable portfolio goals. In 2010 Alaska set a non-binding goal to generate 50% of the state's electricity from renewable sources by 2025.

An RPS is a state law requiring utility companies to generate a specified percentage of their electricity from renewable resources by a certain date. For example, Nevada law mandates investor-owned utilities within its jurisdiction to produce 25% of their electricity from renewables by 2025. The percentage and end date vary widely from state to state. In 2015, Hawaii increased its RPS to 100% by 2045. Utilities are typically given interim milestones, and pay a fine if they do not reach those milestones. Most states allow utilities to purchase renewable energy credits (RECs) to meet their RPS and avoid fines. The RPS approach forces different entities and renewable energy resources to compete to meet the standard.

Alaska Energy Authority

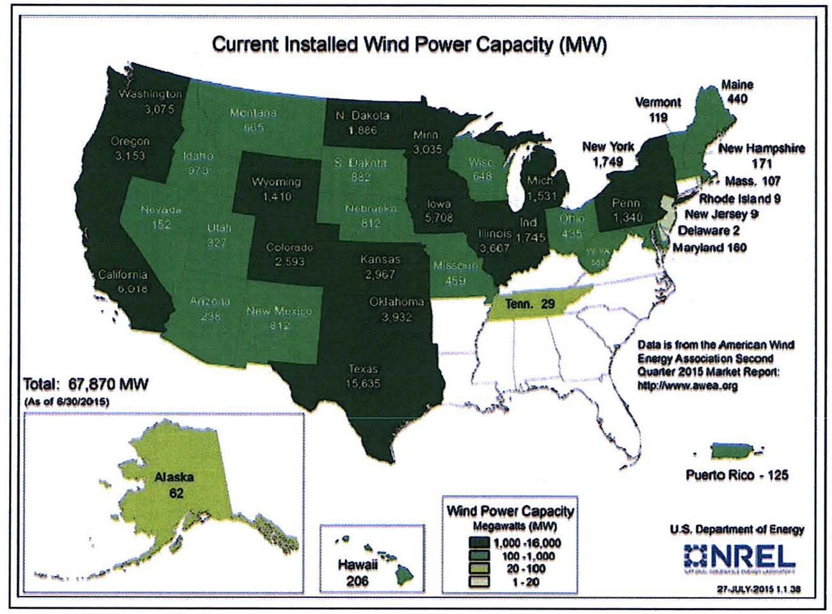
Renewable energy creates jobs for Alaskans.

Clean Energy Funds

Most Clean Energy Funds are supported through small, mill rated utility surcharges called system benefit charges. Depending on the state, these Funds are also known as "Renewable Energy" or "Public Benefit" Funds. Clean Energy Funds support the development of renewable energy and energy efficiency by helping remove market barriers, lowering financing costs, developing infrastructure, supporting research and development and public educating. For example, system benefit charges in Oregon are deposited into the independent Energy Trust of Oregon to fund eligible efficiency, wind, solar electric, biomass, small-scale hydro, tidal, geothermal, and fuel cell projects through grants, loans, rebates, equity investments, and other financing mechanisms.

Terms of these funds vary. Some states have funds scheduled to last only five years while others have open-ended funds. Longer-term funds provide greater stability for renewable energy developers. Alaska's Renewable Energy Fund was established in 2008 to support renewable energy development and is funded through year-to-year appropriations by the state legislature. The Fund is authorized through 2023. Although legislative intent language calls for $50 million in annual appropriations to the Fund, Alaska's year-to-year fiscal realities dictate how much money the legislature appropriates to the Fund each year.

In states with both a RPS and a Clean Energy Fund, the two policies work together to stimulate the renewable energy market. RPS standards "pull" renewable energy technologies into a state by providing long-term market certainty that reduces investment risk and levels the playing field for developers. Clean Energy Funds "push" clean energy technologies by lowering market investment barriers through direct incentives that support infrastructure needed to develop renewable energy. As a result, Clean Energy Funds help states meet their RPS requirements.



National Renewable Energy Laboratory

At 67,870 MW generation capacity, US wind power accounted for 6% of the nation's total electricity generation in 2015. The US was second only to China in the amount of total installed wind generation.

Feed-In Tariffs

Feed-in tariffs are used in more than 20 countries worldwide and are considered by many to be the most successful policy mechanism for stimulating rapid renewable energy development. They give renewable energy producers guaranteed access to the electric grid at a price set by the regulatory authority, providing producers the contractual certainty needed to finance renewable energy projects. They also enable homeowners, farmers, cooperatives, and others to participate on equal footing with commercial renewable energy developers. Performance-based payment levels give producers incentive to maximize the overall output and efficiency of each project. Tariffs are typically differentiated by technology and project size. Tariffs for new projects are also subject to periodic review to determine if the program is sufficiently robust, and prices paid for renewable electricity are often reduced over time as technologies mature. Vermont, California, Maine, Washington, Oregon, and Hawaii all have some form of statewide feed-in tariff designed to incentivize technology development and deployment.

REAP

Kodiak Electric Association installed three 1.5 MW wind turbines on Pillar Mountain in 2009 and then doubled the size of the wind farm in 2012. The project now supplies more than 18% of the community's electricity. Combined with the Terror Lake hydroelectric project, KEA can shut off their diesel generators almost all year.

Renewable Energy Credits (RECs)

Utilities recognized years ago that there was market demand for clean, renewable energy when customers agreed to pay more for resources like wind. However, with the price of wind and solar dropping quickly over the last several years, today almost all utilities sell the social and environmental attributes of renewable energy separate from the actual electrons rather than charging a premium for renewable power. Also known as "green tags," renewable energy certificates (RECs) are essentially the bragging rights created when renewable energy is produced. Each REC represents the production of one megawatt hour of renewable energy and the displacement of approximately 1,400 pounds of CO_2 emissions. Buyers of RECs include utilities in compliance markets trying to meet state RPS requirements, and federal agencies, municipalities and corporations committed to voluntarily supporting increased renewable energy production. For example, Microsoft Corporation, Unilever, Georgetown University and the National Hockey League all purchase RECs to offset 100% or more of their electricity use.

Electricity Feed Laws and Advanced Renewable Tariffs

Electricity feed laws and advanced renewable tariffs (ARTs) are used in a number of countries and are considered to be the world's most successful policy mechanisms for stimulating rapid renewable energy development. They give renewable energy producers guaranteed access to the electric grid at a price set by the regulatory authority, providing producers the contractual certainty needed to finance renewable energy projects. They also enable homeowners, farmers, cooperatives, and others to participate on equal footing with commercial renewable energy developers. Performance-based payment levels give producers incentive to maximize the overall output and efficiency of each project.

ARTs are the modern version of Feed Laws, although they differ from simpler feed laws in several important ways. Tariffs are differentiated by technology, project size, or, in the case of wind energy, by resource productivity. Tariffs for new projects are also subject to periodic review to determine if the program is sufficiently robust, and prices paid for renewable electricity are often reduced over time as technologies mature.

The Canadian province of Ontario enacted North America's first comprehensive program of Advanced Renewable Tariffs in 2009, and revised it in 2010. The program offers "microFIT" 20- to 40-year contracts to

Alaska Volcano Observatory

Steam vent on Kiska Volcano in the Aleutian Islands. Several communities in the Aleutians are considering developing their geothermal resources.

producers of wind, hydro, biomass, landfill gas, and solar photovoltaic energy at prices ranging from 10 to 80 cents/kWh. Contracts differentiate between small and large energy producers, and are available to homeowners, businesses and commercial energy producers. Additional financial incentives are offered for projects developed by First Nations, farmers, cooperatives, and community groups.

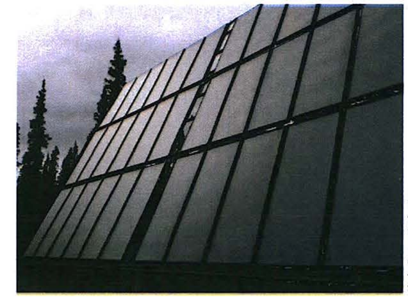
In 2009 Vermont adopted a modest version of an Advanced Renewable Tariff. The program is currently capped at 127.5MW by 2022 of small DG acceptable to the program and offers 25-year contracts for renewable energy producers, with prices varying from 11.8 to 27.1 cents/kWh. The town of Gainesville, Florida also generated widespread publicity in 2009 for adopting a feed-in-tariff to spur installation of solar photovoltaic systems. The tariff offers 20-year contracts that pay between 15 and 21 cents/kWh, depending on the size and configuration of the system. Installations of solar in Gainesville have increased from less than 350 kW in 2009 to over 7,000 kW today. Several other American jurisdictions have enacted some form of feed-in tariff, and feed-in tariff legislation is being debated in several states.

Net Metering

State net metering rules provide an incentive for individuals and businesses to invest in their own small renewable energy systems by allowing them to sell excess power they produce back into the grid. Forty-four states, three territories and the District of Columbia have set mandatory net metering rules. Different standards in each state determine the maximum amount of power an individual can sell back to the utility, the price paid by the utility, and the length of time an individual producer can "bank" the power they produce before a "net" bill. Alaska's net metering regulations, which were promulgated by the Regulatory Commission of Alaska, went into effect in 2010. They apply to renewable energy systems of 25 kW or less, and require large utilities to purchase up to 1.5% of the utility's average load from customers who build projects at a price equivalent to the avoided cost.

Alaska

2008 was a landmark year for renewable energy and energy efficiency in Alaska. The passage of HB 152, which established the Renewable Energy Fund (REF) administered by the Alaska Energy Authority (AEA). Through the first eight rounds of funding, the State Legislature has appropriated $259 million for 287 grants across the state. In 2015, the 54 projects that have been



Alaska Energy Authority

The Denali Education Center is approximately 6 miles south of Denali National Park. They host youth camps and other informational gatherings related to the park and the outdoors. The solar system includes a 1/4 - mile hot water loop for the various cabins fed by 1300 sq. ft. of solar thermal panels.

constructed with REF support saved the equivalent of 22 million gallons of diesel fuel per year. Also, the Cold Climate Housing Research Center published the first of two reports outlining recommended state programs, initiatives, and goals to reduce end-use energy demand and keep hundreds of millions of dollars in the State's economy each year, and the State Legislature appropriated $360 million for home weatherization and rebate programs.

In 2010, the Alaska State Legislature passed two other important bills – SB 220 and HB 306. House Bill 306 established goals to produce 50% of the state's electricity from renewable resources by 2025 and reduce energy use 15% per capita by 2020. Among other provisions, SB 220 mandated that 25% of the state's public buildings be energy retrofitted by 2020 and created a $250 million revolving loan fund administered by the Alaska Housing Finance Corporation (AHFC) to help finance that work.

Senate Bill 220 also established the Emerging Energy Technology Fund (EETF), which is aimed at supporting the development of new technologies not funded under the REF. Administered by AEA, with financial support from the State and the Denali Commission, the EETF has awarded 19 grants for a range of projects that use technologies not yet tested in Alaska as well as technologies that are still in development but could be commercially viable within five years.

Energy Efficiency

Energy efficiency is a common-sense first step in realizing sustainable energy goals. Energy efficient buildings, lighting, heating systems and appliances provide the same level of service as less efficient ones but use fewer kilowatt hours and BTU's. Energy efficiency is typically the least expensive, most cost effective and fastest energy improvement that can be made. In 2010, the state adopted a goal to reduce per capita energy consumption 15 percent by 2020. With the same legislation the state also declared that by 2025, 50 percent of power should come from renewable energy sources. Improving efficiency not only saves energy and money, it allows generated energy to stretch further. Energy efficiency creates a strong foundation for renewable energy.

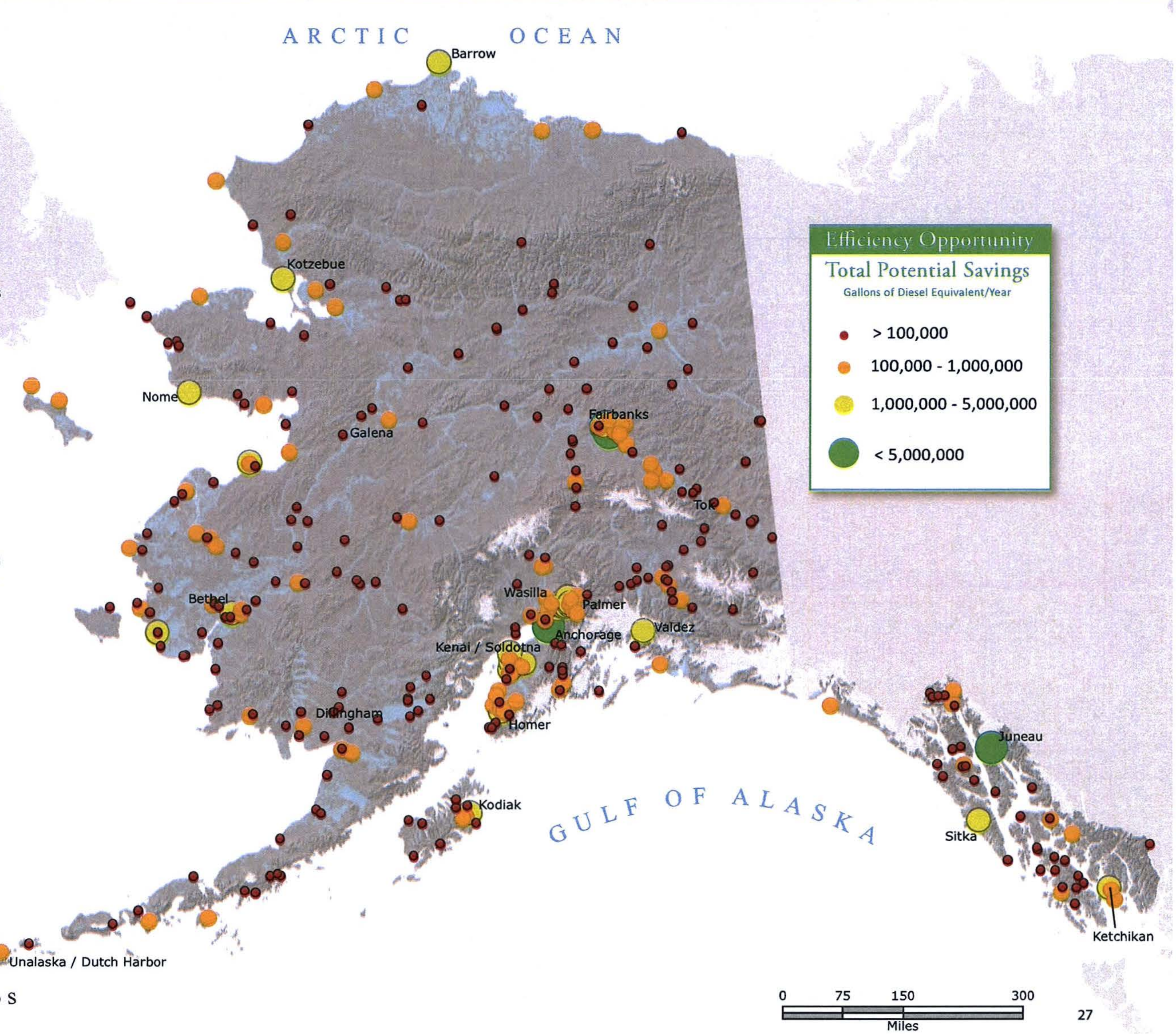
Each year Alaska's residential and commercial sectors use an estimated 118 trillion BTU's of energy for power and space heat. Of this, 45 percent is used in residential buildings and 55 percent is used in public and private commercial buildings and facilities. Reducing energy use in these two sectors by 15 percent would save nearly 18 trillion BTU's annually. At $4/gallon for diesel fuel, this reduction through energy efficiency improvement in residential, commercial and public buildings would keep $500 million in the state's economy each year.

The State of Alaska is working to reduce cost and consumption through programs housed at the the Alaska Energy Authority (AEA), Alaska Housing Finance Corporation (AHFC), and the Department of Transportation and Public Facilities (DOT&PF).

The Alaska Energy Authority administers two non-residential efficiency programs; the Commercial Building Energy Audit (CBEA) program and the Village Energy Efficiency Program (VEEP). The CBEA has provided rebates for more than 230 privately owned non-residential buildings since 2011, identifying an average 28 percent potential savings and a six-year simple payback through economic efficiency measures. VEEP is a grant program which has implemented energy efficiency measures in public and tribal buildings and facilities in 61 small communities since 2005. These improvements are savings rural communities millions of dollars annually while extending the useful life of public infrastructure.

Until recently, Alaska Housing Finance Corporation administerd two residential energy efficiency programs: Home Energy Rebate Program and Weatherization. Between 2008 and 2015, the Home Energy Rebate and Weatherization programs provided efficiency improvements to more than 40,000 households across Alaska, resulting in an average energy savings of 30 percent, the creation of more than 4,000 jobs, and an estimated $56 million in energy saving to Alaskans per year. Weatherization is still available for income eligible households.

The Alaska Department of Transportation and Public Facilities works to improve the efficiency of State of Alaska buildings and facilities through their Energy Program office. Between 2010 and 2015, DOT&PF's Energy Program facilitated efficiency improvements to over 25 percent of state-owned facilities, achieving a cumulative annual cost avoidance of more than $2.4 million.



Energy Efficiency Program Highlights

Energy efficiency improvements help individuals, businesses and governments use less energy, save money, and strengthen local economies. Efficiency measures also help achieve the state's energy efficiency and renewable energy goals. While the availability of natural resources varies by location, energy efficiency is available in every corner of the state.

Rural Alaska Case Study – Revisiting the Whole Village Retrofit

In 2008, AEA and several project partners undertook an intensive energy efficiency improvement effort in the small, rural community of Nightmute. This Whole Village Retrofit (WVR) included energy efficient lighting and weatherization upgrades in 13 community buildings, four teacher-housing units along with powerhouse and transmission system improvements. The effort was intended to maximize energy savings and mitigate the effects of rising heating oil prices. With state and federal funding complemented by significant local cash and in-kind match, the project reduced electricity use by an estimated 59% and displaced nearly 5,000 gallons of heating oil annually through the public building improvements alone.

Energy efficiency is consistently rising to the top of local energy project priority lists across the state through the AEA-led regional energy planning process. The success in Nightmute suggests that this multi-agency service delivery model is one worth replicating, especially if private sector investment can be secured rather than relying exclusively on state grant funding. AEA and partners are exploring the potential to pilot a next generation, fully financed WVR.

Alaska Energy Authority

Commercial Energy Efficiency Case Study

Levi and Anna Thomas participated in Alaska Housing Finance Corporation's Home Energy Rebate program and went from a 2-star home energy rating to a 5-star rating, cutting their gas usage by 65 percent. The couple sent the following note to program managers:
"When I first heard of the program it seemed so elusive and daunting. But from my first audit, I was able to cruise through the upgrades in two months. My wife and I scraped the bottom of the barrel of our finances, holding on to the hope that we were doing everything correctly. Our energy rater was a massive resource. We spent $12,000 and put a lot of sweat equity into the project including BBQ work parties with friends to fuel our projects. Finishing up with AHFC felt so streamlined and getting the rebate check was such a surreal event. My wife and I are so truly grateful and appreciative for the Home Energy Rebate program. We have learned so much and made improvements that otherwise would have not been financially possible."

Non-Residential Energy Efficiency Case Study

In summer 2015 the Department of Transportation and Public Facilities (DOT&PF) closed a precedent-setting $3.5 million deal for energy efficiency upgrades to 16 maintenance facilities in nine different communities in its Northern Region. With an estimated annual energy savings of more than $240,000, this Public Facilities Energy Program project is the first to be financed privately, demonstrating potential for similar public-private partnerships in the future.

DOT&PF's energy program works with other state agencies to facilitate energy efficiency projects that reduce energy consumption and operating expenses in public facilities. Each project is developed to be budget neutral; the guaranteed savings pay for the financing of the energy efficiency improvements over time. DOT&PF administers an ongoing Energy Savings Performance Contracting (ESPC) Term Agreement to assist state and public agencies in procuring the services of Energy Services Companies (ESCO).

The contract for the Northern Region Energy Upgrades project was awarded to Siemens Industry, Inc. in February 2014. With approval from DOT&PF, Siemens solicited proposals for project financing from four institutions familiar with ESCO-based energy projects. Ultimately, Bank of America was selected. The loan transaction was completed in June 2015, creating a clear pathway to procuring private financing solutions for state agencies.

This and future EE projects help the state save energy by improving existing infrastructure, reducing operating costs and creating additional jobs for Alaskans.

Water System Case Study

In 2012, the Alaska Native Tribal Health Consortium (ANTHC) conducted a holistic assessment of energy usage across all the facilities and equipment used to provide clean water and sewer services to the community of Pilot Station. The community has implemented simple retrofit measures on their own accord after receiving the results of the energy audit, and worked with ANTHC to identify funding to complete the more expensive retrofits and training needs. LED interior and exterior lighting, setback thermostats, minor weatherization, heating system efficiency improvements, and new controls to reduce the heating demand of circulating water and sewer system were implemented in 2014 with funding from the State of Alaska and the United States Department of Agriculture, Rural Development. This effort included substantial energy efficiency training for the operators of the sanitation system. The community has recognized a 66% reduction in fuel usage and a 33% reduction in electricity usage in the sanitation system since energy efficiency retrofits and training have been implemented.

Data Collection and Management

The Alaska Retrofit Information System (ARIS) is the state's database to store energy audit and consumption information for both residential and non-residential buildings. ARIS, managed by AHFC, is a useful tool for assessing the current state of residential housing and commercial building stock with respect to energy efficiency. Maintaining building characteristic and energy use information in ARIS allows researchers and energy specialists to more accurately study the impacts of different programs; evaluate technology performance in cold climates; and identify opportunities to decrease energy use through efficiency. Local governments and tribes can also use ARIS to track the energy use in their buildings. AIn an effort to reflect the value of efficiency in a home's sale price, an appraisal tool uses ARIS data to show appraisers comparable residential energy use.

The Alaska Affordable Energy Strategy (AkAES), a program mandated by the legislature as part of the AKLNG legislation in 2014, is required to deliver a plan and proposed legislation to provide more affordable energy to the parts of the state that would not have direct access to a North Slope natural gas pipeline. The AkAES has led to an extensive data collection and modeling effort to estimate the consumption and efficiency opportunity in the AkAES region's residential, non-residential, and water systems in order to compare the efficiency to other energy cost reduction strategies in communities. By collecting available building information from nearly 6,000 non-residential buildings; 17,000 residential buildings from AHFC's BEES, Weatherization, and Home Energy Rebate programs; water system data from ANTHC; and various other sources, communities' heating and electricity consumption has been estimated. The community-level efficiency opportunity draws from these same sources as well as building audit information. All deliverables for the AkAES, including the efficiency opportunity, will be available through AEA's website.

Alaska Energy Efficiency Partnership

The Alaska Energy Efficiency Partnership is a group of more than 70 public, private and non-profit entities that meet quarterly to share information and find collaborative opportunities in the pursuit of shared goals. The Partnership's mission is "[t]o improve the coordination of efforts promoting the adoption of greater end-use energy efficiency measures and energy conservation behaviors in Alaska through information sharing and integrated planning so that Alaska may become the most energy efficient state in the nation."

akenergy efficiency.org

Energy Efficiency is an Investment Opportunity

Energy efficiency is more than swapping out lightbulbs and adding insulation – it creates economic opportunity while improving comfort and it can be done without compromising convenience. Using electricity and heat is an unavoidable reality in our state, where the associated costs for these critical services are double or triple what our friends outside pay. And, despite relatively short-lived trends to the contrary, energy prices generally only go up over time. The longer you wait to take action, the longer you continue to waste energy and money unnecessarily. Take action today, save today and every day after. Your energy efficiency investment grows incrementally, generating savings that can be continuously reinvested in your home, your business, or your community. An investment in energy efficiency is an investment in your future.

Like any good investment, investing in efficiency requires a financial commitment. The savings opportunity, however, can be significant enough that it's worth taking a loan to make this commitment. The cost of repaying that loan is often smaller than the savings generated by the efficiency improvements the loan affords. We're talking about energy efficiency financing, and it's the way of the future.

To finance your energy efficiency investment, you need to start with information. Have your building or facility audited to see what kind of savings is possible. Have the project cost and savings estimates verified. Develop a scope of work. Consider working with a project developer. Initiate negotiations with a lender, public or private. Make sure you get the savings you were promised. And then reap the rewards of your hard work with lower energy bills, a healthier indoor air quality, and more money to spend on other, more important things. For more information about financing energy efficiency projects, go to www.akenergyefficiency.org/financing.

Absorption Chiller - A device that uses heat energy rather than mechanical energy to cool an interior space through the evaporation of a volatile fluid.

Active Solar - A solar water or space-heating system that use pumps or fans to circulate the heat transfer medium (water, air or heat-transfer fluid like diluted antifreeze) from the solar collectors to a storage tank subsystem or conditioned space.

Alternative Fuels - A term for "non-conventional" transportation fuels derived from natural gas (propane, compressed natural gas, methanol, etc.) or biomass materials (ethanol, methanol, or biodiesel).

Anemometer - An instrument for measuring the velocity of wind; a wind gauge.

ASTM - Abbreviation for the American Society for Testing and Materials, which is responsible for the issue of many standard methods used in the energy industry.

Availability - It refers to the number of hours that a power plant is available to produce power divided by the total hours in a set time period, usually a year.

Avoided Cost - The incremental cost to an electric power producer to generate or purchase a unit of electricity or capacity or both.

Biodiesel - A domestic, renewable fuel for diesel engines derived from natural oils like fish and vegetable oil; produced by a chemical process that removes the glycerin from the oil and meets a national specification (ASTM D 6751).

Biomass - Organic matter that is available on a renewable basis, including agricultural crops and agricultural wastes and residues, wood and wood wastes and residues, animal wastes, municipal wastes, and aquatic plants.

Bioenergy – Electrical, mechanical, or thermal energy or fuels derived from biomass.

Capacity Factor - The ratio of the average power output of a generating unit to the capacity rating of the unit over a specified period of time, usually a year.

Co-firing - Using more than one fuel source to produce electricity in a power plant. Common combinations include biomass and coal, biomass and natural gas, or natural gas and coal.

Cogeneration - The generation of electricity and the concurrent use of rejected thermal energy from the conversion system as an auxiliary energy source.

Conduction - The transfer of heat through a material by the transfer of kinetic energy from particle to particle; the flow of heat between two materials of different temperatures that are in direct physical contact.

Convection - The transfer of heat by means of air or fluid movement.

Dam - A structure for impeding and controlling the flow of water in a water course that increases the water elevation to create hydraulic head. The reservoir creates, in effect, stored energy.

District Heating System - Local system that provides thermal energy through steam or hot water piped to buildings within a specific geographic area. Used for space heating, water heating, cooling, and industrial processes. A common application of geothermal resources.

Distributed Generation - Localized or on-site power generation, which can be used to reduce the load on a transmission system by generating electricity close to areas of customer need.

Distribution Line - One or more circuits of an electrical distribution system on the same line or poles or supporting structures, usually operating at a lower voltage than a transmission line.

Domestic Hot Water - Water heated for residential washing, bathing, etc.

Electrical Energy - The amount of work accomplished by electrical power, usually measured in kilowatt-hours (kWh). One kWh is 1,000 watt hours and is equal to 3,413 Btu.

Energy - The capability of doing work; different forms of energy can be converted to other forms, but the total amount of energy remains the same.

Energy Conservation - Reducing energy consumption by changing a behavior or level of service.

Energy Crop - A plant grown with the express purpose to be used in biomass electricity or thermal generation.

Energy Efficiency - Applying better technology and practices to get the same level of service while using less energy.

Energy Storage - The process of converting energy from one form to another for later use. Storage devices and systems include batteries, conventional and pumped storage hydroelectric, flywheels, compressed gas, hydrogen, and thermal mass.

Ethanol - A colorless liquid that is the product of fermentation used in alcoholic beverages, in industrial processes, and as a fuel.

Feedstock - A raw material that can be converted to one or more products.

Fossil Fuels - Fuels formed in the ground from the remains of dead plants and animals, including oil, natural gas, and coal. It takes millions of years to form fossil fuels.

Fuel - Any material burned to make energy.

Fuel Oil - Any liquid petroleum product burned for the generation of heat in a furnace or firebox, or for the generation of power in an engine. Domestic (residential) heating fuels are classed as Nos. 1, 2, 3; Industrial fuels as Nos. 4, 5, and 6.

Generator - A device for converting mechanical energy to electrical energy.

Geothermal Energy - Energy produced by the internal heat of the earth; geothermal heat sources include: hydrothermal convective systems; pressurized water reservoirs; hot dry rocks; thermal gradients; and magma. Geothermal energy can be used directly for heating and cooling or to produce electric power.

Head – A measure of fluid pressure, commonly used in water pumping and hydro power to express height that a pump must lift water, or the distance water falls. Total head accounts for friction and other head losses.

Heat Pump - An electricity powered device that extracts available heat from one area (the heat source) and transfers it to another (the heat sink) to either heat or cool an interior space or to extract heat energy from a fluid.

Hybrid System - An energy system that includes two different types of technologies that produce the same type of energy; for example, a wind turbine and a diesel system combined to meet electric power demand.

Hydroelectric Power Plant - A power plant that produces electricity by the force of water moving through a hydro turbine that spins a generator.

Hydrogen - A chemical element that can be used as a fuel since it has a very high energy content. Although it is often thought of as a fuel, hydrogen is better classified as an energy storage medium because it requires energy, typically from electricity or natural gas, to produce it.

Insolation - A measure of the amount of solar radiation energy received on a given surface area.

Landfill Gas - Naturally occurring methane produced in landfills that can be burned in a boiler to produce heat or in a gas turbine or engine-generator to produce electricity.

Large-scale or Utility-scale - A power generating facility designed to output enough electricity for purchase by a utility.

Load - Amount of electricity required to meet customer demand at any given time.

Meteorological (Met) Tower - A structure instrumented with anemometers, wind vanes, and other sensors to measure the wind resource at a site.

Ocean Energy Systems - Energy conversion technologies that harness the energy in tides, waves, and thermal gradients in the oceans.

Organic Rankine cycle (ORC) – A closed system that uses an organic working fluid instead of water to spin a turbine, and therefore can operate at lower temperatures and pressures than a conventional steam process.

Panel (Solar) - A term applied to individual solar collectors, and typically to solar photovoltaic collectors or modules.

Passive Solar Design - Construction of a building to maximize solar heat gain in the winter and minimize it in the summer without the use of fans or pumps, thereby reducing the use of mechanical heating and cooling systems.

Peak load – The amount of electricity required to meet customer demand at its highest.

Penstock - A component of a hydropower plant; a pipe that delivers water to the turbine.

Photovoltaics (PV) - Devices that convert sunlight directly into electricity using semiconductor materials. Most commonly found on a fixed or movable panel; also called solar panels.

Power - Energy that is capable of doing work; the time rate at which work is performed, measured in horsepower, Watts, or Btu per hour.

Production Tax Credit (PTC) – An incentive that allows the owner of a qualifying energy project to reduce their taxes by a specified amount. The federal PTC for wind, geothermal, and closed-loop biomass is 1.9 cents per kWh.

Radiation - The transfer of heat through matter or space by means of electromagnetic waves.

Railbelt - The portion of Alaska near the Alaska Railroad, including Fairbanks, Anchorage, and the Kenai Peninsula.

Renewable Resource - Energy sources which are continuously replenished by natural processes, such as wind, solar, biomass, hydroelectric, wave, tidal, and geothermal.

Run-of-River Hydroelectric - A type of hydroelectric facility that uses a portion of the river flow with minimal impoundment of the water.

Small-scale or Residential-scale - A generating facility designed to output enough electricity to offset the needs of a residence, farm or small group of farms, generally 250 kW or smaller.

Solar Energy - Electromagnetic energy transmitted from the sun (solar radiation). The amount that reaches the earth is equal to one billionth of total solar energy generated, or the equivalent of about 420 trillion kilowatt-hours.

Solar Radiation - A general term for the visible and near visible (ultraviolet and near-infrared) electromagnetic radiation that is emitted by the sun. It has a spectral, or wavelength, distribution that corresponds to different energy levels; short wavelength radiation has a higher energy than long-wavelength radiation.

Tidal Power - The power available from either the rise and fall or flow associated with ocean tides.

Transmission Grid - The network of power lines and associated equipment required to deliver electricity from generating facilities to consumers through electric lines at high voltage, typically 69kV and above.

Turbine - A device for converting the flow of a fluid (air, steam, water, or hot gases) into mechanical motion.

Wave Energy - Energy derived from the motion of ocean waves.

Wind Energy - Energy derived from the movement of the wind across a landscape caused by the heating of the atmosphere, earth, and oceans by the sun.

Wind Turbine - A device that converts energy in the wind to electrical energy, typically having two or three blades.

Windmill - A device that converts energy in the wind to mechanical energy that is used to grind grain or pump water.

Wind Power Class - A class based on wind power density ranging from 1 (worst) to 7 (best).

Wind Power Density - The amount of power per unit area of a free windstream.

Wind Resource Assessment - The process of characterizing the wind resource and its energy potential, for a specific site or geographical area.

UNITS

Ampere - A unit of measure for an electrical current; the amount of current that flows in a circuit at an electromotive force of one Volt and at a resistance of one Ohm. Abbreviated as amp.

Amp-Hours - A measure of the flow of current (in amperes) over one hour.

Barrel (Petroleum) - Equivalent to 42 U.S. gallons (306 pounds of oil, or 5.78 million Btu).

British Thermal Unit (Btu) - The amount of heat required to raise the temperature of one pound of water one degree Fahrenheit; equal to 252 calories.

Cord (of Wood) - A stack of wood 4 feet by 4 feet by 8 feet.

Gigawatt (GW) - A unit of power equal to 1 billion watts, 1 million kilowatts, or 1,000 megawatts.

Gigawatt-hour (GWh) - One million kilowatt-hours or 1 billion watt-hours.

Hertz - A measure of the number of cycles or wavelengths of electrical energy per second; U.S. electricity supply has a standard frequency of 60 hertz.

Horsepower (hp) - A measure of time rate of mechanical energy output; usually applied to electric motors as the maximum output; 1 electrical hp is equal to 0.746 kilowatts or 2,545 Btu per hour.

Kilowatt (kW) - A standard unit of electrical power equal to one thousand watts, or to the energy consumption at a rate of 1000 Joules per second.

Kilowatt-hour (kWh) - A common measurement of electricity equivalent to one kilowatt of power generated or consumed over the period of one hour; equivalent to 3,412 Btu.

Megawatt (MW) - One thousand kilowatts or 1 million watts; standard measure of electric power plant generating capacity.

Megawatt-hour (MWh) - One thousand kilowatt-hours or 1 million watt-hours.

Mill - A common monetary measure equal to one-thousandth of a dollar or a tenth of a cent.

Quad - One quadrillion Btu.

Therm - A unit of heat containing 100,000 British thermal units (Btu).

Terawatt (TW) - A unit of electrical power equal to one trillion watts or one million megawatts.

Tonne - A unit of mass equal to 1,000 kilograms or 2,204.6 pounds, also known as a metric ton.

Volt (V) - A unit of electrical force equal to that amount of electromotive force that will cause a steady current of one ampere to flow through a resistance of one ohm.

Voltage - The amount of electromotive force, measured in volts, that exists between two points.

Watt (W) - Instantaneous measure of power, equivalent to one ampere under an electrical pressure of one volt. One watt equals 1/746 horsepower, or one joule per second. It is the product of Voltage and Current (amperage).

Watt-hour - A unit of electricity consumption of one Watt over the period of one hour.

Watts per Square Meter (W/m^2) - Unit used to measure wind power density, measured in Watts per square meter of blade swept area.

Data Sources

References

Common Map Layers
Communities: Alaska Department of Commerce, Community, and Economic Development. Community Database Online. www.commerce.alaska.gov/dca/commdb/CF_COMDB.htm

Lakes, Streams, and Glaciers: Alaska Department of Natural Resources. www.asgdc.alaska.gov

Grayscale Elevation Hillshade Image: Resource Data Inc. The elevation image was developed using a 300 meter digital elevation model from U.S. Geological Survey EROS Alaska Field Office. agdc.usgs.gov/data/usgs/erosafo/300m/dem/metadata/dem300m.html

Canada and Russia: Alaska Departmentof Natural Resources. www.asgdc.alaska.gov

Infrastructure
Coal, Gas Turbine, Hydro, and Diesel Sites*: Average generation from Alaska Energy Statistics, 1960-2008, University of Alaska Anchorage Institute of Social and Economic Research, 2011. www.iser.uaa.alaska.edu/Publications/AlaskaEnergyStatistics2011.pdf Average oil, gas, and hydroelectrical generation data augmented via personal communication with AEA staff, operating utilities, Alaska Energy Statistics 1960-2011, preliminary tables.

Pie chart from: Non Utility Data: U.S. Department of Energy, Energy Information Admisnistration, Form 923 Data File F923 www.eia.gov/electricity/data/eia923/

Existing Utility Hydroelectric sites: Alaska Energy Authority hydroelectric database. Spatial location and attribute data updated by HDR Alaska Inc. in 2006 , AEA in 2013 and 2015.

Wind Sites*: Average wind generation from the Statistical Report of the Power Cost Equalization Program, FY2011 and augmented by AEA. Includes projects currently under commissioning and expected to be in operation by the end of 2012. http://www.akenergyauthority.org/PDF%20files/FY11PCEreport.pdf

Electrical Interties: Interties aggregated from data provided by Alaska Electric Light & Power Company, Alaska Power & Telephone Company, Alaska Village Electric Cooperative, Chugach Electric Association, City of Sitka Electric Department, Copper Valley Electric Association, Four Dam Pool Association, Golden Valley Electric Association, Homer Electric Association, Naknek Electric Association, Nushagak Cooperative, and AEA.

Natural Gas Pipelines: ENSTAR Natural Gas Company.

Electric Service Areas: Chugach Electric Association.

Trans-Alaska Pipeline: Alaska Department of Natural Resources. www.asgdc.alaska.gov

Roads: Alaska Department of Natural Resources & Alaska Department of Transportation. www.asgdc.alaska.gov

Energy Efficiency
From www.akenergyefficiencymap.org, a project of Alaska Energy Authority. Map currently depicts only three projects funded through the American Recovery and Reinvestment Act, 2010 – 2012.

Estimated statewide energy use comes from the 2010 Energy Information Administration.

Biomass
USDA Forest Service Forest Inventory and Analysis, Remote Sensing Applications Center 2008 based on J.A. Blackard, et.al. Mapping U.S. forest biomass using nationwide forest inventory data and moderate resolution information. Remote Sensing of Environment 112:1658-1677 http://www.fia.fs.fed.us/

Shore-based Seafood Processors*: Alaska Department of Fish and Game. 2010 Commercial Operators Annual Report, data compiled by the Alaska Fisheries Information Network (AKFIN). www.akfin.org

Class I Landfills*: Alaska Department of Environmental Conservation.

Sawmills*: Alaska Wood Products Manufacturers Directory, September 2004. Juneau Economic Development Council Wood Products Development Service. Dataset augmented via personal communication with Dan Parrent, USFS. http://jedc.org/wood.shtml

Geothermal
Volcanic Vents Wells and Springs by Temperature and Potential Geothermal Resources: Geothermal Resources of Alaska, Motyka, R.J., Moorman, M.A., and Liss, S.A., 1983, Geothermal Resources of Alaska: Miscellaneous Publication MP 8, Alaska, Department of Natural Resources, Division of Geological & Geophysical Surveys, Fairbanks, Alaska – USA www.dggs.dnr.state.ak.us/pubs/pubs?reqtype=citation&ID=671

Wells and Springs by Temperature: Kolker, Amanda, Stelling, Pete, and Cummming, William. Geothermal Exploration at Akutan, Alaska: Favorable Indications for a High-EnthalpyHydrothermal Resource Near a Remote Market. Geothermal Resources Council (GRC) Annual Meeting, October 24-27, 2010. Sacramento, CA. www.geothermal-library.org/index.php?mode=pubs&action=view&record=1028703

Hydroelectric
Existing and Potential Hydroelectric sites: Alaska Energy Authority hydroelectric database. Spatial location and attribute data updated by HDR Alaska Inc. in 2006, AEA in 2013 and 2015.

Ocean & River Hydrokinetic
Tidal Electric Generation Potential: Brian Polagye, 2007. Tidal resource was quantified for 35 transects across tidal channels, perpendicular to the flow. The analysis used NOAA time series of currents and tidal range, as well as bathymetric data. Due to map scale each study site is depicted as a point location rather than a linear transect.

The Wave Energy Resource Assessment project is a joint venture between NREL, EPRI, and Virginia Tech. EPRI is the prime contractor, Virginia Tech is responsible for development of the models and estimating the wave resource, and NREL serves as an independent validator and also develops the final GIS-based display of the data. GIS data from National Renewable Energy Laboratory (NREL) 2011 http://en.openei.org/datasets/files/868/pub/wave_power_density.zip

In-Stream Hydrokinetic: Jacobson, Paul T., Ravens, Thomas, Cunningham, Keith. Assessment of U.S. In-Stream Hydrokinetic Energy Resources. Electric Power Research Institute Presentation. February 8, 2011. Power density estimates based on the cross-section average velocity at the open-water average flow rate at the given site. Open-water power density at the fast flowing portions of the river are several times greater than levels reported here.

Solar
Solar Insolation: U.S. Department of Energy, National Renewable Energy Laboratory, 1999. Data layer provides annual average daily total solar resource averaged over surface cells of approximately 40 km by 40 km in size. http://www.nrel.gov/gis/data.html

Wind
Wind Power: AWS Truepower, LLC Wind Resource Maps of Alaska using the MesoMap® system and historical weather data prepared for the Alaska Energy Authority, September, 2010. Although it is believed to represent an accurate overall picture of the wind energy resource, estimates at any location should be confirmed by measurement. All datasets were clipped to the coastline.

*For data sources with descriptive point locations, the spatial positions were derived by matching the descriptive location to the community location using the U.S. Geological Survey Geographic Names Information System.

For More Information

Alaska
Alaska Energy Authority
www.akenergyauthority.org
Renewable energy resource maps, reports, programs, planning, and financing information.

Alaska Energy Efficiency Partnership
http://akenergyefficiency.org
State-run clearinghouse for information on energy efficiency in Alaska.

Alaska Housing Finance Corporation
www.ahfc.state.ak.us
Residential and community building energy efficiency programs, energy resources library, programs, and financing information.

Denali Commission
www.denali.gov
Independent federal agency created by Congress to provide basic facilities to remote Alaskan communities.

Renewable Energy Alaska Project
www.realaska.org
A coalition of over 70 utilities, developers, Alaska Native corporations, conservation groups and other NGOs that educate the public and policy makers about renewable energy and energy efficiency.

University of Alaska Center for Energy and Power at the University of Alaska Fairbanks
www.uaf.edu/acep/
Applied energy research focused on lowering energy costs and developing economic opportunities

University of Alaska Fairbanks Cooperative Extension Service
www.uaf.edu/coop-ext/faculty/seifert/energy.html
Provides housing technology information to Alaskan home owners and builders.

Efficiency
American Council for an Energy Efficient Economy
www.aceee.org
A nonprofit that acts as a catalyst to advance energy efficiency policies, programs, technologies, investments and behaviors through in-depth technical and policy analysis

Nationwide and Regional
National Renewable Energy Laboratory
www.nrel.gov
USDOE's premier laboratory for renewable energy research and development.

US Department of Energy
www.energy.gov
USDOE home page provides information on federal programs relating to energy.

Rocky Mountain Institute
www.rmi.org
An independent, non-partisan nonprofit that drives the efficient and restorative use of resources by engaging businesses, communities, and institutions to cost-effectively shift to efficiency and renewables.

Policies Supporting: Renewable Energy
Database of State Incentives for Renewables & Efficiency
www.dsireusa.org
Information on tax incentives, rebate programs, portfolio standards, green power programs, and other state-level policies.

National Association of State Energy Officials
www.naseo.org
Represents governor-designated officials from each state.

RE100
www.there100.org/
RE100 is a collaborative, global initiative of influential businesses committed to 100% renewable electricity, working to massively increase corporate demand for renewable energy.

Biomass
National Biodiesel Board
www.biodiesel.org
National trade association representing the biodiesel industry.

Bioenergy Technologies Office
www.energy.gov/eere/bioenergy/bioenergy-technologies-office
USDOE's biomass energy program.

Pacific Regional Biomass Energy Partnership
www.pacificbiomass.org
Promotes bioenergy development in Alaska, Hawaii, Idaho, Montana, Oregon, and Washington.

Geothermal
Geothermal Resources Council
www.geothermal.org
International association for geothermal education including industry, researchers, and government.
Geothermal Technologies Program
www.energy.gov/eere/renewables/geothermal
USDOE's geothermal energy program.

Ocean
Electric Power Research Institute: Ocean Energy Program
www.epri.com/oceanenergy/
Tidal and wave energy webpage for independent, nonprofit energy research center.

Solar
Alaska Sun
www.uaf.edu/ces/energy/alaskasun
Alaskans supporting solar energy with link to Solar Design Manual for Alaska.

American Solar Energy Society
www.ases.org
A national association dedicated to advancing the use of solar energy.

Solar Energy Technologies Program
www1.eere.energy.gov/solar
USDOE's solar energy technology website.

Wind
WindExchange
www.energy.gov/eere/wind/windexchange
Leads the U.S. DOE's efforts to accelerate the deployment of wind power technologies through improved performance, lower costs, and reduced market barriers by working with national laboratories, industry, universities, and other federal agencies to conduct research and development activities.

National Wind Technology Center
www.nrel.gov/wind
USDOE's wind energy research and development facility.

American Wind Energy Association
www.awea.org
National trade association representing wind developers, manufactures, utilities, and others involved in the wind industry.

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Cost Block Information:
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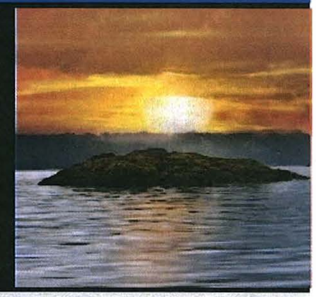
RENEWABLE ENERGY ATLAS OF ALASKA

A Guide to Alaska's Clean, Local, and Inexhaustible Energy Resources







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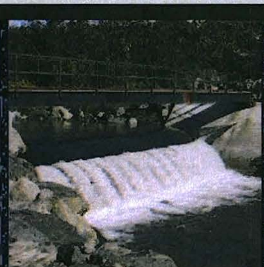



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AEA's mission: Reduce the cost of energy in Alaska.

ALASKA ENERGY AUTHORITY

akenergyauthority.org

RENEWABLE ENERGY FUND

STATUS REPORT AND
ROUND X RECOMMENDATIONS

January
2017

ALASKA ENERGY AUTHORITY

INTRODUCTION

This status report is provided to the legislature in compliance with the program's legislative reporting requirements. From 2008 to 2015, appropriations totaling $257 million have been issued for Renewable Energy Fund (REF) projects. This funding has been matched with hundreds of millions of dollars in funding from local sources to develop projects that reduce and stabilize the cost of energy in Alaska communities.

In the 2016 legislative session, there were no appropriations made to the REF. In recognition of the State's current fiscal challenges, Alaska Energy Authority (AEA), in consultation with the Renewable Energy Fund Advisory Committee (REFAC), made the decision not to release a solicitation for applications for Round X of the REF and instead to supply the legislature with the list of projects that were recommended for Round IX funding for consideration during the 2017 legislative session.

Alaska's Renewable Energy Fund provides benefits to Alaskans by assisting communities across the state to both reduce and stabilize the cost of energy. The program also creates jobs, uses local energy resources and keeps money in local economies.

Managed by AEA, the REF provides funding for the development of qualifying and competitively selected renewable energy projects in Alaska. The program is designed to produce cost-effective renewable energy for heat and power. As the program matures, the quality of proposed projects continues to grow as does the knowledge base for designing, constructing and operating renewable energy projects in Alaska's diverse climates and terrain.

Operational REF projects have an overall benefit cost ratio of 2.51 based on total known project cost, of which State funding is only a portion. Investing in renewable energy will provide price stability and will save Alaska communities millions of dollars for decades to come.

CONTENTS:

This 2017 status report has two parts and a separate appendix:

An appendix of individual project scopes and statuses for funded projects accompanies this report. It is available in searchable PDF form at www.akenergyauthority.org

Additional information is available on AEA's website www.akenergyauthority.org and includes:

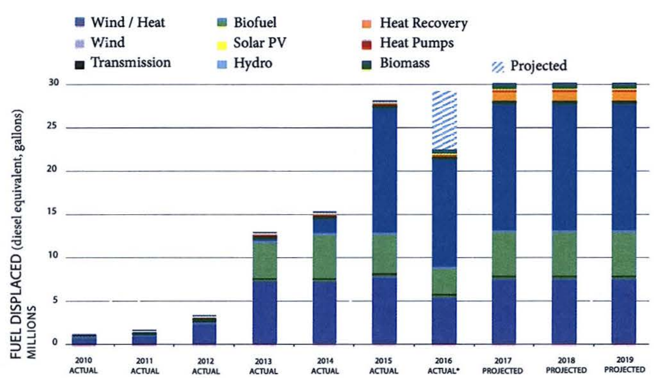
- Appendix of project statuses (Rounds I - VIII)
- Economic evaluations (Round I - IX)
- Application summaries (Round I - IX)

This report only includes performance of REF funded projects and thus is not a complete view of renewable energy production in Alaska.

Figure 1 shows continued strong growth in energy generation and fuel displacement.

Renewable Energy Fund projects saved Alaska communities an estimated 21.2 million gallons of diesel fuel (equivalent) in the first three quarters of 2016, a savings of nearly $44 million dollars.

The majority of projects that became operational in 2016 were heat projects which now comprise 44 percent of all operating.



DEFINITIONS

RECONNAISSANCE: A preliminary feasibility study designed to ascertain whether a feasibility study is warranted.

FEASIBILITY/CONCEPTUAL DESIGN: Detailed evaluation intended to assess technical, economic, financial, and operational viability and to narrow focus of final design and construction. This category also includes resource assessment and monitoring.

FINAL DESIGN AND PERMITTING: Project configuration and specifications that guide construction. Includes land use and resource permits and leases required for construction.

CONSTRUCTION: Completion of project construction, commissioning, and beginning of operations. This category also includes follow-up operations and maintenance reporting requirements.

DIESEL EQUIVALENT GALLON: Most REF communities are displacing diesel fuel (Diesel #2), however some projects displace natural gas, naphtha, propane or Diesel #1. In those instances the displaced fuel is converted to BTUs and then expressed as diesel equivalent gallons for reporting purposes.

B/C: The B/C, or benefit/cost ratio is the total net present value of savings over the life of a project divided by the net present value of a project's total cost. The assumed project life is 50 years for hydro and transmission, 30 years for solar PV and 20-25 years for all others. The B/C is one component of the overall project score; it is possible for a project to score high enough in other areas (e.g. being high cost of energy) to be recommended with a B/C of less than 1.

B/C ratios are calculated using best available data appropriate for the project's development phase. Early phase projects use assumptions based on prior similar experience, late phase projects use refined project models and are much more certain. AEA attempts to be as realistic as possible when using assumptions for early phase projects, while also attempting to avoid rejecting potentially good early-phase projects due to overly conservative assumptions.

TECHNICAL/ECONOMIC SCORE: This score is based on a project's technical and economic viability. The technical score considers resource availability, maturity of the proposed technology, the technical viability of the proposed project, and the qualifications and experience of the project team. The economic score is based on the projected costs and benefits associated with the project including consideration of the future price of fuel, current and future local demand for energy and the ability of the applicant to finance the project to completion.

ENERGY COST BURDEN: Household energy cost divided by household income.

ANSWERS TO COMMONLY ASKED QUESTIONS

WHAT IMPACT DO REF PROJECTS HAVE ON RATES?

It depends. Some electrical projects will lower rates immediately and some may only stabilize rates and keep them from increasing over time due to inflation and changing fuel costs. Heating projects result in immediate and direct fuel savings costs to the building owners.

DO POWER COST EQUALIZATION (PCE) COMMUNITIES BENEFIT FROM THE REF?

Yes, in a number of ways:

1. Statewide, in PCE communities, about 30 percent of total kWhs sold are eligible for the PCE subsidy. That means that any savings from REF projects are passed directly to the other 70 percent of kWhs sold. Schools and privately owned businesses benefit greatly from reduced cost of electricity.

2. REF projects provide stability in the face of uncertain and often volatile fuel prices.

3. 100 percent of the value created by heat projects stays in the community.

4. REF projects create local employment opportunities and local energy independence.

WHICH PROJECTS ARE THE BEST FIT FOR REF FUNDING?

- Technically strong
- Economically viable
- Located in high energy cost communities
- Provides public benefit
- Matching funds provided

HOW MUCH ARE REF PROJECTS REDUCING GREENHOUSE GAS (GHG) EMISSIONS?

2009-2016, an estimated 857,875 metric tons of CO_2.

RENEWABLE ENERGY FUND ADVISORY COMMITTEE

The Renewable Energy Fund Advisory Committee is comprised of nine members, five of whom are appointed by the governor to staggered three-year terms, with representation from each of the following groups:

- One member from a small Alaska rural electric utility, Brad Reeve
- One member from a large Alaska urban electric utility, Bradley Evans
- One member from an Alaska Native organization, Jodi Mitchell
- One member from businesses or organizations engaged in the renewable energy sector, Chris Rose
- One member from the Denali Commission, Kathleen Wasserman
- Four remaining members come from the legislature:
    - Two members of the House of Representatives, appointed by the Speaker of the House of Representatives, Rep. Bryce Edgmon and Rep. Jim Colver
    - Two members of the Senate, appointed by the President of the Senate, Sen. Lyman Hoffman and Sen. Anna MacKinnon

In establishing the program, the REFAC worked with AEA to define eligibility criteria for the Renewable Energy Fund grants, to develop methods for ranking projects, and to adopt regulations identifying criteria to evaluate the benefit and feasibility of projects seeking legislative support. The REFAC continues to consult with AEA, offering valuable guidance and policy direction regarding the application and evaluation process, and final funding recommendations.

Following is a summary of REFAC involvement with REF in Round X.

- AEA staff and REFAC members met in June 2016 to update members of operating projects and active grants and to discuss a path forward for Round X of the Renewable Energy Fund.
- In recognition of the State's current fiscal challenges and in an effort to not unduly burden potential applicants the REFAC supported the decision to not issue a request for new applications.
- Instead, the same list of ranked recommended projects that were provided to the legislature for FY16 funding consideration but did not receive funding, will be resubmitted for FY17 funding consideration.


Rep. Edgmon


Rep. Colver


Senator Hoffman


Senator MacKinnon


Brad Reeve


Bradley Evans

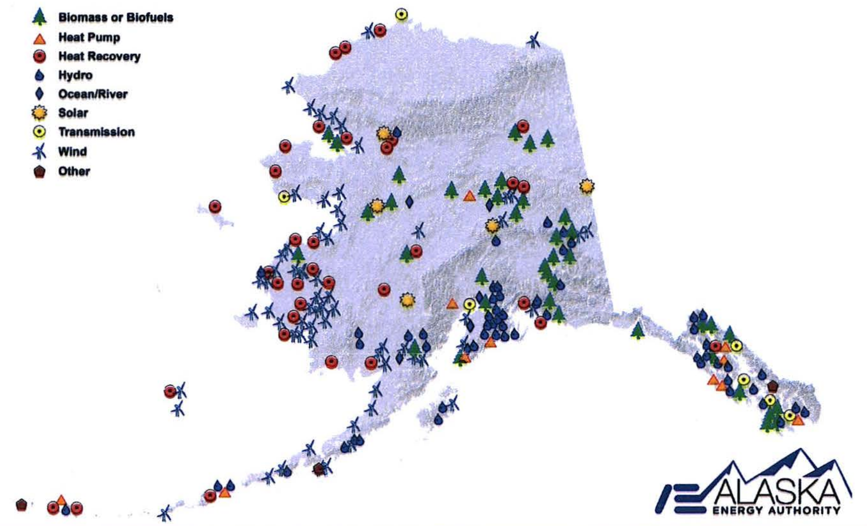

Jodi Mitchell


Chris Rose


Kathy Wasserman

Figure 2 below demonstrates the wide geographic distribution of REF projects across all areas of the state. Most funding is provided to high cost-of-energy communities.

RENEWABLE ENERGY FUND PROJECTS
ROUNDS I-VIII



FUNDED GRANTS BY ENERGY RESOURCE ($ millions)
ROUNDS I-VIII

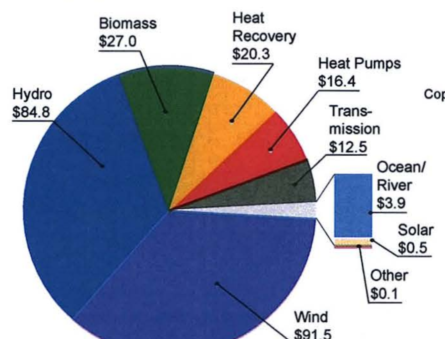


Figure 3 shows funding by energy resource, with wind and hydro grants making up just less than 70 percent of total funding.

FUNDED GRANTS BY ENERGY REGION ($ millions)
ROUNDS I-VIII

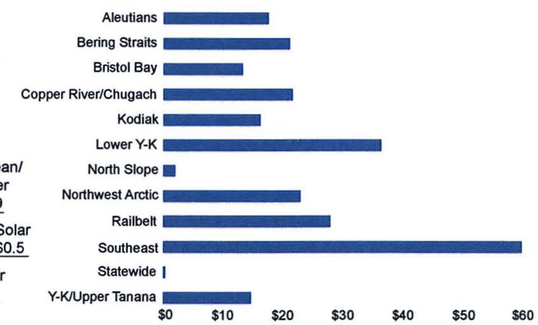


Figure 4 shows cumulative grant funding by AEA energy region totaling to $257 million in rounds I-VIII. The three highest recipients to date are Southeast with $60 million, Lower Yukon-Kuskokwim with $36.6 million, and Railbelt with $28.2 million.

PERFORMANCE & SAVINGS

- The present value of the capital expenditures used to build the 66 projects that were operational by the third quarter of 2016 is $562 million and the present value of benefits is $1,413 million. Based on the present value of capital cost and future estimated benefits, these projects have an overall benefit-cost ratio of 2.51.
- For every dollar invested, these projects have an estimated return of $2.51. It is important to note that the REF invested $158 million of total project costs in these 66 projects. The balance was invested from other sources.
- The technology with the largest number of generating projects continues to be wind, at 27 percent. This share has declined each year since 2013 when wind projects represented 40 percent of all REF projects.
- Biomass projects continue to come online and currently account for 20 percent of all active projects. Heat recovery projects make up an additional 20 percent of operational projects; these projects take heat from diesel powerhouse engines that would otherwise be wasted and put that heat to use in buildings and water systems, displacing thousands of gallons of costly heating fuel.
- The large majority of both capital cost and future benefit are from hydroelectric and wind projects. This is because of a handful of relatively large hydro and wind projects in more populated parts of the state including the Railbelt, Kodiak and Sitka.
- Three additional projects have come online in the fourth quarter of 2016 and will be included in the May 2017 update of this report.
- See pages 6 and 7 for information about where these $1.4 billion of benefits accrue.

REF CURRENTLY OPERATING PROJECTS - 2016 Q3

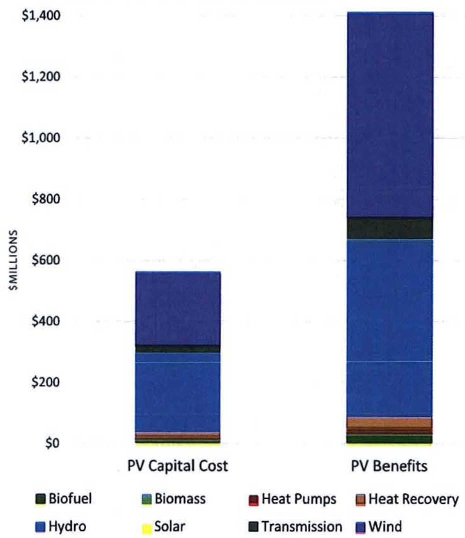


Figure 5 shows the present value (PV) of the 66 projects that are operational at end of Q3 2016.

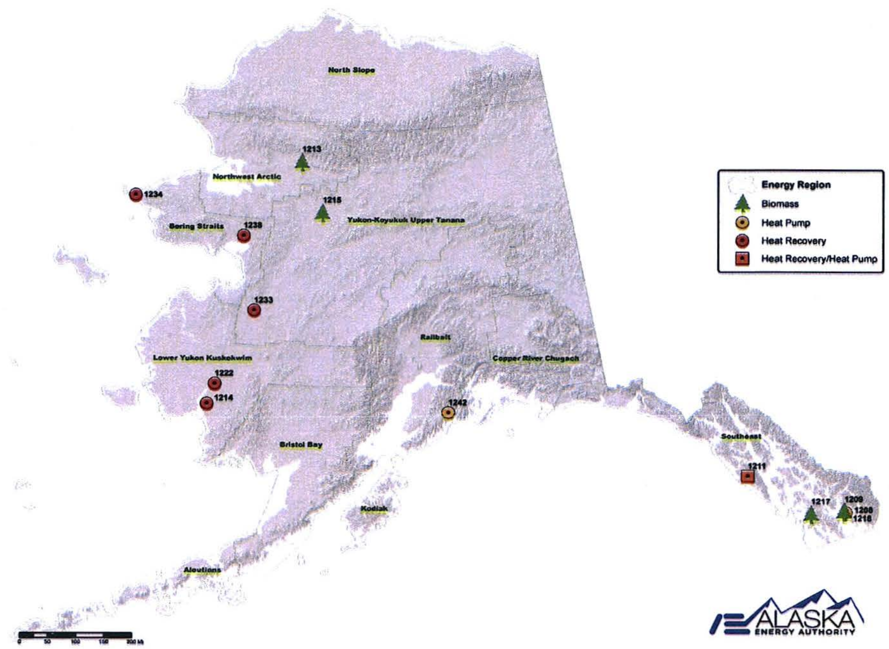
GRANT AND FUNDING SUMMARY

	Round I	Round II	Round III	Round IV	Round V	Round VI	Round VII	Round VIII	Round IX	Totals
Applications Received	115	118	123	108	97	85	86	67	52	851
Applications Funded	80	30	25	74	19	23	26	10	-	287
Grants Currently in Place	9	4	8	19	8	16	21	9	-	94
Amount Requested[1] ($M)	$453.8	$293.4	$223.5	$123.1	$132.9	$122.6	$ 93.0	$ 43.8	$ 50.0	$ 1,536.1
AEA Recommended ($M)	$100.0	$ 36.8	$ 65.8	$ 36.6	$ 43.2	$ 56.8	$ 59.1	$ 20.6	$36.1	$ 455.0
Appropriated ($M)	$100.0	$ 25.0	$ 25.0	$ 26.6[2]	$ 25.9	$ 25.0	$ 20.0[3]	$ 9.5[4]	-	$ 257.1
Match Budgeted ($M)[5]	$ 10.1	$ 7.0	$ 8.6	$ 58.4	$ 5.7	$ 32.8	$ 8.1	$ 0.2	-	$ 130.8

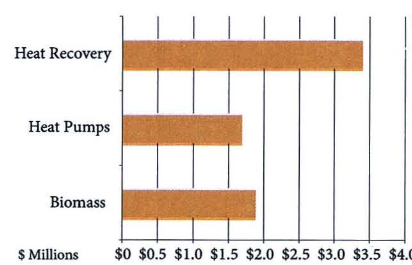
NOTES:

1. Total grant amount requested by all applicants.
2. $26.6 million was appropriated for round IV, and an additional $10 million was re-appropriated from previous rounds for use in round IV.
3. $20 million was appropriated for round VII, and an additional $2.8 million was re-appropriated from previous rounds for use in round VII.
4. $9.5 million was re-appropriated from the Mt. Spurr geothermal project (FSSLA 2011 CH5, P137) for round VIII, and an additional $2.0 million was re-appropriated from previous rounds for use in round VIII.
5. Represents only amounts recorded in active and completed grants, does not capture all funding needed to construct the project.

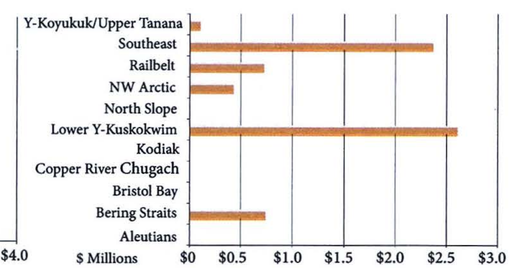
RENEWABLE ENERGY FUND
ROUND X | RECOMMENDED HEAT PROJECTS



HEAT PROJECTS
BY RESOURCE

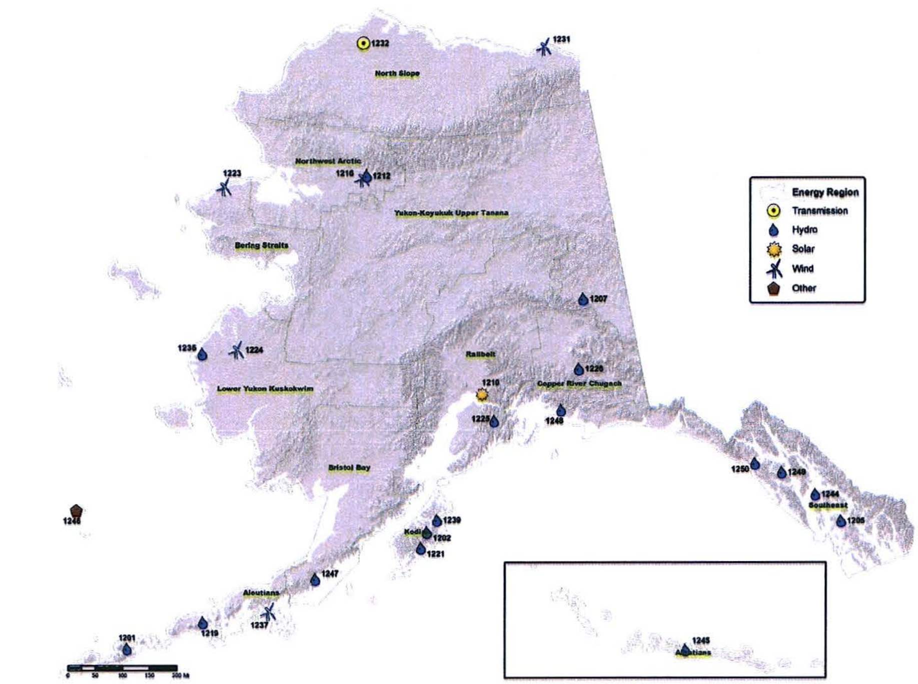


HEAT PROJECTS
BY REGION

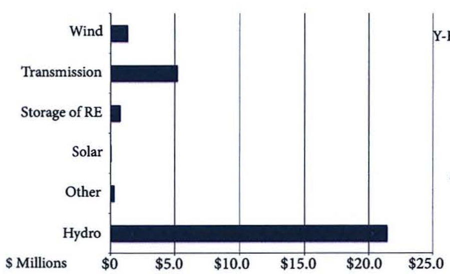


The two bar charts show Round IX recommended projects by energy resource and by region for heat projects. None of these projects received funding for FY16 and are being resubmitted for consideration for FY17 funding. The top three ranked heat projects are heat recovery projects, two in the Bering Straits and one in the Yukon-Koyukuk/Upper Tanana energy regions.

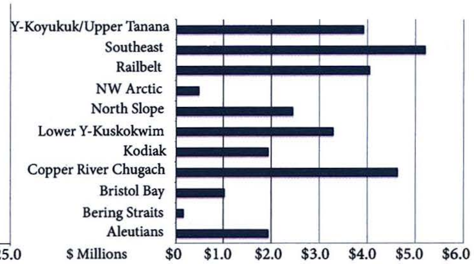
RENEWABLE ENERGY FUND
ROUND X | RECOMMENDED STANDARD PROJECTS



STANDARD PROJECTS
BY RESOURCE



STANDARD PROJECTS
BY REGION



The two bar charts show Round IX recommended funding by energy resource and by region for standard projects. None of these projects received funding for FY16 and all but one are being resubmitted for consideration for FY17 funding. Waterfall Creek, a hydroelectric project in King Cove, was recomended for Round IX funding but has since secured financing through AEA's Power Project Fund loan program and the Alaska Municipal Bond Bank Authority to construct the project.

RENEWABLE ENERGY FUND SUCCESS STORY

ALLISON CREEK HYDROELECTRIC PROJECT
The project has a capacity of 6.5 MW and will displace 15 gigawatt-hours of diesel-generated electricity annually

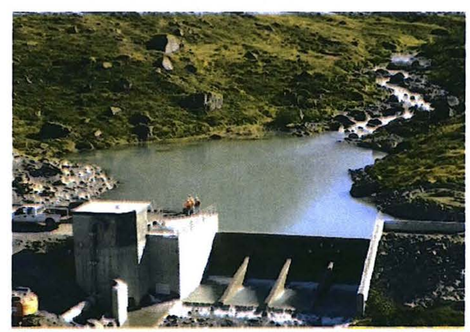
REF AWARDS | $10.3 million
DIRECT STATE APROPRIATION | $10 million
MATCHING FUNDS | $34.7 million
TOTAL PROJECT COST | $55 million
EXPECTED PROJECT LIFE | 50 years

Developing a hydro project in the Allison Creek drainage was a concept considered for many decades. In 2016, modern equipment, efficient contracting and construction and funding from the REF program. coupled with the dedication of Copper Valley Electric Association (CVEA), converged to make the Allison Creek Hydroelectric Project a reality.

The project serves more than 8,000 members of the CVEA cooperative in 15 communities in Southcentral Alaska. Like most rural areas, the high and variable cost of fuel is a burden. The Allison Creek project reduces dependence on fossil fuels and provides electric cost-stability and certainty in the region.

The Allison Creek project will provide an additional 15 GWh of hydro power on an annual basis. However, should demand in the area grow, the project has the potential to generate about 23 GWh annually. Total estimated fuel savings from the Allison Creek hydro is 725,000 gallons annually at present day demand.

The Allison Creek Project is a run of river (ROR) hydro project that is operated in conjunction with the existing Solomon Gulch storage hydro project to displace diesel generation to meet the demands of the service area.



The Allison Creek hydro project involved construction of a diversion structure at an elevation of 1,300 feet which diverts up to 80 cubic feet per second (cfs) of water from the creek into a 40 inch buried steel penstock to generate 6.5 megawatts of power via a single twin jet Pelton turbine.

Major features of the infrastructure include:

A 16 foot high diversion structure above a glacial moraine foundation spanning approximately 95 feet across Allison Creek.

A 7,900 foot long steel penstock ranging in size from 40 inch diameter at the intake to 36 inch diameter at the powerhouse.

A 700 foot long 16 foot diameter tunnel housing the 36 inch diameter penstock.

A 65 foot x 65 foot powerhouse with a floor slab to peak roof height of 48 feet, pitched to guide snow away from parking and the entrance to the building. The building also supports a large crane for handling the generation equipment.

A single twin jet 6.5 MW Canyon Pelton turbine and a tailrace located above the anadromous salmon reach of lower Allison Creek.

A 3.8 mile long 34.5 kV transmission line to the Copper Valley switching station near the Petro Star facility along Dayville Road.

PERFORMANCE OF RENEWABLE ENERGY FUND PROJECTS

PROJECTS IN OPERATION DURING THE PERIOD 2009- 2016

						2015			
						Energy Production		Fuel Displaced	
	Technology Type	Fuel Displaced	Grantee	Project Name	Start date	Electrical (MWh)	Thermal (MMBtu)	Diesel (Gal x 1000)	Value ($ x 1000)
	ELECTRICAL PROJECTS								
1	Hydro	Natural Gas	Chugach Electric Association, Inc.	Stetson Creek Diversion/Cooper Lake	08/15	2,994	-	401	142
2	Hydro	Diesel	Inside Passage Electric Co-op	Gartina Falls - Hoonah	07/15	568	-	38	144
3	Hydro	Diesel	Chignik Lagoon Power Utility	Packers Creek	03/15	562	-	52	235
4	Hydro	Diesel	City of Akutan	Akutan Hydro	12/14	11	-	1	5
5	Hydro	Diesel	City and Borough of Sitka	Blue Lake Expansion	11/14	59,272	-	4,559	14,594
6	Hydro	Diesel	City of Ketchikan	Whitman Lake	10/14	8,762	-	674	2,851
7	Hydro	Diesel	Kodiak Electric Assoc.	Terror Lake	01/14	118,044	-	8,432	34,233
8	Hydro	Diesel	Cordova Electric Co-op	Humpback Creek	07/11	3,074	-	236	768
9	Hydro	Diesel	Gustavus Electric	Falls Creek	07/09	2,149	-	165	613
10	Hydro	Diesel	City of Atka	Chuniixsax Creek	12/12	381	-	29	150
11	Landfill Gas	Nat Gas	Municipality of Anchorage	Anchorage Landfill Gas	08/12	50,032	-	4,783	1,079
12	Solar PV	Diesel	Alaska Power Company	Eagle Solar Array Project	01/16	-	-	-	-
13	Solar PV	Diesel	AK Village Electric Co-op	Kaltag Solar	10/12	8	-	1	2
14	Transmission	Diesel	AK Electric Light & Power	Snettisham - Juneau	01/14	936	-	72	112
15	Transmission	Diesel	Alaska Power & Telephon	North Prince of Wales Intertie	09/11	1,352	-	104	289
16	Transmission	Diesel	Nome Joint Utility System	Banner Wind Transmission	10/10	1,650	-	102	307
17	Wind	Diesel	Nome Joint Utility System	Banner Peak Wind Expansion	08/13	1,642	-	100	304
18	Wind	Diesel	Northwest Arctic Borough	Buckland, Deering, Noorvik Wind Farm	01/16	-	-	-	-
19	Wind	Naphtha	Golden Valley Electric Assoc.	Eva Creek	10/12	72,639	-	5,115	8,324
20	Wind	Diesel	Kotzebue Electric Association	Kotz Wind-Battery-Diesel	05/12	2,511	-	171	542
21	Wind	Diesel	AK Village Electric Co-op	Shaktoolik Wind	04/12	283	-	22	84
22	Wind	Diesel	AK Village Electric Co-op	Emmonak/Alakanuk Wind	09/11	327	-	23	84
23	Wind	Diesel	AK Village Electric Co-op	Quinhagak Wind Farm	11/10	403	-	31	115
24	Wind	Diesel	AK Village Electric Co-op	Mekoryuk Wind Farm	11/10	180	-	13	48
25	Wind	Naphtha	Alaska Environmental Power	Delta Area Wind Turbines	09/10	2,013	-	130	351
26	Wind	Diesel	Kodiak Electric Assoc.	Pillar Mountain Wind	09/10	29,107	-	2,050	5,417
27	Wind	Diesel	AK Village Electric Co-op	Toksook Wind Farm	08/09	168	-	12	46
	ELECTRICAL PROJECTS SUBTOTAL					359,069	-	27,317	70,838
	ELECTRICAL & HEAT PROJECTS								
28	Hydro	Diesel	City of Pelican	Pelican Hydro Upgrade	03/13	1,298	-	93	415
29	Biomass	Diesel	AK Gateway School District	Tok Wood Heating	10/10	306	6,136	59	124
30	Heat Recovery	Diesel	City of Unalaska	Unalaska Heat Recovery	09/14	470	-	36	114
31	Wind/Heat	Diesel	Tuntutuliak Comm Svs Assoc.	Tunt Wind-Diesel Smart Grid	01/13	215	128	17	64
32	Wind/Heat	Diesel	Kwigillingok Power Company	Kwig Wind-Diesel Smart Grid	02/12	464	238	38	126
33	Wind/Heat	Diesel	Aleutian Wind Energy	Sand Point Wind	08/11	974	360	72	326
34	Wind/Heat	Diesel	Puvurnaq Power Company	Kong Wind-Diesel Smart Grid	12/10	330	435	29	96
35	Wind/Heat	Diesel	Unalakleet Valley Electric Co	Unalakleet Wind Farm	12/09	972	228	72	273
	ELECTRICAL & HEAT PROJECTS SUBTOTAL					5,029	7,525	416	1,537
	HEAT PROJECTS								
36	Wind	Diesel	AK Village Electric Co-op	Chevak Surplus Wind to Heat Water	07/15	-	121	1	6
37	Wind	Diesel	AK Village Electric Co-op	Gambell Surplus Wind to Heat Water	07/15	474	174	2	6
38	Biomass	Diesel	Ketchikan Gateway Borough	Ketchikan Gateway Borough Biomass Heat	08/16	-	-	-	-
39	Biomass	Diesel	Venetie Village Council	Venetie District Heating	02/16	-	-	-	-
40	Biomass	Diesel	City of Kobuk	Upper Kobuk River Biomass	01/16	-	-	-	-
41	Biomass	Diesel	Lake and Peninsula Borough	Lake and Pen Wood Boilers	01/15	-	45	0	2
42	Biomass	Diesel	Interior Regional Housing	Wood Heating Interior Commmunities	01/15	-	272	3	10
43	Biomass	Diesel	Mentasta Traditional Council	Mentasta Community Facility Heat	10/14	-	542	5	22
44	Biomass	Diesel	City of Tanana	Tanana City-Tribe Biomass	01/14	-	1,360	11	57
45	Biomass	Diesel	Southeast Island School District	Thorne Bay School Biomass	01/13	-	2,121	19	64
46	Biomass	Diesel	Native Village of Eyak	Cordova Wood Processing	12/11	-	840	7	28
47	Biomass	Diesel	Chilkoot Indian Association	Haines Central Wood Heating	10/11	-	141	2	2
48	Biomass	Diesel	Delta/Greely School District	Delta Wood Chip Heating	09/11	-	3,339	32	105
49	Biomass	Diesel	Gulkana Village Council	Gulkana Central Wood Heating	10/10	-	198	2	6
50	Heat Pumps	Diesel	Cook Inlet Housing Authority	Seldovia House Ground Source Heat Pump	01/16	-	-	-	-
51	Heat Pumps	Diesel	City of Seward	Sealife Center Seawater Heat Pump	11/11	-	4,179	40	105
52	Heat Pumps	Diesel	City and Borough of Juneau	Airport Ground Source Heat Pump	05/11	-	6,400	46	153
53	Heat Pumps	Diesel	City and Borough of Juneau	Aquatic Cntr Ground Source Heat Pump	04/11	-	4,621	39	68
54	Heat Recovery	Diesel	Native Village of Quinhagak	Heat Recovery Water Plant & Washeteria	12/15	-	-	-	-
55	Heat Recovery	Diesel	City of Marshall	Heat Recovery - Marshall Water Plant & Store	09/15	-	-	-	-
56	Heat Recovery	Diesel	Atmautluak Traditional Council	Atmautluak Washeteria Heat Recovery	08/15	-	-	-	-
57	Heat Recovery	Diesel	City of Saint Paul Electric Utility	Saint Paul Fuel Economy Upgrade	02/15	-	5,680	51	265
58	Heat Recovery	Diesel	Sleetmute Traditional Council	Heat Recovery to Water Plant	11/14	-	176	2	9
59	Heat Recovery	Diesel	City of Savoonga	Savoonga Heat Recovery - Water Plant	10/14	-	-	-	-
60	Heat Recovery	Diesel	City of Ambler	Ambler Heat Recovery	10/13	-	494	5	26
61	Heat Recovery	Diesel	North Slope Borough	Point Lay Heat Recovery	08/13	-	1,555	15	71
62	Heat Recovery	Diesel	Inside Passage Electric Co-op	Hoonah Heat Recovery Project	08/12	-	4,099	39	148
63	Heat Recovery	Diesel	City and Borough of Wrangell	Wrangell Hydro Electric Boilers	02/11	-	7,588	78	25
64	Heat Recovery	Diesel	McGrath Light & Power	McGrath Heat Recovery	05/10	-	2,390	23	95
65	Heat Recovery	Naphtha	Golden Valley Electric Assoc.	North Pole Heat Recovery	11/09	-	2,040	23	93
66	Solar Thermal	Propane	Golden Valley Electric Assoc.	McKinley Village Solar Thermal	06/10	-	120	1	11
	HEAT PROJECTS SUBTOTAL					474	48,495	[illegible]	1,378
	GRAND TOTAL					364,572	56,020	28,178	73,753

				Project Cost				Recommendation
B/C Ratio	Household Energy Cost	Tech/ Econ Score	State-wide Rank	Project Cost Through Construction	Applicant Grant Requested	Applicant Match Offered	Requested Phase(s)	AEA Recomnd
0.74	$7,963	37.00	40	$15,400,000	$386,000	$100,000	Feas	DNP Stage 2
0.42	$5,594	31.17	41	$3,000,000	$400,000	$2,600,000	Recon	DNP Stage 2
1.07	$7,351	N/A	42	$386,000	$80,000	$10,000	Feas, Design	Not Recomnd
0.13	$8,145	N/A	43	$6,300,000	$440,319	$62,500	Feas	Not Recomnd
0.54	$9,956	N/A	44	$5,289,000	$5,282,000	$277,000	Constr	Not Recomnd
0.29	$6,260	N/A	45	$448,663	$140,000	$210,000	Recon, Feas, Design, Constr	Not Recomnd
0.43	$11,759	N/A	46	$800,000	$384,730	$64,448	Design, Constr	Not Recomnd
0.47	$7,750	N/A	47	$168,000,000	$320,000	$25,000	Design	Not Recomnd
0.37	$9,471	N/A	48	$86,400	$140,000	$210,000	Recon, Feas, Constr	Not Recomnd
1.15	$11,122	N/A	49	$392,959	$95,733	$61,996	Feas	Not Recomnd
0.44	$9,399	N/A	50	N/A	$75,000	$10,000	Feas	Not Recomnd
0.20	$16,003	N/A	51	$2,131,740	$1,490,077	$641,663	Design, Constr	Not Recomnd
N/A	$11,412	N/A	52	N/A	$255,000	$0	Feas, Design, Constr	DNP Stage 1
				$202,234,762	$9,488,859	$4,272,607		

Haida Energy began construction of the Hiilangaay hydroelectric project on Prince of Wales Island. The project will increase hydro capacity on the island by 5MW and received early investment from the Renewable Energy Fund as well as a loan through AEA's Power Project Fund loan program.

APPLICATIONS NOT RECOMMENDED FOR FUNDING

Not Recommended Projects					
Count	Energy Region	ID	Project Name	Applicant	Energy Source
40	Y-K/Upper Tanana	1204	Clearwater Creek Hydropower Project: Phase II	Alaska Power Company	Hydro
41	Railbelt	1229	Knik Arm Power Plant Biomass to Power	Central Environmental Inc.	Biofuel
42	Southeast	1203	Craig Water Treatment Plant Micro-Hydro	City of Craig	Hydro
43	Aleutians	1206	False Pass Hydrokinetic Feasibility Study	City of False Pass	Hydrokinetic
44	Southeast	1227	Hoonah Waste-to-Energy Project	City of Hoonah	Biofuel
45	Railbelt	1228	Point McKenzie Correction Farm Solar	SOA Dept. of Corrections	Solar
46	Northwest Arctic	1230	Kotzebue 100 Kilowatt Solar Array	Kotzebue Electric Association, Inc.	Solar
47	Southeast	1236	West Creek Hydroelectric Project	Municipality of Skagway Borough	Hydro
48	Y-K/Upper Tanana	1241	Minto PV Solar Project	Minto Development Corporation	Solar
49	Copper River/Chugach	1243	Maximizing Cordova Hydro with Controlled Systems	Cordova Electric Cooperative, Inc.	Heat Hydro
50	Y-K/Upper Tanana	1251	Circle 100 Kilowatt Solar Array	Circle Utilities, Inc.	Solar
51	Bristol Bay	1252	Igiugig RivGen© Power System	Igiugig Electric Company	Hydrokinetic
52	Southeast	1240	Solar Panels for Kake Community Buildings	City of Kake	Solar
	Totals Not Recommended Projects				

Some not recommended projects' B/C ratios may not be listed due to incomplete information

NOTES FOR TABLES PAGES 10-11

Individual project summaries are available on AEA's website www.akenergyauthority.org

B/C = AEA Benefit/Cost Ratio over the life of the project.

*Refer to page 15 for an explanation of the benefit-cost ratio and recommended projects with a B/C ratio of less than 1.0.

The rows that appear in bold font are those projects in underserved regions. Applications #1238, 1233 and 1223 were moved up the list during stage four regional distribution.

Impacted Population includes the population of a community(s) or utility service area(s) which a project is located in or may impact.

The Household Energy Cost is a measure of the annual heating and electricity costs for a typical household in a given community.

The technical and economic score is the total stage 2 score and is on a scale of 0 to 100. A minimum score of 40 is required to pass stage 2.

Match offered is applicant's offered cash and in-kind match, including supporting efficiency work and wood harvest value where applicable. If the awarded funding amount is reduced from the requested amount, the required match will also be reduced.

The Energy Region Yukon-Koyukuk/Upper Tanana was shortened to Y-K/Upper Tanana for printing purposes.

†The economic benefits of this project (1209) were ineligible for consideration in the REF evaluation because the project displaces renewable hydro generated energy.

#1207, Yerrick Creek Hydro, is in an under-served region but was not elevated because the funding request was $4 million and only $38,401 was available within the FY16 Governor's budget. Instead #1233, a smaller project from the same region was elevated for nearly full funding.

** Sand Point High Penetration Wind (1237) - As a prerequisite for consideration, if funding is appropriated the applicant shall provide documentation that the proposed engine meets all applicable regulatory requirements.

SP = Special Provisions

2016 - January through September only				Cumulative Total (2009 - 2016)			
Energy Production		Fuel Displaced		Energy Production		Fuel Displaced	
Electrical (MWh)	Thermal (MMBtu)	Diesel (Gal x 1000)	Value ($ x 1000)	Electrical (MWh)	Thermal (MMBtu)	Diesel (Gal x 1000)	Value ($ x 1000)
4,002	-	536	190	6,995	-	936	332
867	-	59	184	1,435	-	97	328
546	-	51	177	1,108	-	103	412
47	-	5	14	58	-	7	19
44,729	-	3,441	8,361	112,756	-	8,674	25,110
6,231	-	479	1,256	17,480	-	1,345	4,916
93,272	-	6,662	19,987	220,621	-	15,714	56,980
3,331	-	256	743	17,801	-	1,364	4,698
1,682	-	129	424	13,734	-	1,022	3,740
226	-	17	119	1,283	-	99	553
33,772	-	3,229	586	186,685	-	17,815	8,131
17	-	1	6	17	-	1	6
8	-	1	3	34	-	2	10
936	-	72	157	2,807	-	216	381
1,222	-	94	264	5,745	-	406	1,312
982	-	60	151	8,130	-	488	1,490
753	-	46	115	4,290	-	262	807
95	-	7	40	95	-	7	40
49,428	-	3,481	4,355	278,547	-	19,616	41,029
2,001	-	136	369	11,909	-	810	2,718
354	-	27	114	1,287	-	99	398
563	-	40	206	2,450	-	174	725
495	-	38	189	2,833	-	213	877
115	-	8	50	1,056	-	72	289
938	-	61	159	9,983	-	626	1,615
21,620	-	1,523	2,750	146,304	-	10,297	30,831
563	-	41	248	1,722	-	123	552
268,794	-	20,500	41,215	1,057,164	-	80,588	188,296
869	-	62	191	3,880	431	282	1,174
71	3,794	37	106	646	29,216	276	769
406	-	31	54	956	-	74	188
181	-	14	67	747	696	57	246
271	153	22	104	994	696	82	321
742	-	55	248	4,580	773	336	1,539
364	420	32	145	1,602	2,033	141	568
925	-	67	305	6,561	779	471	1,747
3,828	4,367	319	1,218	19,966	34,624	1,718	6,552
-	73	1	4	-	195	2	10
-	85	1	4	-	294	3	11
-	190	2	1	-	190	2	1
-	307	3	27	-	307	3	27
-	247	3	13	-	247	3	13
-	35	0	2	-	81	1	4
-	911	8	42	-	1,183	11	52
-	705	6	11	-	1,247	11	33
-	554	5	23	-	3,886	35	131
-	487	4	6	-	4,241	38	106
-	1,066	8	22	-	5,986	48	170
-	-	-	-	-	852	8	18
-	1,370	13	24	-	16,407	158	495
-	379	4	8	-	4,377	40	132
-	205	2	1	-	205	2	1
-	2,090	20	18	-	16,599	160	391
-	6,400	46	145	-	36,117	266	899
-	2,955	25	30	-	17,920	152	350
-	625	6	28	-	625	6	28
-	1,703	15	80	-	1,703	15	80
-	64	1	4	-	64	1	4
-	3,414	31	114	-	9,094	82	379
-	175	2	8	-	351	3	17
-	1,214	9	46	-	1,214	9	46
-	315	3	18	-	1,325	14	103
-	827	8	14	-	4,535	43	182
-	14,606	140	441	-	29,411	283	1,029
-	2,385	25	69	-	40,063	408	734
-	1,731	17	124	-	15,723	147	872
-	2,016	23	59	-	17,229	287	810
-	101	1	3	-	762	7	47
-	47,235	430	1,390	-	232,433	2,245	7,177
272,621	51,602	21,249	43,823	1,077,130	267,057	84,550	202,025

The power and heat generation presented is this table is the annual amount produced by projects that have received REF investment. In certain cases the interactions between REF-funded and previously existing or subsequently built projects are not separable. These cases are noted and total renewable generation is provided.

Project specific notes:

Row 1 - Stetson Creek Diversion: Values based on grantee reported performance for period and modeled value of diversion project.

Row 5 - Blue Lake Expansion: The production numbers shown are for the whole system.

Row 7 - Terror Lake Hydro: REF funded the installation of turbine three at Terror Lake. The production numbers shown are for the whole hydro system. Years prior to 2015 reported modeled estimates of turbine three contributions. The cumulative total is the sum of all years as reported.

Row 14 - Snettisham Transmission Line Avalanche Mitigation: actual production values are not available, the figures reported are based on initial economic valuation.

Rows 25 and 27 - Delta and Toksook performance values are only for REF funded turbines, not the whole wind farm. Delta performance is estimated, grantee is no longer required to report.

Row 29 - Tok Wood: 2016 values are lower b/c the system shut down to install new steam engine and replace turbine.

Row 31 - Tuntutuliak Wind: Electric values are reported through PCE reporting.

Row 32 - Kwigillingok Wind: Electric values are reported through PCE reporting. Heat values are based on prior years reported values.

Row 34 - Kong Wind: Heat values are based on prior years reported values.

Row 40 - Cordova Wood Processing: Estimates based on prior year production is presented.

Row 44 - Tanana Biomass: value reported based on prior years reported.

Row 45 - Juneau Airport Ground Source Heat Pump: the project does not have metering. The values reported are estimates based on grantee information.

Row 47 - Haines Wood Heating: the project did not operate in 2016 due to low diesel prices.

Row 58 - Sleetmute Heat Recovery: value reported based on prior year.

Row 59 - Savoonga Heat Recovery: value reported based on application.

Row 65 - North Pole Heat Recovery: value reported based on prior years. Grantee no longer required to report.

RENEWABLE ENERGY FUND SUCCESS STORY

KOBUK BIOMASS

REF AWARD | $356,424
MATCHING FUNDS | $45,449
TOTAL PROJECT COST | $401,873
EXPECTED LIFE | 20 YEARS

In 2013, the City of Kobuk received funding through the Renewable Energy Fund to incorporate a biomass boiler system in their water treatment plant.

The intent of the project was to increase the use of locally available biomass energy for thermal heating. The biomass boiler relies on locally harvested wood, creating new jobs and keeping dollars spent on energy in the community.

In addition to creating local harvest jobs, the biomass boiler also increased the number of work hours available for the water treatment plant operators who now regularly stoke the boiler.

The diesel displaced by this project is approximately 3,550 gallons per year. Over its useful life, the project is estimated to save over $500,000 resulting in a benefit-cost ratio of 1.25

Kobuk's log splitter improves the efficiency of processing their local fuel source

This project was bolstered by the purchase of a 34 ton log splitter, allowing local wood cutters to more easily process timber they have harvested.

The community is very pleased with the biomass boiler; its success has spurred the Northwest Arctic Borough to pursue biomass heating feasibility studies in other communities in the region.

Firewood is harvested and stored near the water treatment plant in Kobuk for up to one year to give the wood time to dry.

REF ROUND X RECOMMENDED PROJECTS WITH LOW B/C RATIOS

The benefit-cost (B/C) ratio is an estimate of a project's life cycle present value (benefits) divided by present costs. A ratio of 1.0 is generally considered the break-even point where the benefits equal the costs, however, this economic metric is only an estimate. Benefits counted in the REF economic evaluation mostly take the form of displaced diesel fuel but this value will fluctuate as it follows the global price of oil. The B/C ratios become more reliable as projects move to later phases of development because more comprehensive cost and benefit information is available and there is less time for circumstances to change before construction. By design in statute and regulations, the B/C ratio is only one portion of the overall project score.

The REF evaluation considers other measures such the local cost of energy, the statewide distribution of grant funds, the amount of matching funds provided, the project's technical feasibility, project readiness, other economic development impacts, and other criteria. This mix of weighted factors allows projects with B/C ratios of less than 1.0 to be recommended if other project merits are high. See Round IX Project Summaries for more information. Early phase projects such as reconnaissance or feasibility studies are designed to determine economic and technical feasibility based on the renewable energy resource available. If there is a reasonable chance of improving economics, projects with moderately low B/C ratios often can advance through the REF evaluation process. Projects receive no points in the scoring criteria if the B/C ratio is below 0.9, and only 1 out of 10 points for 0.9 to 1.0.

Below is more project-specific information about projects with B/C ratios of less than 1.0.

1223 Shishmaref wind: The applicant requested funding for the feasibility stage. The B/C ratio could potentially increase based on site specific meteorological data once it is available for analysis. The state-wide wind model often under-predicts the wind resource on the west coast of Alaska. Wind measurement at the specific targeted site through the requested feasibility study will increase the confidence of the project economics.

1233 Grayling water heat recover: The applicant requested design and construction funding. AEA recommends funding only the final design. AEA believes that cost saving measures can be identified during the final design phase that can significantly improve the project economics.

1249 Indian River hydro: The grant request is to augment existing funding to reduce the new debt applicant requires to complete the project. The project recently completed the first phase of construction and is expected to resume construction in the first half of 2016. The additional funding request would cover project costs that are above the original estimates. As the overall project cost has increased and the benefit has remained constant the B/C ratio has declined to slightly less than 1.0. If grant funded the applicant anticipates that the grant will reduce energy costs to residents by $0.13 per kWh.

1215 Huslia water and clinic biomass: The applicant requested design and construction funding. AEA recommends funding final design only with an emphasis on improving the project economics before committing to construction. If constructed, the project will save the community an estimated 8,474 gallons of fuel per year and would provide local wood fuel jobs. Many of the costs in the B/C ratio would remain in the local economy for wood harvest and biomass plant operator jobs.

1218 Saxman heat pump: The applicant requested funding for final design and construction of an air source heat pump to replace existing oil-fired boilers that are nearing the end of life. The project would replace 100 percent of their heating oil by efficiently using hydro-powered electricity through an air source heat pump to heat the low-income multi-family complex. The economics are challenged by the high renovation costs to allow for lower temperature emitters in the building.

1248 Crater lake hydro: The applicant requested funding for final design. The B/C ratio is based upon initial findings from a draft feasibility study that had not yet been finalized at the time of evaluation, nor accepted by the applicant or AEA. Once the final feasibility study is finalized, the B/C ratio may change up or down. AEA's issuance of the final design grant is contingent upon acceptance of the feasibility study that demonstrates a technically and economically feasible project.

1210 Chugach community solar: The project is recommended for partial funding as AEA believes the feasibility can be completed at half of the applicant's estimated total phase cost. The feasibility study will help determine the project economics, including possible use of federal incentives.

1239 Ouzinkie hydro: The applicant has recently reconstructed a failed dam which provides drinking water for the community. That project was funded through water project funding sources. The REF application seeks design and construction funding to rebuild the end-of-life penstock and hydro turbine to provide electricity. AEA's economic evaluations capture the full cost of each project. In this case the full cost of the dam is counted as a cost, and the full benefits of all hydro power displacing diesel generation is counted as the benefit. This method, while fair and consistent to all applicants, may be a conservative approach due to the dam construction having been completed with other funding. If only the turbine costs and the full hydro benefit are used in the model, the economics are very good. The AEA B/C ratio of 0.73 provides information about the net value of the overall project (drinking water and energy) over its lifetime.

1231 Kaktovik wind: The applicant requests funds for final design for wind project. The budget is high due to arctic conditions but the application scored well elsewhere in the evaluation and wind may be the community's only renewable energy option.

PARTIAL FUNDING ROUND IX/X RECOMMENDED PROJECTS

In the table on pages 10 and 11 there are a number of projects with a recommendation for partial funding. The table below provides the rationale behind each of these recommendations.

1245 Adak hydro: Application requested funding for feasibility, design and construction. AEA recommends partial funding to complete only the feasibility study.

1238 Koyuk water heat recovery: Application was for funding final design and construction. AEA recommends limiting funding to final design to evaluate the potential to improve project economics and better assess value.

1233 Grayling water heat recovery: Application was for funding final design and construction. AEA recommends funding only the design phase to allow for more refined construction cost estimates prior to making a determination about funding the construction phase. Additionally, the funds requested for design were higher than expected. AEA recommends partial funding for final design phase only.

1221 Old Harbor hydro: Applicant requested funding for final design, including extensive geotechnical work. AEA recommends fully funding the design and partially funding geotech work with the recommendation that ground penetrating radar and/or seismic surveys be done prior to investing in costly helicopter supported drilling.

1214 Eek water heat recover: Application was for final design and construction. AEA recommends funding only the design phase to allow for more refined construction cost estimates prior to making a determination about funding the construction phase. Additionally, funds requested for design are higher than expected. AEA recommends partial funding for final design phase only.

1235 Scammon Bay hydro: Application requested funding for stream gauging and preliminary design. AEA recommends the project for partial funding to complete stream gauging to better understand the hydroelectric resource potential of Hillside Creek.

1215 Huslia water and clinic biomass: Application was for funding final design and construction. Recommend partial funding of $53,116 to complete the design phase only and to better evaluate the potential for an economic project.

1201 Unlaska inline micro-turbines: Application was for funding feasibility, final design and construction. AEA recommends partially funding the feasibility and final design phases of this project to better understand operation of power recovery turbine and pressure reduction valve under varying flow conditions and events such as load rejection.

1217 Klawock school biomass: Application requested funding for final design and construction. While the economics of this project are good, the engineering will be challenging due to the site constraints. Recommend partial funding for the development of final design and a business/operating plan.

1210 Chugach community solar: The application for a 500 kW solar garden project is recommended for funding at 50% of the requested level. AEA estimates that the applicant should be able to complete the proposed feasibility study, conceptual design and cost estimate within this reduced budget.

1209 Ketchikan schools central heating: Application requested feasibility and design funding. AEA recommends partial funding of for a feasibility study phase only to better assess the potential economic benefit.

ROUND X RECOMMENDED APPLICATIONS

The recommendations for Round X are identical to last year's Round IX recommendations with the exception of Waterfall Creek in King Cove which has withdrawn their application. There was no new request for Round X applications due to lack of funding for projects that were evaluated and recommended for funding in the 2016 legislative session.

The 38 projects recommended for Round X funding collectively requested $40.3 million in grants and offered $27.7 million in matching funds. AEA recommends funding of $35.4 million for these 38 projects.

REVIEW PROCESS

The recommendation process involves three stages of review and scoring and a fourth stage where regional distribution is applied. The first three stages evaluate and score: eligibility, technical and economic feasibility, cost of energy, experience and qualifications, and ranking based on criteria established in statute and regulation.

The technical and economic evaluation is a thorough vetting process conducted by AEA technical reviewers, independent economists, and the Department of Natural Resources. Following the third stage of evaluation, AEA presents a ranked list of recommended projects, a list of not recommended projects, and a regional distribution recommendation to the REFAC to ensure that there is regional equity in the cumulative rounds I through IX funding.

ADVISORY COMMITTEE/REGIONAL DISTRIBUTION

Below is the approach to regional distribution.

Calculating a regional funding target: Use a regional population weighted "burden of energy cost" metric to establish regional funding bands. The burden of energy cost for a household is calculated based on regionally appropriate average annual residential heating fuel equivalent consumption, 6,000 kWh per year electric consumption and household income.

Burden of energy cost = (HH cost of electric + heat energy) / HH income

A regional population weighted burden of energy cost is calculated for each energy region in the state. The burden number is then used to calculate a target funding level for each region, such that regions with high energy cost burden are eligible to receive more funding cumulatively across all years of the REF.

Underserved: In order for a region to be classified as underserved they must have received less than 50 percent of the calculated target. Projects in underserved regions will be moved up on the list (if the project they are replacing is in an adequately or overserved region).

- Based on Round I-VIII funding both Yukon-Koyukuk/Upper Tanana and Bering Straits are considered underserved. In Round IX three projects were moved up for this reason.

Overserved: For a region to be considered overserved they must have received more than two times their calculated target. To achieve a better balance of funding across the state, regions that are determined to be overserved will be capped so their share of the overall fund cannot grow.

- Based on Round I-VIII funding both Southeast and the Railbelt are considered overserved; neither region had a project that ranked within the Governor's budget so this rule did not affect any region this round.

AEA'S RECOMMENDATIONS

The REFAC met in June 2016 and accepted AEA's recommendation to not solicit additional applications for Round X of the REF.

Instead, with the support of the committee, AEA presents the legislature with the following tables of recommended projects for funding consideration. The ranked list of recommended projects for Round X is identical to the Round IX list presented last year with the exception of Waterfall Creek Hydro which has secured funding and is nearly through construction.

Pages 10 and 11 identify all projects that are recommended for funding by AEA in ranked order. Standard electric projects are blue and heat projects are orange. Notes for both recommended and not recommended project tables appear after the not recommended list on page 14.

REF ROUND X RECOMMENDED PROJECTS RANK LIST

Blue cells indicate a standard electric generation application

Orange cells indicate a heat project application

Recommended Projects											Project Cost			Recommendation			
Count	Energy Region	ID	Project Name	Applicant	Energy Source	B/C Ratio	Impacted Pop.	Household Energy Cost	Tech/ Econ Score	State-wide Rank	Project Cost Through Construction	Applicant Grant Requested	Applicant Match Offered	Recommended Phase(s)	AEA Recomnd	Recommended Funding	Cumulative Funding
1	Copper River/Chugach	1226	Fivemile Creek Hydroelectric Project	Chitina Electric Inc. (CEI)	Hydro	1.71	116	$12,269	75.67	1	$6,589,090	$3,400,000	$2,600,000	Constr	Full	$3,400,000	$3,400,000
2	Aleutians	1237	Sand Point High Penetration Wind System	Sand Point Generating, TDX	Wind	2.19**	946	$10,793	83.33	2	$1,067,309	$649,030	$423,275	Design, Constr	Full	$649,030	$4,049,030
3	Bering Straits	1234	Wales Water System Heat Recovery	City of Wales	Heat Recovery	1.44	146	$17,269	72.50	3	$653,277	$650,047	$6,566	Design, Constr	Full	$650,047	$4,699,077
4	Aleutians	1245	Adak Hydro Power Generator	TDX Adak Generating, TDX	Hydro	1.75	247	$14,961	59.50	4	$1,750,000	$294,102	$126,044	Feas	Partial	$19,600	$4,718,677
5	Bering Straits	1238	Koyuk Water System Heat Recovery	City of Koyuk	Heat Recovery	1.06	321	$18,742	61.50	8	$695,269	$688,386	$6,884	Design	Partial	$90,922	$4,809,599
6	Bering Straits	1223	Shishmaref Wind Feasibility & Conceptual Design	Alaska Village Electric Coop	Wind	0.93*	607	$15,812	52.50	18	$2,529,400	$152,000	$8,000	Feas	Full SP	$152,000	$4,961,599
7	Y-K/Upper Tanana	1233	Grayling Water System Heat Recovery	City of Grayling	Heat Recovery	0.98*	191	$12,652	54.50	21	$431,982	$427,705	$4,277	Design	Partial	$38,401	$5,000,000
7	Y-K/Upper Tanana	1233	Grayling Water System Heat Recovery	City of Grayling	Heat Recovery	0.98*	191	$12,652	54.50	21	$431,982	$427,705	$4,277	Design	Partial	$11,599	$5,011,599
8	Railbelt	1242	Heat Pump System for City of Seward	City of Seward	Heat Pump	1.97	2,768	$9,005	83.17	5	$955,458	$725,000	$125,000	Design, Constr	Full	$725,000	$5,736,599
9	Southeast	1244	IPEC Gunnuk Creek Hydro Rehab in Kake	Inside Passage Electric Coop	Hydro	2.23	1,913	$10,561	73.00	6	$5,715,000	$3,920,000	$1,545,000	Constr	Full SP	$3,920,000	$9,656,599
10	Lower Yukon-Kuskokwim	1224	Mountain Village-St. Mary's Wind Intertie	Alaska Village Electric Coop	Trans, Wind	1.00	1,524	$12,362	66.00	7	$6,196,000	$3,196,000	$3,000,000	Design, Constr	Full SP	$3,196,000	$12,852,599
11	Southeast	1250	Elfin Cove Hydroelectric Permitting	Elfin Cove Utility Commission	Hydro	1.22	16	$12,008	67.33	9	$3,705,000	$88,000	$22,000	Design	Full	$88,000	$12,940,599
12	Northwest Arctic	1216	Shungnak Wind-Diesel Conceptual Design	Native Village of Shungnak	Wind	1.04	460	$17,752	50.00	10	$5,598,500	$135,000	$39,000	Feas	Full SP	$135,000	$13,075,599
13	Lower Yukon-Kuskokwim	1222	Bethel Power Plant Heat Recovery Module	Alaska Village Electric Coop	Heat Recovery	2.16	6,241	$10,766	71.67	11	$8,233,369	$2,555,489	$283,943	Constr	Full SP	$2,555,489	$15,631,088
14	Bristol Bay	1247	Chignik Hydroelectric Dam Project	City of Chignik	Hydro	1.86	96	$8,746	73.67	12	$7,783,428	$1,025,175	$60,251	Design	Full	$1,025,175	$16,656,263
15	Kodiak	1221	Old Harbor Hydro Geotech & Final Design	Alaska Village Electric Coop	Hydro	1.38	213	$12,095	68.50	13	$9,317,500	$1,092,500	$57,500	Design	Partial	$792,500	$17,448,763
16	Kodiak	1202	Upper Hidden Basin Geotech Investigation	Kodiak Electric Association	Hydro, Storage	4.24	8,465	$7,047	79.00	14	$79,247,000	$750,000	$750,000	Feas	Full	$750,000	$18,198,763
17	Southeast	1249	Indian River Hydroelectric Project - Construction	Tenakee Springs Electric	Hydro	0.94*	128	$11,498	56.33	15	$5,473,280	$809,000	$1,115,280	Constr	Full	$809,000	$19,007,763
18	Northwest Arctic	1212	Cosmos Hills Hydro Design & Permitting	NANA Regional Corporation	Hydro	1.08	734	$15,410	40.50	16	$50,797,871	$341,335	$37,200	Design	Full	$341,335	$19,349,098
19	Lower Yukon-Kuskokwim	1214	Eek Water System Heat Recovery	City of Eek	Heat Recovery	1.01	349	$12,572	59.50	17	$311,394	$308,311	$3,083	Design	Partial	$50,000	$19,399,098
20	Southeast	1211	Sitka Wastewater Plant Effluent Heat Pump	City and Borough of Sitka	Heat Pump	1.13	9,061	$6,991	72.50	19	$826,067	$667,000	$113,000	Design, Constr	Full	$667,000	$20,066,098
21	Y-K/Upper Tanana	1207	Yerrick Creek Hydro Construction	Upper Tanana Energy	Hydro	1.23	1,539	$7,963	57.17	20	$20,744,264	$4,000,000	$15,000,000	Constr	Full SP	$3,925,000	$23,991,098
22	Southeast	1205	Neck Lake Hydropower Project: Phases II-III	Alaska Power Company	Hydro	1.21	39	$9,630	63.17	22	$3,016,475	$395,200	$98,800	Feas, Design	Full	$395,200	$24,386,298
23	Lower Yukon-Kuskokwim	1235	Scammon Bay Hydroelectric Project	City of Scammon Bay	Hydro	1.25	528	$12,698	49.67	23	$4,283,056	$305,000	$3,050	Feas	Partial	$90,000	$24,476,298
24	Y-K/Upper Tanana	1215	Huslia Water & Clinic Biomass Boiler	City of Huslia	Biomass	0.72*	338	$13,795	44.67	24	$496,526	$491,610	$4,916	Design	Partial	$53,116	$24,529,414
25	Aleutians	1219	False Pass Hydro Feasibility & Conceptual Design	City of False Pass	Hydro	1.87	34	$8,145	73.67	25	$4,380,000	$187,000	$33,000	Feas	Full	$187,000	$24,716,414
26	Aleutians	1246	St. Paul Island 80% Renewable Energy Feasibility	TDX Power, Inc.	Other, Wind	1.66	436	$8,560	48.83	26	$5,731,500	$265,200	$66,300	Recon, Feas	Full	$265,200	$24,981,614
27	Northwest Arctic	1213	Ambler Washeteria and City Office Biomass Heating	City of Ambler	Biomass	1.06	274	$11,345	49.17	27	$484,691	$429,892	$54,799	Design, Constr	Full SP	$429,892	$25,411,506
28	North Slope	1232	Atqasuk Transmission Line Design and Permitting	North Slope Borough	Trans, Other	2.02	4,698	$3,417	78.00	28	$32,840,509	$2,017,818	$201,782	Design	Full	$2,017,818	$27,429,324
29	Southeast	1218	Saxman Low-Rent Multifamily Air Source Heat Pump	Tlingit-Haida RHA	Heat Pump	0.93*	8,314	$6,194	60.83	29	$438,341	$296,038	$213,193	Design, Constr	Full	$296,038	$27,725,362
30	Aleutians	1201	Unalaska Water Treatment Inline Micro Turbines	City of Unalaska	Hydro	1.24	4,689	$7,677	58.00	30	$1,340,000	$1,100,000	$240,000	Feas, Design	Partial	$144,000	$27,869,362
31	Southeast	1208	Ketchikan High School Biomass Boiler	Ketchikan Gateway Borough	Biomass	1.33	8,314	$6,194	82.67	31	$1,365,890	$1,251,000	$0	Constr	Full	$1,251,000	$29,120,362
32	Southeast	1217	Klawock School Biomass Fuel Boiler Project	Klawock City School District	Biomass	1.38	802	$7,488	59.67	32	$858,556	$833,556	$25,000	Design	Partial	$111,986	$29,232,348
33	Copper River/Chugach	1248	Crater Lake Power and Water Project	Cordova Electric Cooperative	Hydro, Storage	0.91*	2,286	$11,122	45.17	33	$17,306,696	$1,227,000	$420,680	Design	Full SP	$1,227,000	$30,459,348
34	Railbelt	1210	Chugach Electric Solar Project	Chugach Electric Association	Solar	0.36*	172,380	$3,751	59.67	34	$1,814,049	$100,000	$100,000	Feas	Partial	$50,000	$30,509,348
35	Railbelt	1225	Grant Lake Hydroelectric Project	Kenai Hydro LLC	Hydro	1.10	49,918	$6,643	56.67	35	$58,936,366	$4,000,000	$875,528	Design	Full	$4,000,000	$34,509,348
36	Kodiak	1239	Ouzinkie Hydroelectric Power Project	City of Ouzinkie	Hydro	0.73*	171	$7,460	40.67	36	$4,603,385	$397,427	$4,014	Design, Constr	Full SP	$397,427	$34,906,775
37	North Slope	1231	Kaktovik Wind Diesel Design	North Slope Borough	Wind	0.79*	251	$6,293	58.17	38	$7,606,795	$440,000	$44,000	Design	Full	$440,000	$35,346,775
38	Southeast	1209	Ketchikan Schools Recreation Heating Plant	Ketchikan Gateway Borough	Biomass	N/A†	8,314	$6,194	62.00	39	$2,600,000	$220,000	$0	Feas	Partial	$40,000	$35,386,775
	Sub Totals, All Recommended Projects										$367,155,275	$40,258,526	$27,715,642			$35,386,775	

See page 14 for table notes

Individual project summaries are available on AEA's website