EMERGING SECTOR SERIES:

Renewable Energy

GROWTH AND OBSTACLES IN THE RENEWABLE ENERGY SECTOR IN ALASKA

Presented To The Alaska Division Of Economic Development

CED
Center *for* Economic Development

UAA Business Enterprise Institute
University *of* Alaska Anchorage

Prepared By
The University Of Alaska
Center For Economic Development
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I. Executive Summary

Necessity often breeds innovation. High fuel costs, lack of electrical grid infrastructure, and a culture of adaptation create the perfect environment to help make Alaska a global leader in renewable energy. A part of the Emerging Sector Series, sponsored by the State of Alaska Division of Economic Development, this report attempts to characterize the state's renewable energy industry. Its purpose is to assess the health of this relatively young sector, discover areas of opportunity and competitive advantage, and offer recommendations to support further growth. For this report, analysts at the University of Alaska Center for Economic Development interviewed dozens of renewable energy businesses and other stakeholders, and reviewed secondary literature and publicly available data. Major findings include:

- **Over 100 Alaska businesses operate in the renewable energy realm.** These include firms that describe themselves as having a defined focus on energy efficiency.
- **National and international demand for renewables is high and growing.** Renewable energy consumption will more than double by 2050 in the US and around the world. The microgrid niche, in which many Alaska firms specialize, will grow to a $20 billion industry by 2020. Prices for solar and battery technology are rapidly declining as well.
- **Alaska firms focus on selling expertise.** A majority of the firms interviewed sell expertise rather than (or in addition to) products or installation services. In this knowledge-based industry, many specialize in optimizing energy systems for remote or extreme conditions.
- **Scalable business models are rare.** Most firms operate on a professional services business model, which generally has difficulty realizing cost efficiencies with growth. This may hinder the export of Alaska expertise.
- **Capital is the largest constraint identified by businesses participating in the interviews, followed by gaps in the workforce.** The state's current constrained fiscal situation has eliminated nearly all state funding for renewable energy projects, and energy businesses are looking for new methods of financing.

Most of the businesses interviewed have put thought into ways to move the renewable energy industry toward faster growth, especially related to financing. Energy stakeholders in both the nonprofit sector and government also shared perspectives on strategies to boost the sector. Based on this information, and additional research, this report suggests three areas of strategic focus to grow the renewable energy sector in Alaska as an economic driver:

- **New financing models based on debt and private sector leverage.** As grant funding disappears, new approaches to financing like an in-state green energy bank could fill the gap. Utilizing the new property assessed clean energy (PACE) legislation passed in 2017 also holds promise.
- **Renewable energy workforce.** A quality workforce is required for this skill-intensive industry. Existing initiatives by the Renewable Energy Alaska Project and the UAF Alaska Center for Energy and Power hold promise in building a renewable energy knowledge economy.
- **Entrepreneurship and innovation.** Alaska's entrepreneurship ecosystem is maturing, and includes an energy-focused business accelerator and increasing sources of startup capital. The knowledge embedded in the state's renewable energy firms could generate new products through design sprints or design thinking-inspired formats.

II. Introduction and Statement of Purpose

In Alaska, renewable energy and related technologies are usually promoted as a way to reduce the cost of electricity, reduce reliance on diesel fuel, and minimize environmental impacts. The notion of energy innovation as an economic driver for the state receives less attention. This study, part of the Emerging Sector Series, explores the potential of Alaska's renewable energy entrepreneurs to grow and scale their firms and become major drivers of the economy. The overall purpose of this series of reports is to generate forward-thinking economic and business development strategies that address the unique challenges of doing business in Alaska. This study was completed by the University of Alaska Center for Economic Development (UACED) under the sponsorship and direction of the State of Alaska Department of Commerce, Community, and Economic Development's Division of Economic Development (DED).

In studying renewable energy and renewable technology firms, this report aims to:

- Identify the firms and entrepreneurs operating in the renewable energy and efficiency technology realm.
- Assess the broader context for the sector in the national and global economy.
- Gain an understanding of Alaska's competitive strengths in the energy realm, from the perspective of those running the businesses whenever possible.
- Identify barriers to growth, and areas where different types of assistance could enable growth.
- Provide recommendations to policymakers, economic development practitioners, and entrepreneurs to facilitate growth in the industry.

UACED analyzed previous studies, surveys, and white papers from the National Renewable Energy Laboratory (NREL), the Alaska Center for Energy and Power (ACEP), the Cold-Climate Housing Research Center (CCHRC), Alaska Energy Authority (AEA), Renewable Energy Alaska Project (REAP), and others. From a review of these works, UACED prepared a brief questionnaire and asked for responses from more than 100 contacts in the public, private, and nonprofit sector that provide renewable energy services or products. UACED also performed one-on-one interviews with companies and subject matter experts to garner additional information. The questionnaire is located in Appendix A, and the aggregated results are described throughout the report.

ACEP President's Professor Mari Shirazi works in the Power Systems Integration Lab with Lab Manager David Light. Photo Credit: JR Ancheta/UAF

III. Why Renewable Energy in Alaska?

Stephen Trimble thinks Alaska's solar industry is at the same point it was in Colorado a decade ago. "At first it was just early adopters, but now you see panels on every third or fourth house there," he says. Seeing an opportunity to plant his flag in a high-growth industry, Trimble founded Arctic Solar Ventures in Anchorage in 2015. Since then, Trimble says the company has seen three consecutive years of 300 percent revenue growth--a strong testament to growing demand for solar power in the state.

Arctic Solar Ventures designs and installs solar arrays for grid-connected homes and businesses, primarily on Alaska's road system. The company also sells some panels and equipment wholesale, including to rural parts of the state. Trimble says customers are generally motivated to adopt solar to reduce power costs, take advantage of federal tax incentives, or to reduce their carbon footprint. In Southcentral Alaska, solar panels have an eight-to-ten-year payback period (the time it takes for energy savings to equal the cost of installation). As panel prices continue to decline, this period should shorten.

As quickly as his company has grown, Trimble still thinks Alaska is early in its embrace of solar power. Just as other states have seen solar move from an early adopters' pursuit to something more mainstream, so will Alaska. In 2018, Arctic Solar Ventures will install utility-scale solar arrays in Anchorage and Fairbanks, which will be the state's largest installations.

> Renewable energy is energy that is collected from resources which are naturally replenished on a human timescale, such as sunlight, wind, rain, tides, waves, biomass and geothermal heat.

Trimble is not alone in being bullish on renewable energy. Numerous studies and articles have celebrated the potential for renewable energy for Alaska. Pages upon pages have detailed the opportunity to deploy renewable energy solutions to improve efficiency, resiliency, sustainability, and long-term cost savings on energy.[1] Others have promoted the export of Alaska grown technology, products, and expertise.[2] But does Alaska have competitive advantages in the development of renewable energy-related technology? If so, can these advantages be monetized and exported to produce wealth for Alaskans?

Arctic Solar Ventures installers work during a residential solar project in Palmer, AK. Photo Credit: Stephen Trimble, Arctic Solar Ventures

To answer these questions, it is helpful to look at the past. The first renewable energy implementation in Alaska took place in the late 19th Century in Southeast Alaska when hydroelectric dams were installed to provide power to residents as well as mines. More recently, rural Alaskans found that wind turbines could produce power at a cheaper rate than diesel generators. With the help of public funds from the Alaska Energy Authority's Renewable Energy Fund (REF), wind, hydroelectric, biomass, solar, and other technologies have been deployed statewide.

Paradoxically, Alaska's high energy costs may constitute a competitive advantage for the state. A major driving force behind the adoption of renewable systems is the potential to displace costly diesel generation. In rural communities, electricity may cost upwards of $1.00 per kilowatt hour (kWh), against a statewide average of $.22/kWh and a national average of $.13/kWh.[3] Alaska has the highest per capita energy expenditures of any state. This means that renewable technologies that are uneconomical in the Lower 48 states, where electricity from conventional sources is more affordable, can make financial sense in Alaska.

Added to this is the state's famously vast and varied landscape. Just as the state is rich in minerals, hydrocarbons, timber, and seafood, it also has wind, geothermal, hydro, and even solar resources. High costs and abundant renewable resources have made Alaska a proving ground for renewable technologies. Flywheels, microgrid technologies, geothermal, and other technologies have been successfully tested and pioneered in Alaska.

The world outside of Alaska is also embracing renewable energy, which opens the door to exporting Alaska expertise and new technologies. In the US, the Energy Information Agency (EIA) expects renewable generation capacity is expected grow by 2.4 percent annually for the next three decades, doubling by 2050 (see below) to about 30 percent of all power capacity.[4] Global use of renewables is expected to follow a similar pace. EIA projects power generation by coal, nuclear, and liquid fuels (chiefly diesel) to decline, with natural gas and renewable energy making up the difference.[5] Other estimates are even more aggressive.

> A microgrid is a small network of electricity users with one or more supply sources. Microgrids may be "islanded" or disconnected from any larger grid, or connected to a centralized national grid but able to function independently.

Microgrids are another growth avenue that plays to Alaska's strengths. These are small-scale grids for distributing electricity, which may or may not be connected to a larger network of power grids. Globally, microgrids constitute a rapidly growing industry. Navigant Research, a market research consultancy, expects microgrid products and services to become a $20 billion industry by 2020.[6]

Roughly 200 islanded (unconnected) microgrids operate in Alaska, estimated to be 12 percent of the world's microgrids.[7] Integrating renewable sources into islanded microgrids is a technically difficult endeavor, since most renewable sources are sensitive to variable, inconsistent production. This puts Alaska's energy entrepreneurs in a pioneering role, as many of the firms highlighted in this study specialize in this type of integration. Use of renewables in microgrids is also a research specialty of ACEP at the University of Alaska Fairbanks.

IV. Alaska's Renewable Energy Assets

Alaska's status as an early mover in renewable energy stems from unique challenges, as well as supportive institutions, natural assets, and human capital.

Natural Assets

Alaska's vast size and diverse landscapes often inhibit economic development by raising the cost of doing business. Much of the state lacks road connections, or electrical interties, which would be expensive to build over such distances. Crisscrossed by mountain ranges, rivers, wetlands, and islands, Alaska's landscape is diverse and often impenetrable for commercial exchange.

This diversity also translates into an abundance of renewable resources. AEA publishes the annual Alaska Renewable Energy Atlas to document the renewable energy potential for all parts of the state through a series of maps. The Atlas testifies to plentiful biomass, geothermal, hydroelectric, ocean and river hydrokinetic, solar, and wind resources in the state.

Wind

Wind energy has been a major target of public investment in Alaska renewables, making up the largest share of grants under the Renewable Energy Fund.[8] As the map below shows, wind energy is especially strong along the Bering Sea and Arctic coasts, as well as the Aleutian Islands. About 30 wind installations are located in Alaska, and all but three are in rural communities outside the Railbelt, the region extending from the Kenai Peninsula to Fairbanks. Kotzebue boasts of being the first Arctic community in the world to install wind turbines[9] and Kodiak's wind system, in conjunction with a hydroelectric dam, allows the local utility to shut off its diesel generators.[10]

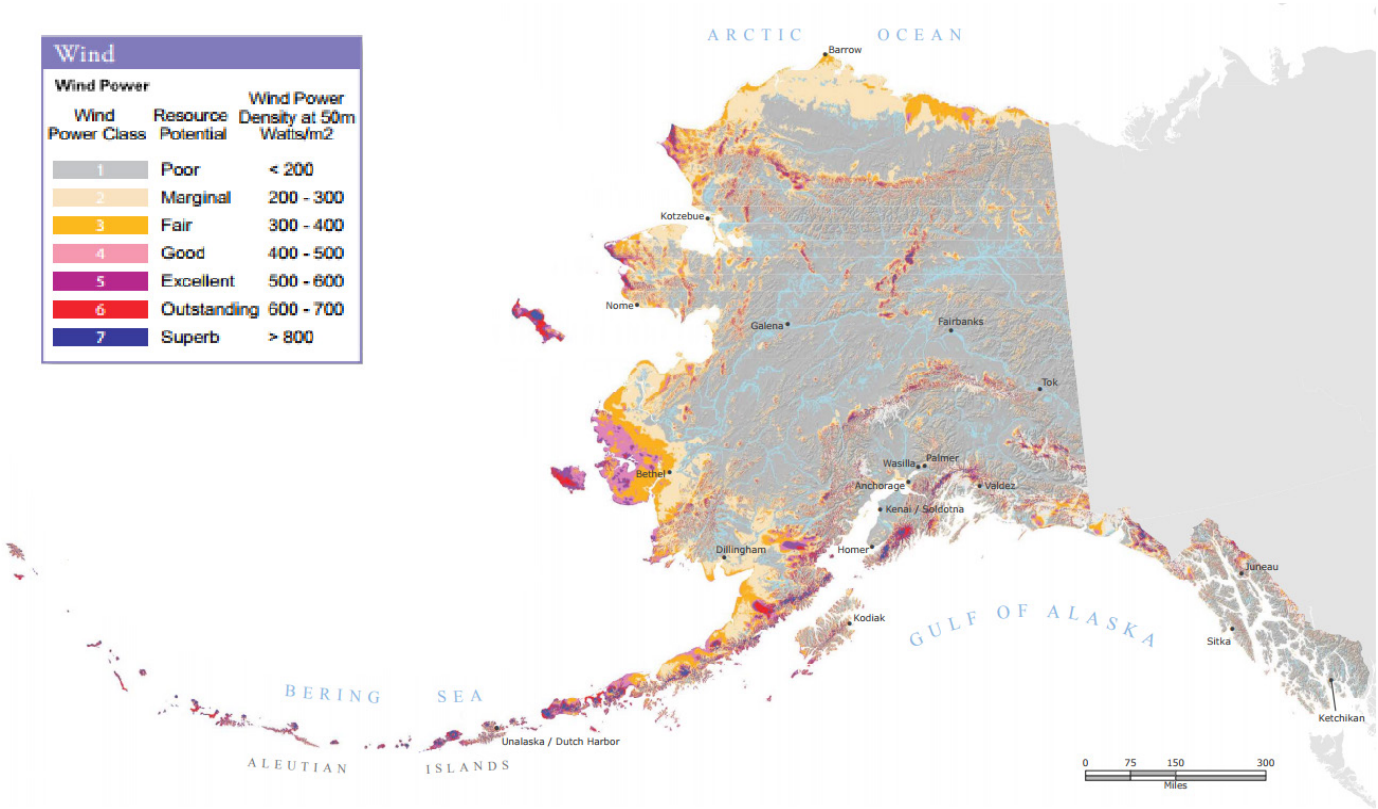


Figure 1: Wind class map of Alaska. Source: Alaska Renewable Energy Atlas 2016.

Solar

Although known for long, dark winters Alaska's solar resource shows promise. Several Alaska companies specialize in solar installations for residential and commercial buildings. The US Department of Energy found in a 2016 report that the state has some surprising advantages in solar energy, despite the northern latitude. These include long daylight hours in the summer and "low ambient temperatures that improve the efficiency of solar modules and the reflectivity of sunlight off of snow cover on the ground." The same report also observed that for many communities, solar power may be less expensive than diesel fuel due to the declining cost of photovoltaic cells used to generate electricity.[11]

Although solar power is somewhat less common in Alaska than in several other states, interest appears to be increasing quickly. Utility-scale solar arrays are currently being planned for Anchorage, Fairbanks, and the Kenai Peninsula. Companies like Arctic Solar Ventures report fast-growing revenue (300 percent for three consecutive years) in residential solar installations, which are becoming increasingly visible throughout the state. Rural communities have also begun to utilize solar, such as Eagle, in Interior Alaska.[12]

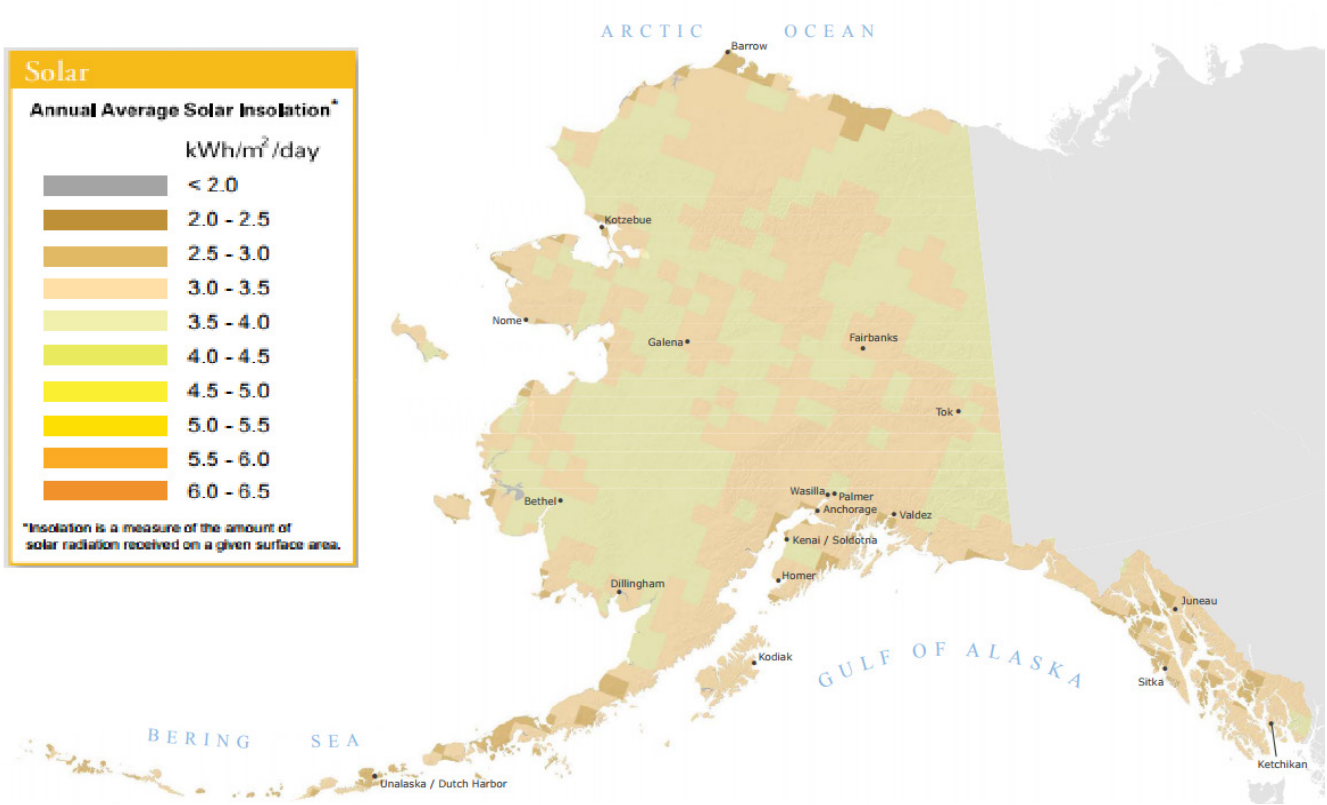


Figure 2: Solar potential for Alaska. Source: Renewable Energy Atlas, 2016.

Hydroelectric and Hydrokinetic (ocean and river)

Alaska produces about a third of its power from hydroelectric dams in the Southeast, Southcentral, and Southwest parts of the state.[13] Dams are a long-established method for generating power from a water source. Hydrokinetic systems on the other hand produce power from moving water such as a river, ocean tides or waves, without requiring a dam. Alaska's coastline is about the same length as the entire Lower 48 coastline combined, with some of the world's largest tidal movements. This gives rise to a potentially enormous energy source.[14] The Ocean Renewable Power Company is one example of a company working to commercialize both river and tidal hydrokinetic power in Alaska. The company installed one of its power systems in the Kvichak River in 2015, which provides about a third of the power needs for the remote village of Iguigig.[15]

Biomass

Biomass refers to biologically-based sources of fuel like wood, methane from landfills, and even fish oil. Some communities and organizations in the Interior and Southeast regions have installed biomass boilers to burn wood pellets. These are most frequently used to heat larger systems such as schools and public buildings, but the Tok School also uses one to produce electricity. Some businesses like Superior Pellets in Fairbanks earn revenue by manufacturing pellets from woody biomass.[16] Others, such as Sealaska Corporation in Juneau, import the wood pellets via barge from out of state.

Geothermal

The volcanically-active Aleutian Islands, along with sections of Southeast, the Interior, and the Seward Peninsula show high geothermal potential. Chena Hot Springs near Fairbanks has been a success story for geothermal power in Alaska, using the natural springs to power a resort on site. Other parts of the state have been assessed for geothermal power, like Mount Spurr near Anchorage and Mount Makushin near Unalaska. Hot springs in the state tend to have a lower temperature than those used for power in other parts of the world like Iceland, but Chena Hot Springs has proven successful in spite of this barrier.[17]

Institutional Assets

A number of public and nonprofit entities support renewable energy systems or efficiency upgrades through research and development (R&D), financing, business and entrepreneur support, or advocacy and information. The list on the following page, although not exhaustive, shows wide participation in renewable energy by a number of organizations and programs. The decline in oil prices in 2015 has led to dramatically smaller budgets for state entities like AEA. Launch Alaska, an energy-focused startup accelerator founded in 2015, is the first entity in Alaska with a dedicated focus on entrepreneurship in energy, receiving federal and private sector support.

ACEP's Amanda Byrd uses a drone to capture footage of local Kongiganak wind technicians repair a turbine
Photo Credit: ACEP

Organization	Role in Renewable Energy Sector
Research and Development	
Alaska Center for Energy and Power (ACEP) at University of Alaska Fairbanks	Operates Power Systems Integration Laboratory to test and evaluate microgrid technologies with an emphasis on renewables and energy storage. Hosts the Arctic Remote Energy Networks Academy.
Cold Climate Housing Research Center	Develops energy efficient housing and building designs for cold climate regions. Tests and adapts technologies related to energy use and efficiency for buildings.
Financing and Technical Assistance	
Alaska Industrial Development and Export Authority (AIDEA)	Invests in enterprise infrastructure (which may include energy projects) to leverage private investment.
Alaska Energy Authority (AEA)	Provides funding for energy projects, including loan programs and Renewable Energy Fund (not currently active) and Emerging Energy Technology Fund assists communities in operating and maintaining power systems. Owns and operates some utility assets.
Alaska Housing Finance Corporation (AHFC)	Runs energy efficiency programs for residential and commercial buildings, including loan programs for efficiency and retrofitting.
State of Alaska Division of Economic Development	Hosts a variety of loan funds, including some that can be used for energy projects.
Denali Commission	Federal funds for rural infrastructure projects, including renewable energy systems in rural Alaska.
USDA Rural Development	Offers grant and loan guarantee programs that may be used for energy projects.
US Economic Development Administration	Funds economic development planning and public works projects
Business and Entrepreneurship Assistance	
Launch Alaska	A startup accelerator with an energy focus. Provides companies with mentorship, training, and seed capital.
UAA Business Enterprise Institute	Hosts economic and business development programs, including the Alaska Small Business Development Center, Center for Economic Development, Cooperative Development Center, and others that assist energy businesses and entrepreneurs.
Advocacy and Information	
Renewable Energy Alaska Project (REAP)	Promotes renewable energy and energy efficiency programs and educates the public on their benefits. Also leading a renewable jobs workforce effort.
Workforce Training	
Alaska Vocational Technical Center (AVTEC)	Offers energy-related vocational training such as power plant operation. Students can receive wind turbine operation training.

Renewable Energy Projects in Alaska

The largest public investments in renewable energy in Alaska occurred between 2008 and 2015, when the Renewable Energy Fund (REF) spent a total of $259 million in state appropriations on renewable energy and efficiency projects. The REF leveraged a further $131 million from the federal Denali Commission and other sources.[18] AEA credits the program with saving as much as $74 million in diesel costs statewide.[19] Just as importantly, however, the REF and other funders of renewable energy projects provided the state with an opportunity to test and refine emerging technologies. Although it still exists in legislation, the REF at present has no funding allocated and is effectively dormant.

REF-funded projects provide insight into Alaska's potential to utilize renewable energy from a multitude of natural sources in all parts of the state. Wind and hydroelectric accounted for the largest share, but a number of other project types received significant funding as well.

REF projects by type include:

Project Type	Percentage of Fund
Wind	35%
Hydro	33%
Biomass	10.5%
Heat Recovery	7.9%
Heat Pumps	5.4%
Transmission	4.9%
Ocean/River	1.5%
Solar/Other	.02%

Figure 3: Renewable Energy Fund projects by type

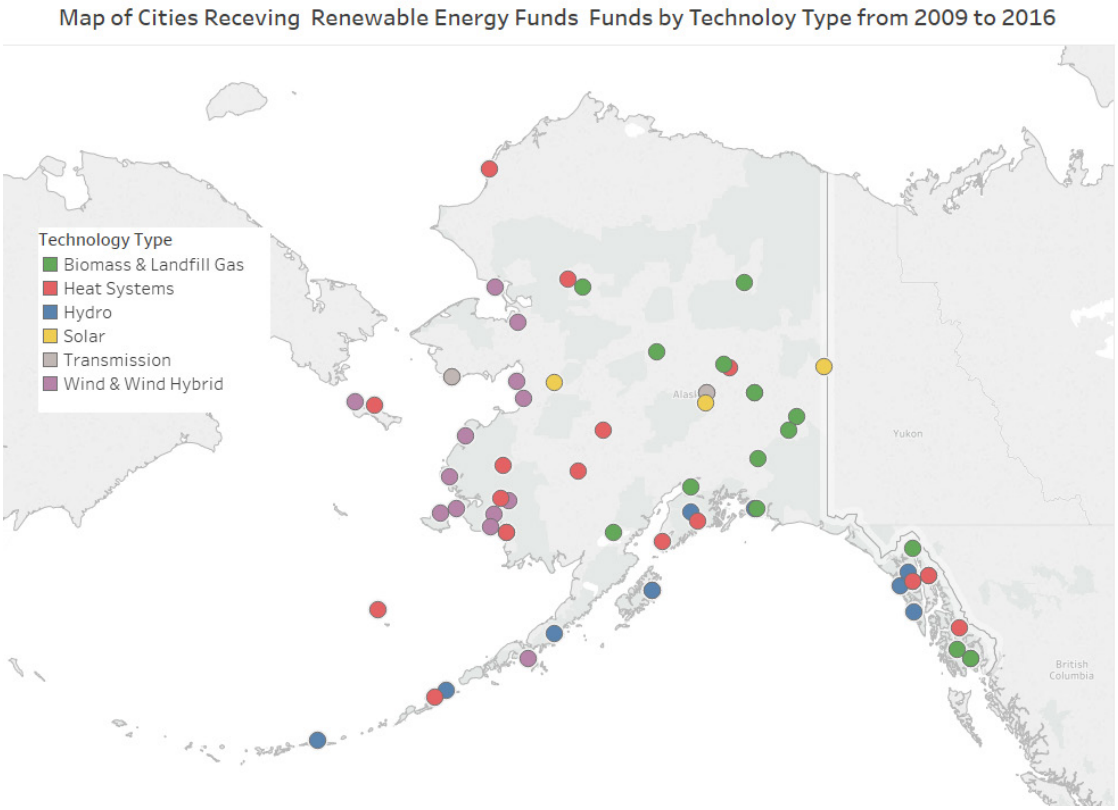


Figure 4: Selected projects funded by the Renewable Energy Fund between 2009 and 2016. Source: AEA.

IV. National and Global industry Trends

Nationally-renowned energy economist Tony Seba believes mankind is on the cusp of a massive disruption in the way we produce and use energy. "Just as the Internet and cell phone turned the architecture of information upside-down, the clean disruption will create an energy architecture that is different from the one we know today."[20] Seba believes the rapidly declining costs of solar power and energy storage, combined with the advent of electric vehicles and distributed power will fundamentally reshape whole industries. In his vision, electric vehicles will swiftly replace internal combustion engines in automobiles. Aided by microgrids, electrical generation will be participatory, with individual homes and businesses producing power for their own use and selling surplus power to other consumers. Dramatic improvements in the function and economics of battery technology will underpin these changes, bridging the gap between power production and use.

Seba's predictions are bolder than those of other energy analysts--he believes this "clean disruption" will be largely complete by 2030. Still, data points to trend of rapid adoption of electric vehicles and falling costs for solar power and battery storage. Bloomberg New Energy Finance expects that over $10 trillion will be invested in new power generation between 2017 and 2040, and more than 70 percent will be in renewables.[21]

The US Energy Information Agency (EIA) expects both global and national consumption of renewable energy to roughly double by 2050. Drivers behind this growth include falling manufacturing costs, policy and tax incentives, and improvements in technology. Strong economic growth in developing countries means increasing energy use, and EIA expects renewables to be the fastest growing source.[22]

Solar and wind show especially strong growth patterns, with the solar power sector seeing revenue growth at an annualized rate of about 76 percent between 2011 and 2016 nationwide. Falling prices of solar panels and wind turbine components (many manufactured in China) explain part of this growth. Industry analysts expect this rate of growth to slow somewhat, but both wind and solar should perform well in terms of revenues.[23]

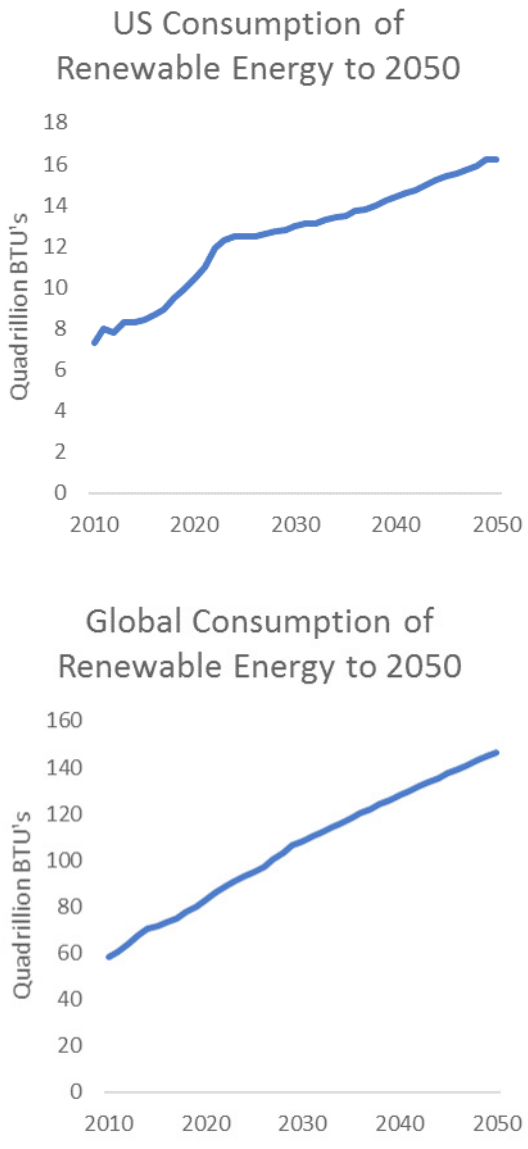


Figure 5: Projections of renewable energy consumption for the US and globe. Source: EIA.

Solar Power

The rapid cost decline in solar photovoltaic cells has been one of the most significant developments in renewable energy in recent years. In 2009, the average cost to install solar was about $7.50 per watt in the US. By 2017, it had fallen to $1.50.[24] Costs may continue to fall at an accelerating pace. Bloomberg believes that by 2040, solar-generated power will cost 66 percent less than in 2017. These falling prices have fueled a boom in the industry, which saw revenue growth of over 75 percent annually between 2011 and 2016.[25]

Solar installations can vary in size from those serving a single residence to larger utility-scale solar farms. Because solar power can be economical at the household level, many states allow excess power to be sold back to the grid. This is helping to drive the trend towards distributed generation in many parts of the US. Analysts expect rooftop solar installations to contribute an increasing share of power production, to as much as five percent of the US total by 2040.[26]

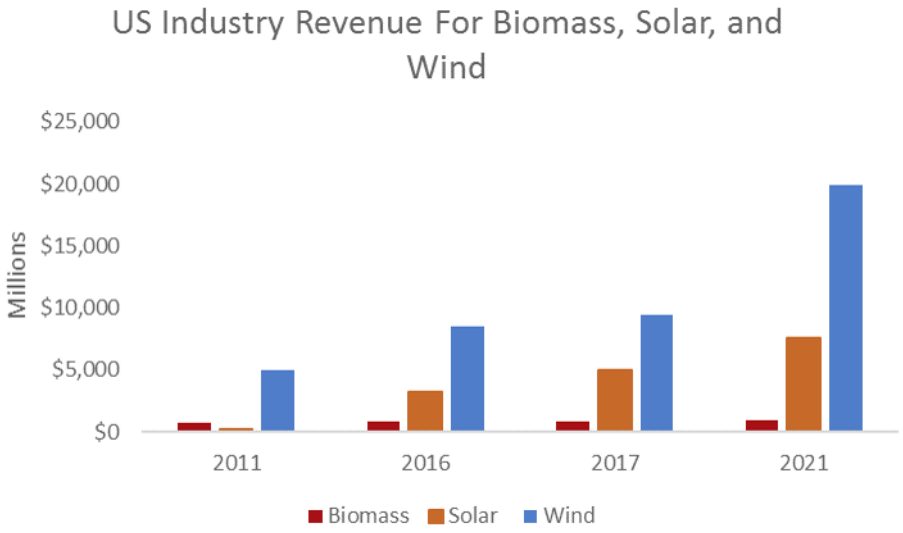


Figure 6: US renewable energy industry performance from 2011 to 2016, forecast to 2021. Source: IBISWorld (2016) for Solar and Wind. IBISWorld (2017) for Biomass.

Solar Energy International (SEI) solar pv installation courses provided in Palmer, AK. Photo Credit: Mark Mastellar, University of Alaska.

Battery Storage

A classic problem with renewable energy is intermittency. Solar panels and wind turbines produce power when the sun is shining or the wind is blowing, but consumers need power at all times. Battery storage provides the crucial link between power created through panels on a sunny afternoon when residential consumption is low, and a dark evening when household power use peaks. Just as solar panels are becoming less expensive, so are lithium-ion batteries. Between 2010 and 2016, lithium-ion battery prices fell by 73 percent. The global market is currently wrangling with an oversupply caused by expansion of manufacturing capacity. Prices may fall still further, with Bloomberg expecting prices to fall from $273 per kWh to as little as $.73 per kWh by 2030.[27]

The anticipated growth in sales of electric vehicles is the primary driver of new investment in battery technology. However, utilities and small-scale power producers also stand to benefit. Renewable power installations will become more feasible and reliable as energy storage solutions decrease in cost. Small grids in rural Alaska, remote mines, oil production sites, or facilities generating independent power could all benefit.

Electric Vehicles

In 2017, the *Economist* predicted "the death of the internal combustion engine" as a result of electric vehicles and cheaper batteries.[28] Electric vehicles do not necessarily depend on renewable energy. However, as the Economist and industry analysts have noted, electric vehicles produce lower carbon emissions than internal combustion vehicles, even when fossil fuels generate the grid electricity that powers them. An electric vehicle charged with power from Chugach Electric Association, for instance, produces 62 percent lower carbon emissions than the average internal combustion vehicle.[29] As a growing share of power production comes from renewables, electric vehicles will reduce their carbon footprint still further. By 2040, electric vehicles may account for more than half of new car sales.[30]

Interest in electric vehicles in Alaska has grown in recent years. As of September 2017, Juneau boasted nearly 200 electric cars along with 10 charging stations.[31] Stations have been installed in Anchorage[32] and Cordova as well.[33] Electric vehicles have the potential to increase power consumption on the grid, and thus grow revenue for utilities.

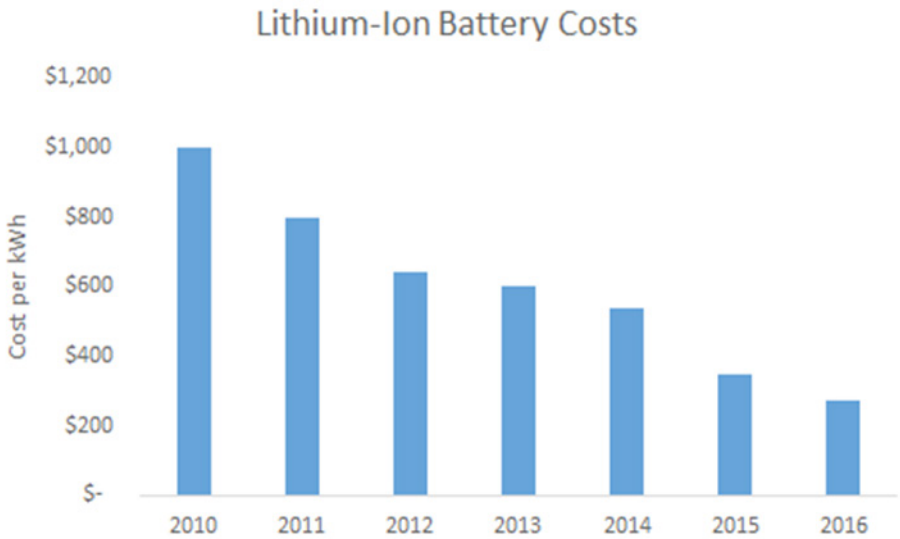


Figure 7: Lithium-ion battery costs since 2010. Source: Bloomberg New Energy Finance.

Movement toward Microgrids

In at least one respect, rural Alaska communities share something in common with communities in the developing world: the use of microgrids. Just as new technologies help drive the use of renewable energy, they also shape the way utilities produce and distribute power. Large, centralized power grids that distribute power from a large plant are giving way to microgrids that generate power from multiple smaller sources. These microgrids are more effective at integrating multiple sources of power, which makes them friendly to renewable sources. Developing countries without established utility infrastructure are adapting microgrid-based systems because they are more cost effective than committing to large-scale grids.[34] These factors resemble the conditions that led to Alaska's large concentration of microgrids, estimated at 12 percent of all microgrids on the planet.[35]

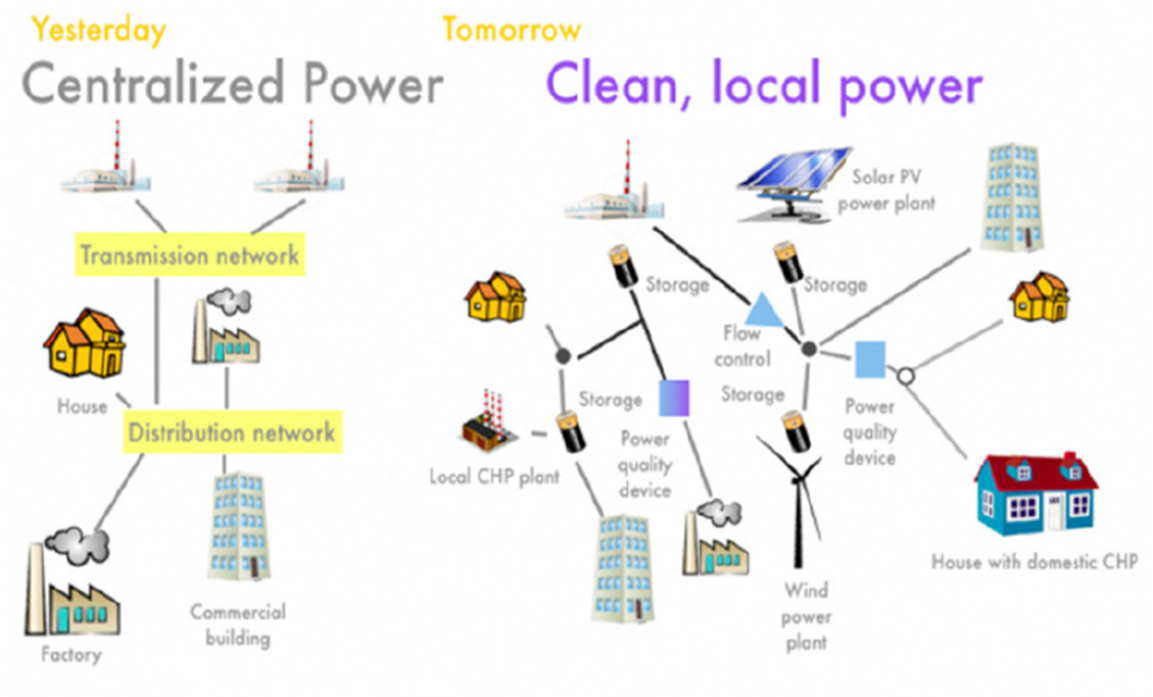


Figure 8: Highlighting the difference between centralized power and microgrid-based decentralized power. Source: Institute for Local Self-Reliance and Navigant Research.

Export Opportunities

A number of energy experts in Alaska believe entrepreneurs and businesses in the state can become leaders in the microgrid and renewable energy industries. With a wealth of microgrid experience and technologies and a history of integrating renewable energy through the REF and other sources, Alaska can claim a leadership role. As microgrids become a major target for investment, Alaskans' expertise in managing decentralized power systems and integrating renewable sources should increase in value. ACEP believes that this expertise includes:

- Design, construction, and operation of microgrids in remote locations.
- Design and use of control systems to generate and distribute power in islanded microgrids.
- Demonstration and refinement of new energy technologies in high cost areas.
- Development of community-centered energy planning.[36]

Alaska as a Global Thought Leader

In developing a knowledge economy around microgrids and renewable energy, ACEP cites Iceland as an inspiration. The small nation is home to United Nations University Geothermal Training Program. This helped to cement Iceland's leadership in the field of geothermal power, by training specialists from all over the world. A niche industry based in Iceland consults on geothermal projects globally partly as a result. In emulation of this, ACEP launched the Arctic Remote Energy Networks Academy (ARENA) in 2016. The goal is to "focus on establishing sustainable energy solutions for remote communities in the arctic and other regions of the world." In 2017, 20 individuals were selected to form sustainable, renewable resource plans to bring back to their communities with them upon the completion of the program.[37]

To date, the most extensive effort to identify export markets for Alaska energy innovations is the 2013 Global Applications Program by ACEP.[38] A team of researchers scored 100 countries on a range of criteria, taking into account factors like population density, electrification rates, power costs, government stability, and business environment (a total of 17 different criteria). The system attempted to generate a list of countries with comparable needs to Alaska. Among the highest scoring countries were those in Sub-Saharan Africa, South America, East Asia, and the Pacific Islands. These regions (or portions of them) resemble Alaska in terms of remoteness, diesel dependency, and utilization of islanded microgrids. The top five scoring countries were:

1. South Africa
2. Vanuatu
3. Chile
4. Senegal
5. Mongolia

Participants in the VOLT49 Energy Sprint meet with mentors
Photo Credit: Ciara Zervantian

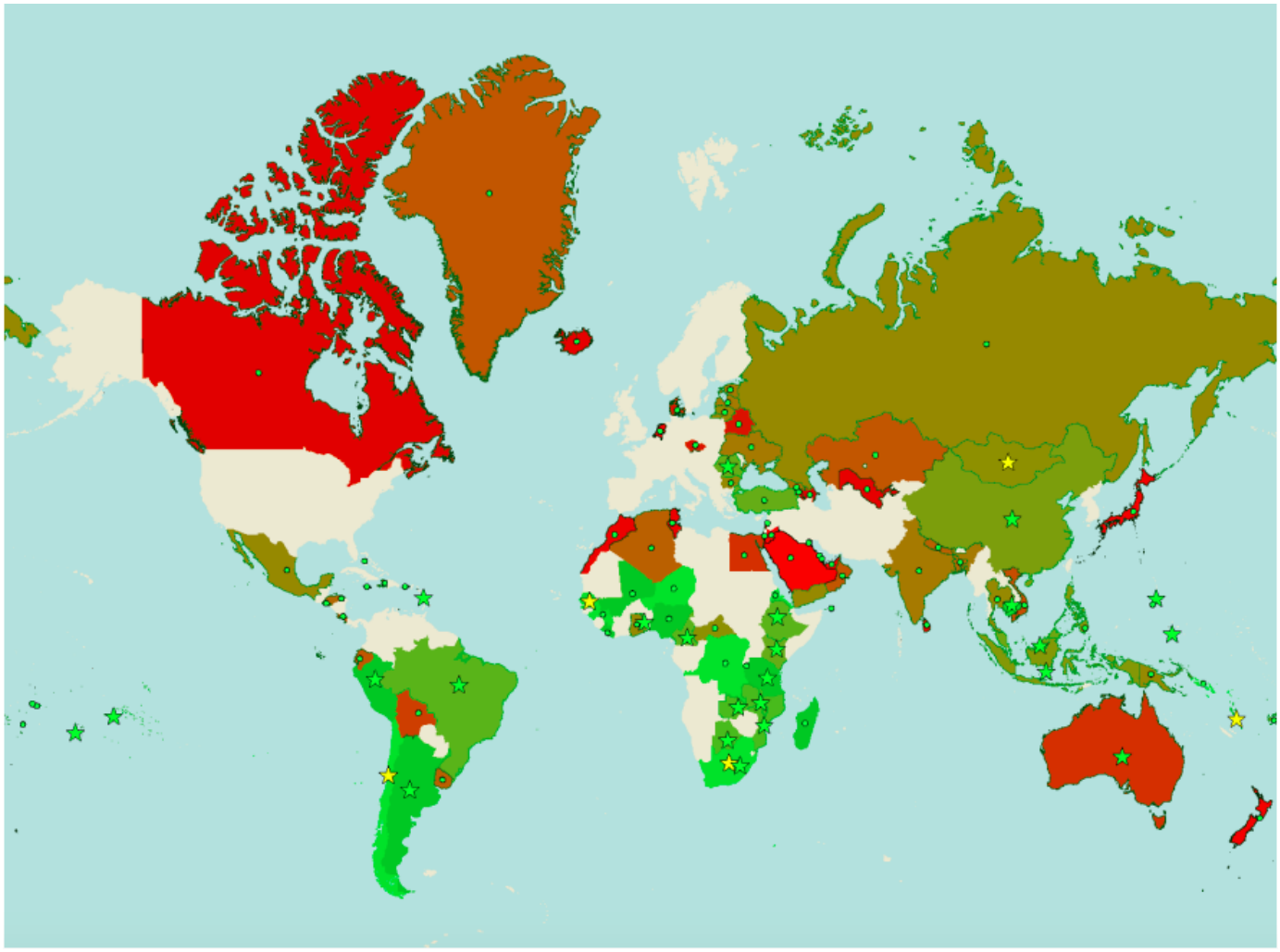


Figure 9: Target nations identified by ACEP's Global Applications Program in 2013. Yellow stars indicate the top five scoring countries, and green stars indicate the next highest tier in the scoring criteria. Source: ACEP, 2013.

Canada: A Neighboring Export Market

Remote communities all over the globe can benefit from Alaska's unique brand of energy expertise, but one promising opportunity is close to home. The federal government of Canada has announced a series of initiatives to address climate change, reduce energy costs, and promote the self-sufficiency of First Nations peoples. This includes the allocation of $400 million CAD to address energy security in the Yukon, Northwest Territories, and Nunavut through the Arctic Energy Fund. A further $220 million has been made available Clean Energy for Rural and Remote Communities Program, largely for indigenous communities. The funding for both programs will be used to upgrade or replace diesel-based energy infrastructure. These initiatives are part of the Canadian government's $21.9 billion effort to improve sustainability and reduce carbon emissions.[39]

Much like Alaska's rural remote communities, those of northern Canada typically depend on islanded microgrids grids and diesel generators. The nation is home to about 200 such grids, about the same number as found in Alaska. The practice of optimizing such microgrids and integrating multiple sources of generation and energy storage is a core competency of many Alaskan energy experts. Some Canadian communities have already consulted with ACEP and other in-state specialists on these topics.

VI. Who Are Alaska's Renewable Energy Companies?

Piper Foster Wilder understands the business potential in Alaska's energy expertise. As founder of 60Hertz Microgrids, she firmly believes Alaskan microgrid know-how can help solve some of the world's energy challenges. 60Hertz aims to provide financing and operations services to Alaskan village utilities and commercial sites. Scalability, however, comes in the form of a smartphone app called Pinga that will help communities in the developing world manage their power systems.

Running a microgrid can be a delicate balancing act. The amount of electricity produced must match the level consumed. Households and businesses use different amounts of power at different times of the day. The balance gets trickier when operators add renewable sources like wind or solar. These sources vary in power output as natural factors like weather and seasons change. Alaskan energy pioneers have found ways to manage this variability through two decades of building renewable systems in rural villages. Pinga captures this knowledge and allows operators to record daily maintenance tasks so critical to proper microgrid funtino, using a smartphone or tablet.

Software applications like Pinga can scale well under the right conditions. Once developed, software exists as data that can be duplicated at virtually no cost, allowing revenues to grow faster than expenses.

Members of 60Hertz, including Piper Foster Wilder (far right) at the beginning of the Launch Alaska 2017 Cohort
Photo Credit: DReFOTO

Renewable Energy Sector Definition

Renewable technology is difficult to define as an industry or sector, since it spans multiple established industry categories ranging from software design to construction. There are two main aspects of the sector as discussed in this study. First is the generation of energy from renewable sources, along with products and services related to this generation. Second is increased energy efficiency or conservation, regardless of the power source. Both of these broad areas offer business opportunities as well as potential value for customers and reduced carbon footprint.

> The renewable energy industry, as described in this report, is made up of firms with a specialty in products or services that relate to renewable energy or energy efficiency.

We define the renewable energy industry as firms that identify themselves as having a defined specialty in products or services designed to increase energy efficiency or produce energy from non-fossil fuel sources. Relatively few businesses in Alaska focus solely on either renewables or efficiency, so it is necessary to include companies earning a majority of their revenues from work unrelated to renewable technology.

Alaska Energy Businesses

Using this broad definition, the authors of this report created a listing of renewable energy companies by drawing on multiple sources. The Alaska Energy Efficiency Partnership, a coalition of multiple energy-related organizations, maintains a website with a listing of energy efficiency contractors and service providers. REAP, a membership-based advocacy organization, has a member directory on its website. ACEP researchers provided a list of companies as well. These sources were supplemented by referrals, media coverage, and web searches to construct a list of 102 companies with a renewable energy focus operating in Alaska.

Through interviews, web searches, and other information, each company was classified by the type of product or service offered. In some cases, firms were assignment more than one. The following six classifications included:

- **Consultants and technical services.** These firms provide subject matter expertise in the form of energy audits and assessments, guidance on renewable installations, and a variety of other knowledge-based services. Although similar to engineering and architecture firms, these firms tend to be smaller and more specialized.
- **Installation and construction.** These are contractors specializing in retrofitting buildings to improve efficiency, or who install renewable energy systems.
- **Architects and engineers.** Most of these firms are multi-disciplinary, with renewable energy being one of several areas of focus. Many of the services offered are similar to consultants, but the firms are usually larger.
- **Utilities and providers.** This category consists of utilities that use renewable sources, or service providers closely associated with utilities, such as independent power producers.
- **Product design and manufacturing.** Companies that create products designed to utilize renewable sources or increase efficiency. Most of these companies are based outside of Alaska.
- **Retailers.** Businesses that sell renewable energy products designed and built by other companies.

Business Classification	Total
Consultants and Technical Services	52
Installation and Construction	28
Utilities and Providers	24
Architects/Engineers	18
Product Design/Manufacture	12
Retailers	7

Figure 10: Types of renewable energy businesses operating in Alaska. Note that the totals do not sum due to some businesses fitting more than one category.

Renewable Energy Business Models

A challenge for Alaska's renewable energy sector is that relatively few firms operate business models with high scalability. Scalability requires a business model that can realize cost efficiencies as the firm serves an ever-increasing customer base. Professional service firms generally have low scalability, since their costs increase in proportion to their revenues. Software lies at the other end of the spectrum, as software companies can grow their market share while seeing smaller increases in costs.[40] The graphs below illustrate the difference between scalable and less-scalable business models.

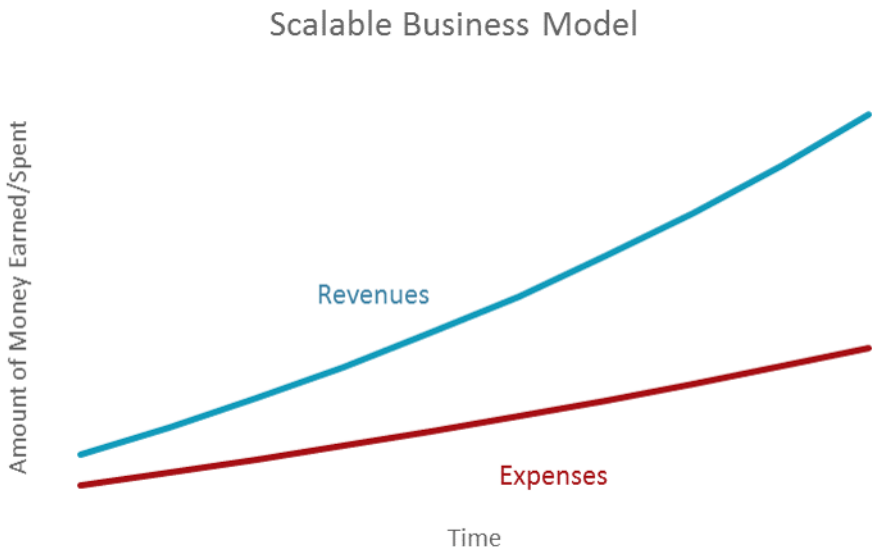


Figure 11: Scalable business models have the potential to grow revenue faster than expenses, increasing their gross profit margin.

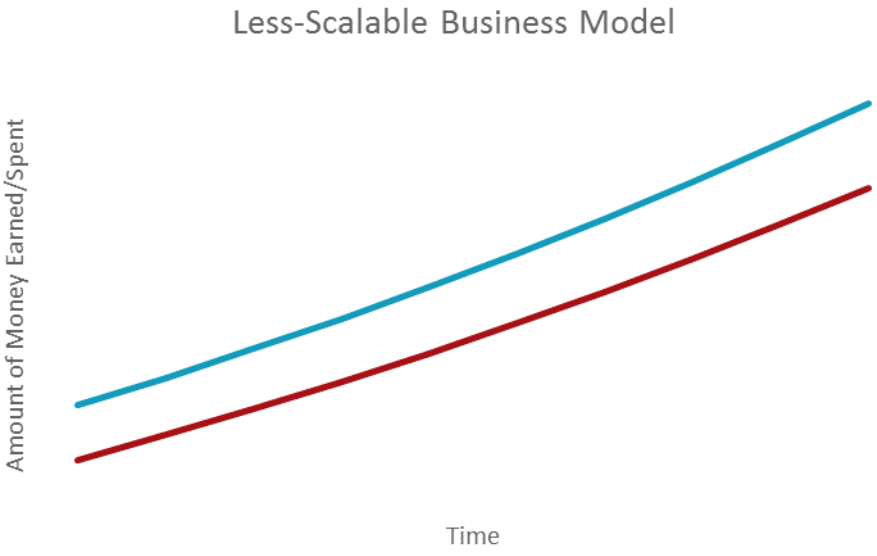


Figure 12 Less-scalable businesses may grow revenue over time, but profit margins stay roughly the same.

UACED identified five types of business models for renewable energy that are present in Alaska, closely mirroring the renewable energy business categories described in the previous section. Each type was rated in consultation with Alaska Small Business Center advisors.

Most of the businesses identified in this study work in the consulting and professional services realm, possessing high levels of expertise but a difficult pathway to scalability. This may change, however, with the entrepreneurial focus on energy through Launch Alaska, increasing focus in this sector by funders, and the sophistication and growth of the entrepreneurship ecosystem in Alaska.

Business Model Type	Scalability	Explanation
Utilities	Low	Growth often depends on population increase or industrial expansion in a service area. By their nature, utilities cannot easily earn revenues outside of their service area.
Professional Services (consultants, technical services, architects, engineers)	Low	Services depend on the billable hours of highly skilled professionals. Costs increase in tandem with revenues as more individuals must be hired if demand increases. Limited economies of scale.
Retail	Low/Moderate	Scalability often depends on a large product line and ability to compete with larger entities with a national or global presence. Small dealerships may have limited expansion opportunity.
Product Design/Manufacture	High	The cost of building a unit tends to decrease with scale in manufacturing, although manufacturing in Alaska can be cost prohibitive. Ownership of a design opens possibilities for licensing revenues.
Software	High	Software (including mobile applications) that assist in monitoring, managing, or operating renewable systems

Figure 13 Business models and scalability. Based on interviews with Alaska Small Business Development Center advisors.

L: Powerhouse in Yakutat. AK Photo Credit: Alaska Division of Economic Development

R: ACEP intern sets up a weather station at Black Rapids, AK. Photo Credit: Todd Paris/UAF

VII. Business Interview Results

Participating Firms Characteristics

A questionnaire was given to renewable energy related businesses that chose to participate in this study (See Appendix A for questionnaire). The majority of participants in this study were for-profit enterprises. However, perspectives from the University of Alaska system, non-profit organizations, federal government, and local government are also included for context. Unless specifically noted, the responses described below come from business interviewees.

Of the eighteen participating companies, six were founded between the early 1950s and early 1990s, and six between 2000 and 2010. The other six firms are considered as startups – less than five years old – and were founded between 2012 and 2017.

The size of these firms varies considerably. Six of the companies have less than five employees, three of them employ between six and eight, and five have from 20 to 175 employees. Two larger international companies are included as well, with the number of employees spanning from 20,000 to 132,000.

Type of Firm	Number of Firms
Engineering and architectural firms	8
Renewable energy systems and installations, energy efficiency	4
Consulting firms (other than Architectural and Engineering firms)	2
Product design/manufacture	3
Software	1

Figure 14: Types of firms participating.

Customer Segments

Most of the companies mentioned more than one main consumer segment. However, the two major segments for these participating firms are utilities, and governments. The government segment includes state, local, and tribal levels of government. At least for the participating sample, commercial and industrial customers are less numerous.

Customer Segments	Number of Firms
Utilities (including co-operatives, and investor-owned)	13
Commercial	1
Government (state, tribal, and local)	9
Department of Defense	2
School districts	1
Non-profit organizations	2
Residential homeowners	2
Industrial	3
Transportation	1
Telecommunications	1
Ports and marine	1

Figure 15: Renewable energy customer segments.

Revenue Size

Few of the participating firms receive all or most of their revenues from renewable energy. For several of the large engineering firms, the share is often less than 10 percent. Those that claimed no renewable energy revenues are startups who have not yet made customer sales.

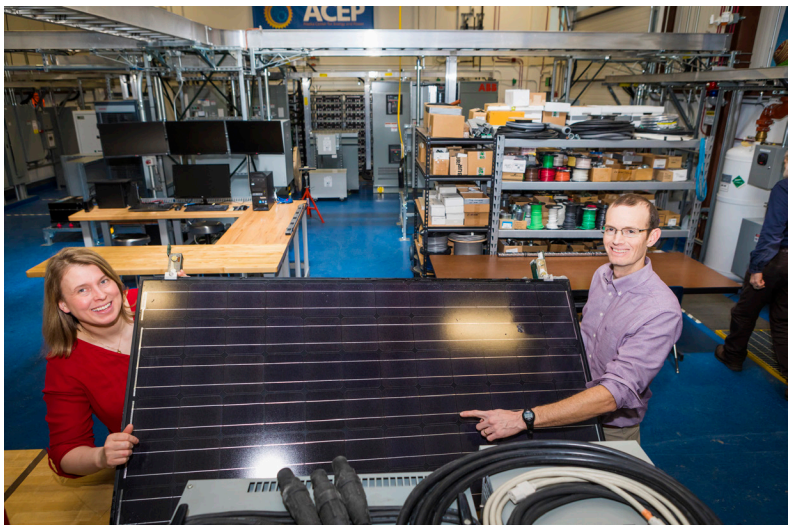
Percentage of revenue related to renewables or energy efficiency	Number of Firms
0% (including pre-revenue)	3
1-4%	3
5-10%	2
20-50%	1
60-90%	0
100%	4
Unknown or declined	5

Figure 16: Share of revenue from renewables or energy efficiency.

Gross Revenue	Number of Firms
> $100,000	1
$100,001-200,000	1
$200,001-400,000	4
$400,001-1,000,000	0
$1,000,001-10,000,000	2
< $10,000,001	2
No annual revenue yet	1
Unknown or declined	7

Figure 17: Revenue size categories.

ACEP researchers Erin Whitney and Chris Pike handle a new solar panel. Photo Credit: JR Ancheta/UAF



Services and Products

All participants reported doing renewable energy work or reported an intention to offer their products and services in Alaska. Furthermore, 65 percent of respondents stated that they work only in Alaska.

Participants answered open-ended questions about their market niche, and a significant majority of the firms reported that they operate as researchers, engineers, architects, designers, consultants, and software developers. This testifies to the strength of the in-state knowledge base in renewable energy.

Capacity to Scale the Business

One question asked: "Would you have the capacity to grow/scale the business if you had increased demand? If not, what are some of the current limitations preventing such growth?" This question is included to gauge whether businesses face internal limitations other than market demand, such as facilities, capital, skills, or equipment. Of all the 18 firms participating in the interviews, 14 reported that they could scale up if they experienced an increase in demand. However, even though a majority of the companies indicated that they currently have the capacity to grow their business, some also cited a factor which limited growth. The most common was lack of sufficient grant funding or the unmet expectation of grant funding. Two firms explained that they were not interested in growth.

Children at play in rural Alaska
Photo Credit: Wade Carroll

Barriers to Growth

Two challenges were the most common among the firms interviewed: access to capital and market demand (or economic conditions). The loss of grant programs like the REF seems to have left a funding vacuum, and the businesses (or their clients) struggle to access other forms of capital. For many businesses, the issue of capital is closely tied to the state budget, with some describing a need to tap loans to replace the grants that are no longer available.

Interviews with government and nonprofit stakeholders shed light on the issues of loans. One commented: "people are not accessing our loan program, they are waiting instead of doing projects that pay back." This indicates a lack of education about loans and knowledge about starting/operating a business and taking on projects. Two commented that the state of the economy is creating a sense of financial insecurity, which leads to a "culture of loan aversion." Of the eighteen businesses, seven listed capital as a major challenges and the same number listed economic conditions.

Workforce Challenges

Businesses in Alaska often name workforce challenges as a major barrier to growing their business. Although most firms interviewed described a difficulty in finding particular skillsets, only one listed it as the "most significant" barrier or problem. When asked what skills are most in demand, most firms described technical or professional areas of expertise. None mentioned soft skills. The engineering firms were the most vocal about the need for technical training in subfields like programming and heating, ventilation, and air conditioning (HVAC).

When questionnaire and interviewers asked about the major barriers that businesses face, participants stated the following, without prompting:

Figure 18: Barriers to growth

Oppotunities for Growth/Suggestions for How to Enable Growth

The final question subjects were asked was: "If the State of Alaska or the University system could do one thing that would improve conditions in your industry, what would it be?" This question prompted lengthier responses than the others, and most firms had specific suggestions to grow the industry.

Restore or Increase Public Funding

As expected, many participants suggested that the state government fund energy, construction, or renewable energy projects to a higher degree. Beyond a request for funding, most participants provided nuanced answers as to how state money could be used more effectively:

- "Provide 25 percent grants to energy projects that the federal government could match"
- "Use state money to really improve the cost of ownership for buildings by investing in redevelopment or improvements to make it more cost effective to live here a long time."
- "Address logistics costs for manufacturing in [Alaska]... set up program for five years allowing [Alaska] manufacturing that have a [minimal] content of imported raw materials … to get goods back to Seattle/Portland ports at no cost so that an AK [manufacturing] business is just as competitive as if they were in the [Northwest].

An electric vehicle in Juneau, Alaska.
Photo Credit: Juneau Economic Development Council

Make it Easy to Find and Access Funding by Creating a Shared Funding Portal

Several participants noted that the federal government, State of Alaska, and nonprofits offer a bewildering variety of grants, loans, and guarantees.[41] These avenues for funding can be tough to navigate. Common criticisms were finding the right funding program, meeting the restrictions, getting the amount needed, and accessing the funds in a timely manner. On the other end of the spectrum, one federal government employee mentioned that companies were not accessing the loans or guarantees that the federal program offers. To address these problems, one interviewee suggested that the government create a common finance portal and a common application for all of the state's energy programs, banks, and other economic development funding programs. They suggested that a common application for funding could be sent to multiple program officers in the federal, state, and nonprofit sector to see if any programs would be a fit for the applicant.

Remove Restrictions that Make it Unreasonable to use Funding for Construction or Planning

Several interviewees mentioned that they do not use government funds because it is much easier to use private sector funds or not pursue certain projects. Interviewees mentioned that the funding has (1) narrow restrictions, and (2) gaps that make them difficult to use. For example, interviewees suggested that many funding programs are capped at amounts that are too low and that programs are unnecessarily restricted based on the type of property (residential, commercial, industrial). As for gaps, certain funding programs do not allow the use of funds across the full cycle of a project. For example, any project requires an evaluation (such as an energy audit), planning, and implementation (construction), but many funding programs prohibit the funding from being used for planning, design, or other necessary steps for a construction project.

Facilitate Public-Private Sector Investment in Energy Projects

Several questionnaire participants and interviewees mentioned that allowing better public-private partnerships would be advantageous. Beyond recommending these partnerships in general, few of these respondents suggested what better public-private partnerships would look like.

Two interviewees suggested that the state form a green bank. A green bank is a publicly capitalized entity established to facilitate private investment in resilient infrastructure.[42] Even though green banks differ in form, they typically use public money to invest alongside private investors – thereby lowering investment risk, while increasing resilient infrastructure, energy jobs, and green benefits such as carbon reductions, wastewater management, climate resiliency, and more.[43]

Facilitate Tech Development with Public Funding and Leverage Private Funding to Suport Research and Development

Several respondents mentioned that funding is needed to drive technology and product development in Alaska. For example, questionnaire respondents requested that the state "increase funding for Alaska Energy Authority's programs that fund […] renewable energy and the Emerging Energy Technology Fund" or provide "continued funding for the Renewable Energy Fund and Emerging Energy Tech Fund."

Other than a government grant to these programs, respondents mentioned tax credits as a potential way to drive private sector funding into such programs. Other states have created tax credit programs (like the Oregon University Venture Development Fund) to drive several million dollars from the private sector into technology development.[44]

Debris diversion project on the Tanana River. Photo Credit: Todd Paris/UAF

Address Gaps in Workforce and Improve Education

Multiple participants stated that workforce gaps are an issue. For technical work, questionnaire respondents mentioned that more apprenticeship programs are needed for renewable energy technology development and that every engineering student should be required to take an HVAC class before graduation. For financial and business work, one respondent suggested that the state needs more workers who understand how to create a business around energy projects, as well as handle the finances of energy projects.

Other respondents suggested that the state needs to relax the regulations and required certifications for rural operators, and instead, allow these operators to work remotely under the oversight of a certified manager or utility operator.

Address the Lack of Customer and Company Awareness through Education

Renewable energy projects often require large outlays of funding upfront, and pay returns over a long period of time (or something like this). A common theme in interviews is limited awareness about the return on investment (ROI) for renewable energy projects. Convincing prospective clients to invest in a renewable energy project can be made more difficult without this understanding of the long-term benefits.

Furthermore, multiple respondents suggested that the prior availability and dependence on grants has hindered the private financing of projects.

As for renewable energy businesses themselves, two interviewees asked about the status of the commercial Property Assessed Clean Energy (PACE) legislation, and where it was in its implementation (it was passed in April 2017).[45] Each of these interviewees mentioned that the legislation could be used to help their projects, but they were unsure of the details, or any opportunities to make use of the financing structure. Educating companies themselves on the benefits of this legislation would further the renewable energy industry in Alaska.

In both cases, respondents mentioned that state government and the University of Alaska could provide education to customers, communities, and businesses about how to make use of government funding and its benefits.

- "More awareness to average home owner, show ROI and ease of use."
- "Renewable energy is sometimes very technology intensive, and we find that systems do not continue to work for the owners long term unless someone takes care of it. Can we train Alaskans to take care of our systems and truly understand if they are cost effective, factoring in the capital that subsidized the project at the beginning[?]"

Resolve the Sate Budget and Economic Downturn

Some business owners believed the unresolved state budget deficit is a threat to their business:

- "Easy. Balance the budget through increasing revenue and using savings (not cutting budgets). Providing a stable economy will allow business to grow--not leave the state."
- "Fix the state economy."

Solar racks being constructed during BLM Admin Building construction. Photo Credit: Matt Nerlfi, Arctic Solar Ventures.

VIII. Findings and Recommendations

Alaska's renewable energy entrepreneurs work in a knowledge-intensive industry that confronts the challenges of remote locations and extreme climates. The problems they solve in managing microgrids, designing systems, and reducing consumption may seem unique, but often parallel challenges seen around the world. This lends credence to the idea that a clean-energy knowledge industry based in Alaska can sell its expertise globally.

Findings

The most significant findings from the interviews and research include:

Alaska Focus on Selling Expertise

Alaska renewable energy businesses excel at integrating renewable energy systems, but many do not focus on renewable energy alone. Most Alaska companies and institutions integrate fossil fuel technologies, smart monitoring technologies, and renewable energy generation, and provide these services and products to Alaska utilities, property owners, and communities. As a result, Alaska companies do not focus on just renewable energy, instead, they focus on advancing a variety of energy technologies and engineering knowledge for use in remote and Arctic conditions.

Scalable Business Models are Rare

Despite the concentration of knowledge in renewable energy, and the identification of over 100 renewable energy businesses, scalable business models remain elusive. Most firms operate on a professional services business model.

Access to Financing is the Largest Constraint

Many of the state's renewable energy businesses serve clients that relied on state grants that are no longer available. Numerous respondents suggested that the government change their funding mechanisms in a variety of ways, such as creating a shared funding application or portal, removing restrictions on funding sources, facilitating private investment in projects, and facilitating tech development with a combination of public and private capital.

STRENGTHS: Alaska firms primarily provide (1) consulting expertise or (2) software that codifies expertise as products. The primary advantages are that both have lower fixed costs and can be exported easily.

WEAKNESSES: Dependence on grant funding, difficulty communicating ROI to customers, little evidence of scalability.

Workforce Development Needs Remain

Numerous respondents suggested that the state provide funding to educate Alaska workers through apprenticeships and specific classes. Others suggested that the state reduce the restrictions on remote operators of utilities. Industry research at the national level also suggests that energy-related occupations like solar installers will grow quickly.

Consumer Education is Needed to Communicat ROI

Several companies suggested that the state should do more to educate customers and communities about the return on investment from renewable energy projects, and energy projects in general.

Recommendations

Recommendation 1: New Financing Models

The interviews made clear that renewable energy has been heavily dependent on grant funding that is no longer available. More broadly, businesses named access to capital as a primary (or at least major) barrier to growth. Other models of finance will be necessary, including loans and various forms of private investment. Fortunately, renewable energy and energy efficiency can reduce energy costs for households and facilities. This means energy upgrades that increase cash flow can be used to service debt. Green Banks and PACE are two ways to provide this type of debt financing. Green banks are finance entities with a mandate to fund clean energy projects. They are usually affiliated with the public sector and use government funds to leverage private capital. A handful of states have created green banks. For example, the Connecticut Green Bank is a private entity run by an independent board of directors, formed in 2011.[46] It currently leverages public funding to drive private financing by managing $48 million in public funding and $268 million in private investment. The bank claims that every $1 in public funds it invests produces $6 in private investment.[47] Green banks reduce risks for private investors, and can stimulate demand for the types of businesses interviewed in this study. REAP has been seeking support for the creation of an Alaska green bank, to continue advancing energy projects.

The Connecticut Green Bank works in conjunction with that state's PACE mechanism. PACE allows owners of commercial buildings to borrow money for energy upgrades. Repayment of the loan is added to the property taxes the owner pays. The upgrades reduce the operating cost of the building, so even with the additional debt payment the owner may still see an overall cost reduction. If the owner sells the property, the new owner will take over the payments, since they are part of the property tax assessment. PACE financing is usually lower cost than traditional debt, and allows for longer repayment terms. In the spring of 2017, the Alaska State Legislature approved PACE legislation.[48]

Since PACE is new to Alaska, it is not yet clear to what extent it will be used. Local governments control the use of the program (since they are the taxing jurisdictions) and most are unfamiliar with business lending. This makes a green bank a strong complement to PACE in providing the expertise and private leverage. Educating businesses and local governments about PACE should be a priority for the renewable energy sector.

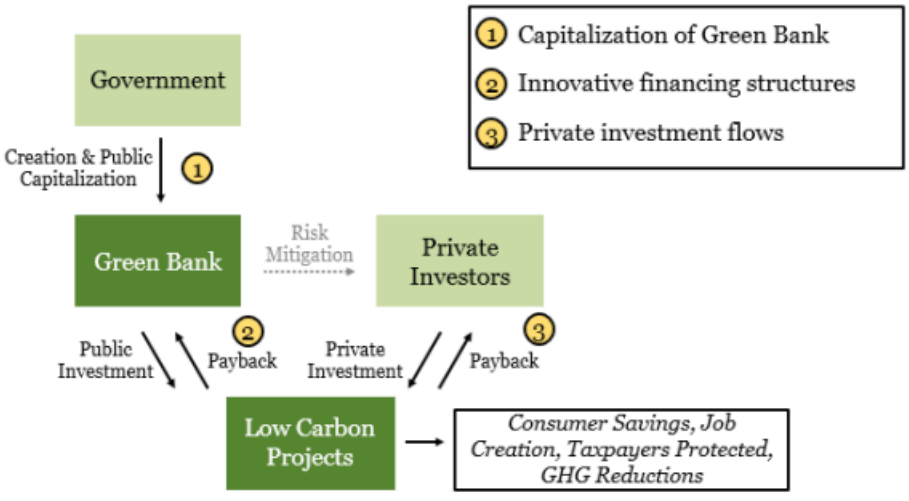


Figure 19: How green banks work. Source: Coalition for Green Capital

Recommendation 2: Workforce and Education

All of the renewable energy companies participating in this study are highly skilled, and most cited the need for technical skills among their employees. Most are knowledge-based firms like consultants and engineers who require extensive training, sometimes professional licensing and certificates. Existing efforts in renewable energy workforce development should be continued and expanded upon, with as much input as possible for the private sector. Some of the firms mentioned subjects that should be covered in engineering classes within the University of Alaska, for instance, which deserves further exploration.

REAP is taking the lead through its Alaska Network Energy Education and Employment (ANEEE) program to evaluate and ultimately improve training and education in the renewable energy realm. ANEEE, launched in 2016, will attempt to build a network to better align renewable energy training offerings with demand from employers. The first phase is conducting a thorough assessment and asset map of workforce and education programs and needs in the state.[49] Under UAF, ACEP's ARENA program is another promising effort, and has the potential to help cement Alaska's leadership in the growing niche of microgrid operation and systems integration. Just as Iceland has become a global center of geothermal expertise, Alaska can find a parallel role in microgrids and renewables. The international knowledge sharing can also help to attract entrepreneurial talent to the state.

Recommendation 3: Entrepreneurship and Innovation

Alaska is home to a rapidly maturing entrepreneurship ecosystem with angel investors, pitch events, business plan competitions, and co-working spaces. In 2015, Launch Alaska became the state's first startup accelerator and declared a focus on renewable energy starting in 2016. Providing capital, mentorship, and guidance, Launch Alaska has the potential to focus resources toward a growing a high-tech, scalable renewable energy sector. In addition to supporting Launch Alaska, however, energy innovation promoters in the state could do more to channel entrepreneurial efforts. The deep knowledge base that exists in state has produced few scalable companies, illustrating the need for more emphasis on cultivating innovation. One way to encourage innovation is through innovation sprints. This is a method pioneered by Google to speed up the creation of new products through an intensive, five-day process. Teams form around product concepts, and after refinement and validation, they produce a prototype. Products could include software, physical devices, or even service offerings. Alaska's first public sprint took place in 2017, and was specific to ocean technology, but included one energy product—a small-scale tidal generator. Energy-themed sprints could tap into the state's deep bench of energy experts to create new technology. Launch Alaska, angel investors, and the startup ecosystem at large could then help grow companies that result.

Unalakleet inside powerhouse. Photo Credit: Alaska Division of Economic Development

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X. Contributors

Nolan Klouda

Adam Krynicki

Margo Owens Fliss

Gretchen Wieman Fauske

Steven Amundson

Britteny Cioni-Haywood

Alyssa Rodrigues

Penny Gage

Carole Triem

Special Thanks

Business

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ABB

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Arctic Heat Technology Inc.

Stantec

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Gray Stassel Engineering

Daylight Energy Services

Government/Nonprofit

Alaska Center for Energy and Power, UAF

Alaska Energy Authority

Aleutian Pribilof Islands Association

Fairbanks North Star Borough

Renewable Energy Alaska Project (REAP)

Rural Alaska Fuel Services, Inc.

USDA Rural Development

XI. Appendix A: Renewable Energy Questionnaire

Emerging Industries Series: Renewable Energy

1. Email address *

2. What is the name of your company/entity?

3. What type of entity do you represent?

Mark only one oval:

o Company Native or Village Corp.

o University

o Nonprofit Financier

o Federal Government

o State Government

o Community Government

o Other:

4. What is your name?

5. What is your position/title?

6. When was your company/entity founded?

7. What products or services do you sell?

8. How many people do you employ?

9. What is your entity's approximate annual revenue? (kept confidential, OK to skip)

10. In the last year, have your revenues increased, decreased, or stayed about the same?

Mark only one oval.

o Increased

o Deceased

o Stayed the same

o Other:

11. Roughly what percentage of your revenue is from sales of renewable energy equipment or services?

12. What are your main customer segments? (for example, commercial property owners, municipalities, utilities, local machine shops, military, large industrial buyers like oil or trucking companies, etc.)

13. Where is the majority of your customer base located? (percentage in-state, out of state US, international)

14. How did you identify an opportunity for this product/service and this market?

15. Would you have the capacity to grow/scale the business if you had increased demand? If not, what are some of the current limitations preventing such growth?

16. What barriers to your business growth have you experienced? (examples: workforce skills, regulations, access to capital, cost of supplies/materials, freight costs, economic conditions)

17. Which barrier or obstacle is the most significant? (Examples: Legal, Financial, Lack of Assistance)

18. Which companies do you consider to be your main competitors?

19. What workforce skills are most in demand for your business? Are training needs being met?

20. If the State of Alaska or the University system could do one thing that would improve conditions in your industry, what would it be?

XII. Appendix B: Selected Interview Responses

Services and Products

Below is an overview of the variety of services and products that the participating companies in the interviews provide, or intend to provide.

Product designers/manufacturers:

- Outdoor electric heating systems (in development)
- Power conversion & filtering IP (in development)
- Marine renewable energy systems

Installation and retail:

- Installation of efficiency upgrades
- Sales of 3rd party LED lighting, batteries, solar supplies

Engineers, architects, and consulting firms:

- Maintenance services
- Professional architecture and design (multiple firms)
- Engineering Services (multiple firms)
- Power technology engineering
- Engineering for Rural Alaska energy projects (multiple)
- Commissioning services
- Strategic services for the marine renewable industry
- Surveying

Software:

- Industrial automation/SCADA IoT solution for industrial process monitoring and control
- Infrastructure finance, aggregation, and operations and maintenance (O&M) software

Barriers to Growth

Access to capital:

- "Access to capital for end users remains a primary obstacle, with perceived risk limiting both lenders' interest as well as the communities' willingness to engage in traditional financing."
- "Cost of capital, economic conditions, consumer education"
- "Access to capital is the biggest obstacle"
- "Access to seed capital"
- "A reliance on grants for funding has limited the communities' ability to approach system design holistically and projects have advanced at irregular pacing as budget allows."
- "Financial (on the client's part) - and awareness in rural communities of project development process."

Regulatory and taxes

- "Regulations, public awareness, lack of state promotion, poorly defined permitting processes."
- "Regulations; control of electrical power generation by an oligopoly."
- "Taxes for small businesses are tough - why would I continue with a small business when I am taxes at 30-50% with payroll taxes."

Demand and economic conditions:

- "Demand for services seems to have flattened."
- "Need market demand outside of Dept of Defense"
- "Economic conditions in AK"
- "General economics, consistent government spending, high cost of construction, lack of redevelopment of existing properties. Sprawl is not helpful for us."
- "Government gridlock."
- "Professional design services are not needed to the extent expected."
- "State of AK fiscal situation and funding for construction and upgrade projects."

Customer or public perception:

- "A lack of expertise in the communities contributes to confusion and decision paralysis in advancing a project with many vendor and technology options."
- "No movement in USA to get off oil"
- "Customer capacity to take on control/automation/cost saving projects."
- "Building owners don't understand long-term (10yr+) cost of ownership or capital"

Workforce Development

Engineering and architecture:

- "We need instate grown Architects, and more electrical engineers."
- "Power engineering and programming
- "Engineering graduates…Concerned UA is getting less attractive to talented students"
- "Engineering"
- "Engineering, yes we have plenty of training."
- "Workforce skills in demand include drafting, SCADA programming, permitting expertise, and electrical integration engineering."
- "Mechanical and electrical engineering expertise; within the supply chain: advanced composites manufacturing, steel fabrication, product assembly, on-water services"

Other:

- "Writing and quantitative analysis"
- "Econometric, updates on technology. Training needs are met."
- "Carpentry, roofing, electrical (solar installation) - we have to lead in this and call in outside resources to meet our needs."
- "Scaleable manufacturing"
- "Sriters and researchers-UA system has good masters programs for environmental planning"
- "Heat pump trained pros"
- "Electrical and instrumentation technicians and technical sales."
- "Will need industrial sales, manufacturing and logistics personnel. Yes...current and expected needs are being met."
- "Food business acumen and solid customer services combined with an ability to create a useful web interface"

Opportunities for Growth

- "Revise operator/plant certification rules to allow for remote oversight of plant with qualified remote tech supporting local operators with lower level certs that need time. Too many remote sites do not have the qualified operators needed for new systems."
- "Engage students in power system design, specifically focused on the intricacies of renewable integration and modeling"
- "License [Solar Energy International] training for solar installers."
- "Make it easier for start ups to find competent interns; develop a more visible university/industry partnership; renewable economic modeling/financial modeling"