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Powering the Arctic

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The authors prepared this report as part of the Graduate Practicum in Public Policy, a two-quarter sequence required for Master's in Public Policy Program students. Commander David M. Slayton and Admiral Gary Roughead at the Hoover Institution advised the project. The clients for this project were the Hoover Institution and the Brookings Institution. The full report can be obtained from the Public Policy Program webpage.[1]

This brief presents research into current and future energy needs in the Arctic, evaluates energy source options, and concludes with a primary policy recommendation.

Introduction

Demand for energy in the Arctic is projected to grow significantly over the coming decades, and the region has no integrated plan to replace or augment its existing energy infrastructure. The costs of providing electricity to Arctic Alaska are higher than in more densely populated areas. Further, the environmental costs of energy extraction and generation are much higher in this region than elsewhere. Currently there exists no mechanism for internalizing these distribution and environmental costs. Mandates such as a Renewable Portfolio Standard would more properly align the costs and benefits of energy generation in Arctic Alaska.

Rising temperatures and melting ice will result in increased access to the region, accelerating discussions of potential Arctic development. When planning for increased activity in the Arctic, policymakers must address the challenges facing the construction of ports, energy generators, roads, water treatment facilities, and other infrastructure. The current U.S. domestic policy landscape in the Arctic is complex, as agency responsibilities overlap and no single agency oversees Arctic activities. However, because the United States will be chair of the Arctic Council from 2015 to 2017, U.S. leaders will soon be in a position to influence policy changes with far-reaching global impact. This brief considers policy remedies for U.S. energy and security needs in the context of a rapidly changing environment and an influx of new Arctic activity.

Current Resources and Energy Requirements

This section discusses the current resources and energy requirements of Arctic Alaska in order to facilitate advanced planning of the proposed energy mix.

Current Capacity

Current energy capacity in Arctic Alaska is characterized by growing demand, non-traditional transmission, and heavy reliance on diesel fuel despite large natural gas reservoirs. The United States can expect an increase in the energy required by local residents, business interests, and government entities in the Arctic territory. Increased emissions come with increased activity—and carbon emissions and other environmental factors in the Arctic can have an impact on the global climate and environment several orders of magnitude greater than emissions originating elsewhere.[2] Because the Arctic environment is fragile and remote, energy technologies adopted in the

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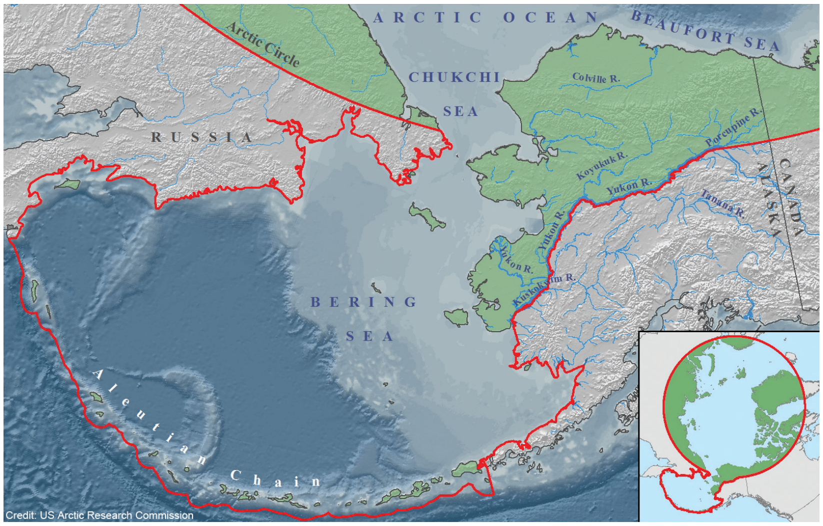
[1] Access the full report at *http://publicpolicy.stanford.edu/system/files/Arctic%20-%20Final%20Report.pdf.*

[2] Sasser, Erika, et al. "Report to Congress on Black Carbon." *Environmental Protection Agency,* March 2012. Web. 14 June 2013. *http://www.epa.gov/blackcarbon/2012report/fullreport.pdf.*

Figure 1

The Arctic region is located within the legal Arctic boundary (red).



Note: Defined as the global territory north of the Arctic Circle, the Arctic includes territory of the United States, Canada, Russia, Norway, Finland, Sweden, Iceland, and Denmark (Greenland). In 1984, as interest grew in minerals in the Arctic, the United States expanded its definition to include more of northwestern Alaska, the Chukchi Sea, the Bering Strait, and the Aleutian Island chain. National Science Foundation (NSF). "Arctic Research and Policy Act of 1984 (amended 1990)." *NSF*, 15 November 1990. Web. 4 March 2013. *http://www.nsf.gov/od/opp/arctic/iarpc/arc_res_pol_act.jsp.* O'Rourke, R. "Changes in the Arctic: Background and Issues for Congress." DIANE Publishing, 2011. Web. 3 December 2012. *http://www.fas.org/sgp/crs/misc/R41153.pdf.* Page 2.

Source: U.S. Arctic Research Commission. "Arctic boundary as defined by the Arctic Research and Policy Act." USARC, 27 May 2009. Web. 14 June 2013. *http://www.arctic.gov/maps.html.* Page 1.

region must be properly sensitive to the environment.

Additionally, due to the entire region's widely dispersed population centers, it is not economically viable to provide energy to the Arctic via traditional transmission lines and grid connections from the south. Up to the present, energy solutions in the region have been limited mainly to diesel generators, which are inefficient, can exacerbate the albedo effect,[3] and have a fuel supply that is vulnerable to interruption. Interruptions can have dire consequences, as was starkly evident in a recent refueling incident in Nome, Alaska, when the town was in danger of running out of fuel and heating oil in the dead of winter.[4] The Arctic needs new energy solutions that incorporate advanced technology to meet the unique requirements of the region. Existing energy infrastructure in the U.S. Arctic is not sufficient to meet the growing needs of the region.

Alaska's main sources of electricity generation as a percentage of total generation are natural gas fired plants (58 percent), hydroelectric plants (20 percent), petroleum fired plants (16 percent), and coal fired plants (6 percent).[5] While generating only one-tenth of a percent of all U.S. electricity, Alaska's petroleum-based electricity accounts for fully 8 percent of the U.S. total and is ranked fourth in the United States for total amount of electricity generated from petroleum liquids.[6] Renewable energy, not including hydroelectric dams, has not been utilized at any scale in the state (less than 0.2 percent, the lowest of any state).[7]

The Arctic region of northern Alaska accounts for only 5 percent of the state's installed capacity (Figure 2), but the energy mix differs greatly. Of the 111 MW of installed power plant capacity in the Alaskan Arctic, fully two-thirds of the generation comes from diesel fired, internal combustion engines. The other third is from a single gas turbine generator facility in Barrow, Alaska.[8] Diesel generation, especially on the small scale as found in the Alaskan Arctic, is not only the least efficient means of producing electricity but also one of the most polluting from an environmental standpoint.

Energy Requirements

Under an assumption that the Alaskan Arctic region will develop into a similar industrial center and export facility as the Kenai Peninsula

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[3] Albedo definition: "The fraction of solar radiation reflected by a surface or object, often expressed as a percentage. Light-colored surfaces (such as those covered by snow and ice) have a high albedo; dark surfaces (such as dark soils, vegetation, and oceans) have a low albedo." Sasser 2012. Page xx.

[4] Yardly, William. "A New Race of Mercy to Nome, This Time Without Sled Dogs." *The New York Times,* 9 January 2012. Web. 21 February 2013. *http://www.nytimes.com/2012/01/10/us/icebreaker-slowly-carves-path-for-tanker-to-bring-emergency-fuel-to-alaska.html?_r=0.*

[5] Randstad Engineering. "U.S. State Power Plant Statistics." *Randstad,* date unknown. Web. *http://www.thinkenergygroup.com.*

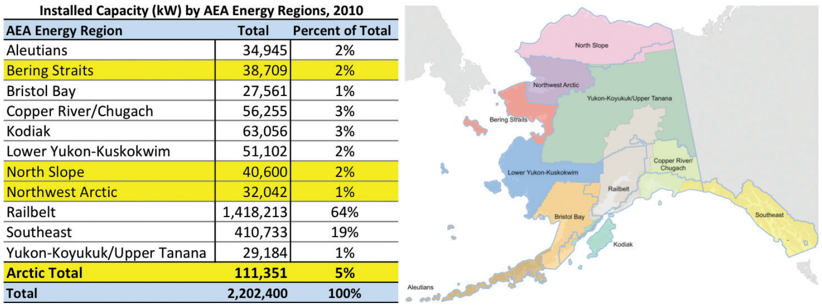
[6] U.S. Energy Information Administration (EIA). "EIA state profile: Alaska." *EIA*, July 2012. Web. 22 February 2013. *http://www.eia.gov/beta/state/?sid=AK.*

[7] U.S. Energy Information Administration (EIA). "Renewable market share of net generation by state." *EIA*, July 2012. Web. 22 February 2013. *http://www.eia.gov/renewable/annual/trends/pdf/table1_27.pdf.*

[8] Fay, Ginny, Alejandra Villalobos Meléndez, and Corinna West. "Alaska Energy Statistics: 1960-2011 Preliminary Report." *Institute of Social and Economic Research University of Alaska Anchorage* and *Alaska Energy Authority,* November 2012. Web. 14 June 2013. *http://iser.uaa.alaska.edu/Publications/2012_11-AlaskaEnergyStatisticsCY2011PreliminarySummary.pdf.*

Figure 2

Installed capacity (kW) by AEA Energy Regions
(Arctic regions highlighted in yellow)



Installed Capacity (kW) by AEA Energy Regions, 2010

AEA Energy Region	Total	Percent of Total
Aleutians	34,945	2%
Bering Straits	38,709	2%
Bristol Bay	27,561	1%
Copper River/Chugach	56,255	3%
Kodiak	63,056	3%
Lower Yukon-Kuskokwim	51,102	2%
North Slope	40,600	2%
Northwest Arctic	32,042	1%
Railbelt	1,418,213	64%
Southeast	410,733	19%
Yukon-Koyukuk/Upper Tanana	29,184	1%
Arctic Total	**111,351**	**5%**
Total	**2,202,400**	**100%**

Source: Fay, Ginny, Alejandra Villalobos Meléndez, and Corinna West. "Alaska Energy Statistics: 1960-2011 Preliminary Report." Institute of Social and Economic Research University of Alaska Anchorage and Alaska Energy Authority, November 2012. Web. 14 June 2013. *http://iser.uaa.alaska.edu/Publications/2012_11-AlaskaEnergyStatisticsCY2011PreliminarySummary.pdf.*

south of Anchorage, the supporting energy infrastructure of the Arctic will need to grow fivefold to more than 550 MW of installed capacity.[9] This capacity need translates into an energy need of roughly 3,850 GWh annually (550 MW at 80 percent availability year-round).[10] Such energy growth is possible, but not with the technologies currently deployed in the region. For example, although large volumes of natural gas are extracted during oil production on the North Slope, this supply currently has no way of reaching local markets in Alaska or being exported to foreign markets. Therefore, it is pumped back into the ground for repressurization of producing wells or used as fuel to operate equipment at oil production facilities.[11] Both combined cycle generation plants and fuel cells could utilize this excess natural gas production to provide electricity for a developing Arctic.

Energy Options

The energy solutions for the U.S. Arctic should match the conditions presented in the unique environments, such that local demand for energy is supplied through local resources to the furthest extent possible. Here we outline the energy options that may be available to power the Arctic.

Natural Gas

Expanded use of natural gas in Alaska's Arctic region seems to be the most natural bridge to a more secure energy infrastructure. As discussed above, natural gas is already produced relatively close to population centers and future commercial hubs (Figure 3). With one-third less carbon intensity than gasoline and diesel, it also represents a more environmentally friendly solution than existing methods of power generation in the region.[12] Natural gas is versatile: It can be used directly for domestic and industrial heating needs or as a fuel for utility-scale electricity generation via combined cycle gas turbines (CCGTs) or fuel cells.

According to current production and projections, natural gas alone could provide sufficient capacity to meet consumption within the state. If all current natural gas production were to be converted to electrical energy, it could provide as much as 6,380 GWh of energy annually. This is nearly double the projected energy need of 3,850 GWh in a more developed Arctic. Today, these extensive natural gas resources are often viewed as a waste product, since delivery to either domestic or foreign markets remains infeasible. Should access to markets become available, the amount and rate of production are likely to increase.

Nuclear

Small Modular Reactors (SMRs) represent a new generation of nuclear power plants worldwide. They are a fraction of the size of traditional nuclear reactor facilities and range from 10 MW to 300 MW in capacity.[13] A potential solution for distributed energy needs, the technology has been mentioned as a

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[9] Randstad. Assuming 80 percent capacity availability during the year. Average availability depending on technology usually ranges from 85 to 95 percent, so the 80 percent is an attempt to account for the uncertainties of operating in the harsh Arctic environment.

[10] Assuming 80 percent capacity availability during the year. Average availability depending on technology usually ranges from 85 to 95 percent, so the 80 percent is an attempt to account for the uncertainties of operating in the harsh Arctic environment.

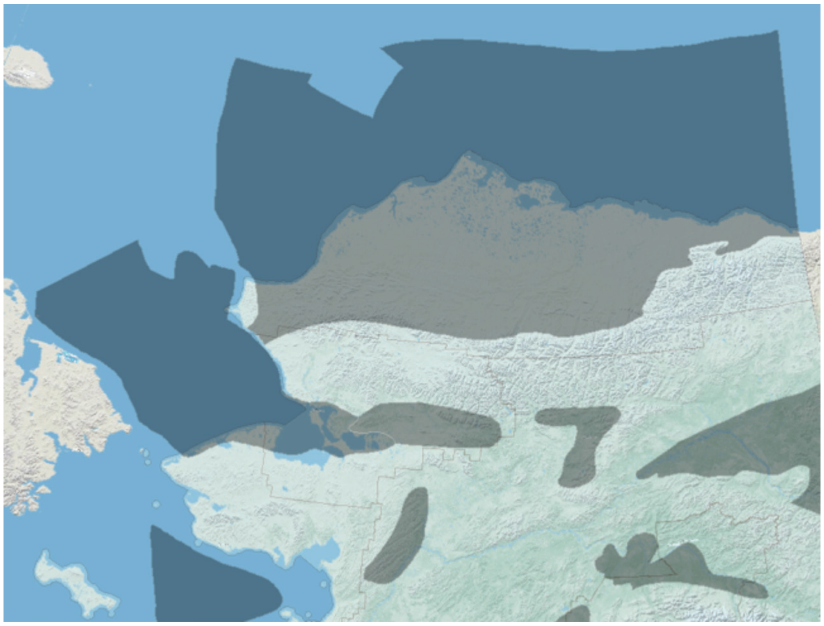
[11] U.S. Energy Information Administration (EIA). "Alaska State Energy Profile." EIA, July 2012. Web. 14 June 2013. See "Analysis: Natural Gas." *http://www.eia.gov/state/print.cfm?sid=AK.*

[12] British Columbia Ministry of Energy. "Determination of Carbon Intensity for the Renewable and Low Carbon Fuel Requirements Regulation." British Columbia Ministry of Energy, December 2010. Web. 22 February 2013. *http://www.em.gov.bc.ca/RET/RLCFRR/Documents/RLCF006%20Determination%20of%20carbon%20intensity.pdf.*

[13] Traditional nuclear power plants have capacities in excess of 1,000 MW. Holdmann, Gwen. "Small-Scale Modular Nuclear Power: An Option for Alaska? Draft Executive Summary." *University of Alaska, Alaska Center for Energy and Power* and the *Institute of Social and Economic Research*, March 2011. Web. 14 June 2013. *http://www.uaf.edu/files/acep/Executive-Summary-3-2-11.pdf.* Page 3.

Figure 3

Projected oil and gas reservoirs in Northern Alaska (highlighted in gray)



Note: Darkened regions (dark gray and dark blue-gray) indicate (onshore and offshore, respectively) sources of oil and gas.

Source: Alaska Energy Data Inventory ArcGIS. "Oil and Gas." Alaska Energy Data Inventory, 2011. Web. *http://akenergyinventory.org/data/.*

possibility for developing distributed energy infrastructure in the Arctic.

Unfortunately, no small-scale nuclear reactor technology is approved for commercial use in the United States, including Alaska. In fact, no SMR manufacturers have even submitted requests for design review and approval to the Nuclear Regulatory Commission (NRC). Even if a proposal were submitted today, the process could take more than 10 years to award final approval. Therefore, at least with regard to any SMR technology that could be installed in the United States, this option remains in the pre-commercial phase of development.

Renewable Energy Solutions

The remoteness of demand centers in the Alaskan Arctic results in issues like high fuel costs, limited fuel options, dependence on imports, supply chain and logistical challenges, and small markets with limited opportunities for profit at scale. Traditional energy solutions may not be favorably transferrable to Arctic applications. Therefore, renewable energy resources, particularly distributed energy generation, appear to be suitable options.[14]

Geothermal

Significant geothermal resources are known to exist in Alaska. However, there is almost no information on the thermal regime except in very localized areas, making the long-term development of geothermal sources speculative at this point.[15] In addition, Alaska's Arctic region has lower temperature gradients and heat flows than traditional high-quality hydrothermal reservoirs like those found in Iceland.[16] While Alaska does have some of these higher-quality geothermal reservoirs, very few of those sites are in the northern Arctic region of the state (Figure 4). Where the resource does exist, development of those sites should be encouraged and pursued.

Using the operating Chena Hot Spring geothermal power plant located outside Fairbanks as an example, the total geothermal resource available on the Seward Peninsula could amount to as much as 3 MW of generating capacity, or 2.5 GWh of energy production each year. Though that production may seem small in comparison with the overall need, exploitation of this geothermal resource would replace more than 20 percent of the currently installed diesel generating capacity while eliminating a large part of the supply chain uncertainty that exists in the Arctic for traditional fuel supplies.

Wind

Alaska has an abundance of potential wind resources, hosting the largest area of class 7 wind power in the United States (Figure 4).[17] In addition, the offshore wind potential of Alaska, particularly

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[14] Johnson, Eric, et al. "Stranded Renewable Energy Resources of Alaska." *Alaska Center for Energy and Power, University of Alaska Fairbanks,* June 2012. Web. 22 February 2013. *http://www.uaf.edu/files/acep/Standed- Renewables-Report-Final.pdf.*

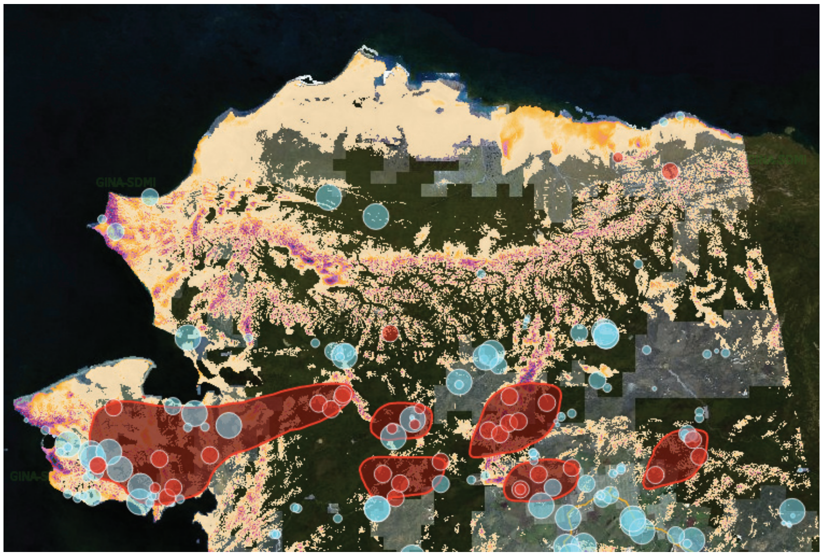
[15] Tester, Jefferson, et al. "The Future of Geothermal Energy." *MIT,* 1 November 2006. Web. 22 February 2013. *http://mitei.mit.edu/publications/reports-studies/future-geothermal-energy.*

[16] Southern Methodist University (SMU) Geology Department. "Geothermal Map of North America," *SMU Geology Department,* 2004. Web. 22 February 2013. *http://smu.edu/geothermal/2004namap/2004namap.htm.*

[17] Wind power classes are classifications of wind speed and power density on a scale of 1 to 7 in order to determine generally the suitability of a location for wind farm development. Elliot, D.L., et al. "Wind Energy Resource Atlas of the United States," *National Renewable Energy Laboratory,* 1986. Web. 8 November 2011. *http://rredc.nrel.gov/wind/pubs/atlas/.*

Figure 4

Combined resource map of Alaska (geothermal potential highlighted by red, greatest wind potential highlighted by purple in the yellow-to-purple gradient, and hydroelectric potential highlighted by blue circles)



Source: Alaska Energy Data Inventory ArcGIS. "Hydroelectric, Wind, Geothermal." Alaska Energy Data Inventory, 2011. Web. 22 Feb 2013. *http://akenergyinventory.org/.*

along the Aleutian arc and off the islands in the Bering Sea, is tremendous.[18] Even with such abundant wind resources, wind accounted for only 0.3 percent of the electricity generated in Alaska in 2011.[19]

One major issue with wind energy is its intermittency. Therefore, to be a reliable supplier of energy, wind turbines need to be combined with either an energy storage solution or an augmentation system that can produce energy when the wind is not blowing. Currently, wind energy is deployed in Alaska on a limited scale using combined wind-diesel generation units. Coupled with the wind turbine, a diesel generator switches on when the wind dies down.

Current wind projects in Arctic Alaska total just over 7MW of capacity, installed and under construction.[20] As an intermittent resource, this capacity translates into just over 20 GWh generated each year. While wind resources are very site specific and therefore difficult to estimate, the installed capacity would need to grow by eight times to replace the existing fossil fuel power plants in the Alaskan Arctic. Given that wind farms in the north of Alaska are relatively recent developments, it is reasonable to think that such an expansion is possible. Furthermore, the existing diesel units in many northern communities could be combined with wind solutions to consistently provide for industry and individual needs.

Hydroelectric

Hydroelectric power is the most abundantly developed renewable resource in the state and contributes 24 percent of the electricity consumed in Alaska.[21] However, nearly all of the installed capacity is located in the more populated areas of southern Alaska. In the north, hydro power would need to be developed on a smaller scale using run-of-river generators or harnessing tidal power. Despite the vast potential in Alaska, the technology to capture and convert ocean and river energy is still pre-commercial, and much of Alaska's resource is in the most remote locations of the state (Figure 4). The immaturity of the technology has limited the development of resources globally. The additional element of remoteness in Alaska has made the discussion of developing Alaska's stranded ocean energy resource speculative at best.

Biomass

While biomass can refer to the burning of woody plants and agricultural refuse or the conversion of such organic material to an energy product like biofuel, the focus in the Alaskan Arctic should be on waste-to-energy solutions. Human waste or garbage is already produced in the region, and the disposal can be especially

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[18] Elliot, D.L., et al. "Wind Energy Resource Atlas of the United States," *National Renewable Energy Laboratory,* 1986. Web. 8 November 2011. *http://rredc.nrel.gov/wind/pubs/atlas/.*

[19] Fay, Ginny, et al. "Alaska Energy Statistics, 1960-2011 Preliminary Report." *University of Alaska Anchorage Institute of Social and Economic Research* and *Alaska Energy Authority,* November 2012. Web. 19 February 2013. *http://iser.uaa.alaska.edu/Publications/2012_11-AlaskaEnergyStatisticsCY2011PreliminarySummary.pdf.*

[20] Alaska Energy Authority. "Wind Systems Operating in Alaska." *Alaska Energy Authority,* 2012. Web. 28 January 2013. *http://www.akenergyauthority.org/programwindprojects.html.*

[21] Alaska Energy Authority Renewable Energy Alaska Project. "2009 Renewable Energy Atlas." *Alaska Energy Authority,* 2009. Web. 20 July 2011. *http://www.akenergyauthority.org/publications.html.*

problematic in the Arctic. Therefore, it seems sensible to explore the possibility of using this waste as a fuel resource.

In rural Alaska, burning waste is a widespread practice to reduce waste volume, decontaminate refuse, and make waste less attractive to animals. Burn systems range from inexpensive but hazardous open burning to more effective but costly incinerators. Some form of incineration may be a valid option for a community in which a raw garbage landfill cannot be properly located, operated, closed, or monitored. This may be true in situations where water pollution, animal attraction, and other health and safety issues result from improper disposal of raw garbage.[22] Though simply burning waste is generally cheaper and easier than other waste disposal options, new waste-to-energy systems should be considered for Arctic Alaska.

On average, waste-to-energy plants are able to convert every 1.5 tons of waste to 1 MWh of energy.[23] The average American produces 4.5 pounds of waste per day; for Barrow, Alaska, with a population of 4,300, this means 3,500 tons of waste annually.[24] If this waste were to be processed in a waste-to-energy facility, this could produce 2.3 GWh of energy per year. Again, this is only a portion of the overall energy demand for the community, but this solution also addresses the problem of municipal waste that is especially difficult in the Arctic.

Energy Options Summary

Table 1 aggregates the combined wind, geothermal, and hydro resources potential to show that a renewable-only solution will be insufficient (Table 1). From a location standpoint though, there is consistent coverage of the coastal stretches of northern Alaska that are likely to experience the most development. Therefore, renewable resources should be developed to a large extent but also combined with other energy solutions.

Table 1

Combined renewable resource shortfall

Renewable Resource Potential	GWh
Geothermal	3
Wind	100
Hydro	760
TOTAL	363
Total Energy Needed	3,860
Renewable Shortfall	3,498

Policy Recommendation

To enable this energy mix, incentives must be properly aligned. We recommend the implementation of a state-level Renewable Portfolio Standard (RPS). An Alaskan RPS is presently needed in the absence of federal action. The state may issue tradable certificates for a given quantity of energy produced from renewable energy sources, including the wind, geothermal, or small-scale hydroelectric potential that span the state. These Renewable Energy Certificates (RECs) thereby create a new market and make renewable energy targets more palatable for utilities and communities.[25] Alaska can issue multiple credits for a particular energy in a particular region, according to the environmental benefits that accrue from an increased deployment of a particular technology, or the lower costs of deployment, due to regional suitability as outlined in "Energy Options" above. RPSs are politically feasible, already mandatory in 30 states and the District of Columbia, and voluntary in seven more.[26] With an RPS, Alaska can bolster locally sourced, renewable energy industries. This is the first step the region may take toward energy security. For more information on energy needs and recommendations, please refer to the full report.

Conclusion

This brief presents research on current and future energy needs in the Arctic and our evaluation of energy source options. The optimal energy mix has three principal components:

- Utilization of natural gas resources from reservoirs in the North Slope Borough
- Development of geothermal generation in the Nome Borough
- Exploitation of wind resources on the western coasts of the Northwest Arctic Borough and the Nome Borough.

These major resources for energy generation should be supplemented through waste-to-energy systems. Lastly, many of the major potential

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[22] Alaska Energy Authority and Alaska Department of Environmental Conservation. "Burning Garbage and Land Disposal in Rural Alaska." *Alaska Energy Authority and Alaska Department of Environmental Conservation*, May 2004. Web. 22 February 2013. *http://www.akenergyauthority.org/AEAdocuments/BurningGarbage.pdf.*

[23] Solid Waste Association of North America (SWANA). "Waste-to-Energy Facilities Provide Significant Economic Benefits: White paper." SWANA, January 2012. Web. 22 February 2013. *swana.org/portals/Press_Releases/Economic_Benefits_WTE_WP.pdf.*

[24] Clean Air Council. "Waste and Recycling Facts." *Clean Air Council*, 2010. Web. 22 February 2013. *http://www.cleanair.org/Waste/wasteFacts.html.*

[25] Farrell, John. "Finding the More Cost-Effective Solar Policy." *Institute for Local Self-Reliance*, October 2011. Web. 3 January 2013. *http://www.newrules.org/sites/newrules.org/files/CLEAN-v-SRECs.pdf.*

[26] EIA. "Most states have Renewable Portfolio Standards." *EIA*, 3 February 2012. Web. 21 February 2013. *http://www.eia.gov/todayinenergy/detail.cfm?id=4850.*

hydro resources in northern Alaska are located toward the interior, so should be more seriously considered in the long-term development plan of the region.

About the Authors

Drew DeWalt is a joint Master of Public Policy and Master in Business Administration graduate. He has focused his program of study on energy resources, energy policy, and entrepreneurship. His practicum project researched distributed energy solutions for the Arctic. The thesis was sponsored by Stanford's Hoover Institute and supported the Institute's work with respect to national security issues in the US Arctic region. Prior to Stanford, he was a nuclear submarine officer in the US Navy. Drew is currently working with his fellow MPP/MBA classmate, Juan Andres Camus, to develop a renewable energy project in Chile.

Katharine McCormick recently completed an MPP degree at Stanford, with a concentration in energy and environmental policy. Katharine received her BA in Comparative Literature and Hispanic Studies from the University of Pennsylvania in 2008. Before coming to Stanford, Katharine taught English, journalism, and environmental science in FutaleufÃº, Chile. In addition, before joining the Public Policy program, she earned an MA in Latin American Studies at Stanford in 2011. She has completed internships at World Wildlife Fund in Washington, DC, and Sowing Empowerment and Economic Development, in Riverdale, Maryland, and worked as a TA for the Introductory Economics Center at Stanford. In July, Katharine will begin work as a MAP Sustainable Energy Fellow at the Natural Resources Defense Fund (NRDC) in Washington, DC

Dylan Plofker graduated with his MA in Public Policy from Stanford, with a concentration in Legal and Regulatory Interventions. Dylan also graduated from Stanford with a BA in Public Policy, with a concentration in Advanced Economic Policy. During his studies Dylan worked for Stanford Student Enterprises, serving as its Director of Capital Group, and interned as an analyst at TCS Capital Management in New York. Dylan is currently living in New York working for Christine Quinn's mayoral campaign.

Maggie Wells is a Master of Public Policy graduate and an MD candidate at Stanford. Her areas of focus include health policy, biomedical ethics, reproductive justice, and the acquisition of cultural competencies among physicians. She researches LGBT-related curricular content in medical schools through Stanford's LGBT Medical Education Research Group. Maggie interned with the Public Affairs office of Planned Parenthood Action Mar Monte to get more pro-choice California state legislators and local officials elected in the 2012 elections. She hopes to practice family medicine and bring lower cost, higher value, dignified medical care to more people.

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