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THE POTENTIAL FOR INFRASTRUCTURE IMPROVEMENTS TO CREATE JOBS AND REDUCE THE COST OF LIVING THROUGH ALL-OF-THE-ABOVE ENERGY AND MINERAL PRODUCTION IN ALASKA

HEARING

BEFORE THE

COMMITTEE ON ENERGY AND NATURAL RESOURCES UNITED STATES SENATE

ONE HUNDRED FIFTEENTH CONGRESS

FIRST SESSION

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THE POTENTIAL FOR INFRASTRUCTURE IMPROVEMENTS TO CREATE JOBS AND REDUCE THE COST OF LIVING THROUGH ALL-OF-THE-ABOVE ENERGY AND MINERAL PRODUCTION IN ALASKA

THURSDAY, MARCH 30, 2017

U.S. SENATE,
COMMITTEE ON ENERGY AND NATURAL RESOURCES,
Washington, DC.

The Committee met, pursuant to notice, at 2:35 p.m. in Room SD–366, Dirksen Senate Office Building, Hon. Lisa Murkowski, Chairman of the Committee, presiding.

OPENING STATEMENT OF HON. LISA MURKOWSKI, U.S. SENATOR FROM ALASKA

The CHAIRMAN. Good afternoon, everyone. The committee will come to order.

I am pleased to welcome a great panel of Alaskans on today's sesquicentennial as we commemorate 150 years since the date Russia transferred to the United States the amazing place that we call Alaska. I had an opportunity to speak to this on the floor yesterday, and we just came from a lunch where we had further conversation, so it is only fitting and appropriate that we take a little bit of time this afternoon.

As a committee, we have been focused on infrastructure as it relates to energy and natural resources, and we have had a broad and expansive discussion. I appreciate the partnership that we have with Senator Cantwell in looking at our nation's energy infrastructure needs.

I think we recognize in the State of Alaska that we come from a state where we have a great deal of resource to offer, but more often than not, our opportunity to access that resource is limited because our infrastructure is limited. So this is an opportunity to talk about how we can enhance our infrastructure and thus better not only Alaska's position, but truly the position of our nation as a whole.

So again, this is the fourth now in our ongoing series of hearings. Over the past few weeks we have focused on infrastructure needed for our electric grid, mineral development, federal land maintenance backlogs, western water supplies, and many of the other challenges within our jurisdiction. But today we are here to examine infrastructure through the lens of Alaska. The United States has had many reasons to be focused on Alaska, and as I noted in

the statement that I made on the floor last night, there were many, many reasons that we looked specifically to Alaska with this purchase from the Russian territory. It was about our fisheries. It was about our strategic location. It was about our mountains. It was about the land itself. It was just to recognize that the size and scope of Alaska offered so much.

One of the best returns that Alaska continues to provide for all of America is really through our natural resource production. We have tremendous stores of all types of energy. We have now produced nearly 19 billion barrels of oil. We have at least twice that left untapped. We have tremendous reserves of natural gas, some 255 trillion cubic feet, just waiting to be brought to market. We have vast amounts of coal, methane hydrates, and unconventional resources as well.

Renewable energy is another hallmark of our state. We have it all. We have hydropower. We have wind. We have solar. We have geothermal. We have ocean energy. We have biomass. We have every renewable resource that you can think of. Many of our communities, especially in our remote areas, are developing hybrid microgrids that integrate these local resources to help them move away from expensive diesel generation. They are pioneering in these areas, and it is good to be a leader and have that be recognized.

Alaska has also been the site of many mineral rushes over the years in Juneau, in the Klondike, in Nome, in Fairbanks. And again, there is plenty more of that where it came from. Today Alaska continues to have a world-class mineral base, ranging from gold, silver, copper, and zinc to rare earth elements, graphite, and platinum group metals, all of which serve as building blocks to our nation's manufacturing sector.

Finally, I often describe myself as a child from the Tongass, having been born in Ketchikan. But when you think about the Tongass, nearly 17 million acres, more than three times the State of Massachusetts, and when you think about our extraordinary timber potential, really greater than any other state in the nation, and yet right now it is just a shell of its former self.

I bring all this up not to recite a litany, but to demonstrate that Alaska was always a resource-producing state. That is where our bounty has been. That was the promise we received at statehood and many times since then. Responsible resource production was how we would become a steady member of our Union, how we would build our economy, and how we would sustain ourselves across generations.

In recent years, access to federal lands and waters has become an issue that threatens our future. We have endured years of seeing our lands and our waters, our best opportunities for economic development, systematically locked down.

But I think that we have an opportunity in a new Administration. Even in the depths of an economic recession that we are clearly seeing now as Alaskans—we know that, and it is a recession with a capital R. We look at this fiscal crisis, but I think we have good reason to be optimistic.

Alaska is truly an all-of-the-above state. We were a true bargain for the country at roughly two cents an acre when that deal was

inked 150 years ago, but it is also critical to remember that we are still a young state. We have very little infrastructure of any kind, especially compared to older states, and we know that new infrastructure is one of the best ways to address our major challenges, including our rural energy costs.

So I look forward to hearing from our witnesses about the opportunities that we have to produce more of Alaska's resources in an environmentally sound manner while maintaining the beauty and the wildlife that make Alaska a great place to call home. We have proven across decades now that that is possible. What we need more than anything is access, and we need a partner at the federal level.

To help put federal policy for Alaska on a better track, today we are here to consider a number of questions. First, what policies should we implement to identify Alaska's energy and mineral deposits, whether through mapping or mineral exploration? And it is great to have at the dais here the Renewable Energy Atlas of Alaska identifying some of our great opportunities there. What policies should we pursue to open more of Alaska's resources to responsible exploration and development? And what types of infrastructure, from roads to ports to pipelines, will we need to bring these resources to market, and what is our federal system capable of in granting approvals on a timely basis?

We are going to hear testimony this afternoon regarding the Port of Nome and all that that opportunity presents. But we know that we need more than one port between Unalaska and the North, so we look to opportunities at Port Spencer, in Wainwright and Barrow, all the way along the coast, a system of ports and recognizing the need that we will have going into the future here, and what can be done to fulfill our state's goal of harnessing more of our renewable resources, especially to help our rural villages reduce the highest energy costs in the nation?

Finally, understanding the status of the state and federal budgets, what are our low-cost options and how can we attract more private sector investment to Alaska?

To help us understand these issues, we have a great panel of witnesses. We have Steve Masterman, who is Alaska's State Geologist. We have Mr. Bob Potrzuski, who is the Deputy Mayor in Sitka, a beautiful community in Southeast. We have Joy Baker from up north, the Executive Director for the Port of Nome. We have Kara Moriarty, who is the President and CEO of the Alaska Oil and Gas Association. We also have Chris Rose. Chris has been before the committee on several occasions. He is the Executive Director of the Renewable Energy Alaska Project. And finally, we have Della Trumble, also not a stranger to this committee, the Business Manager for the King Cove Native Corporation.

This is a good day to be talking about Alaska and a great group of Alaskans to have here. I welcome all of you, and I thank you for traveling such a long distance to be with us.

I am going to turn to Senator Cantwell for her opening remarks and thank her for the partnership that we have had as we have worked, again, not only on national infrastructure issues but her interest in helping us with the Alaska infrastructure piece.

Senator Cantwell.

STATEMENT OF HON. MARIA CANTWELL, U.S. SENATOR FROM WASHINGTON

Senator CANTWELL. Thank you, Chairman Murkowski, for holding this oversight hearing.

As you know, I went to Bethel last February, along with several members of the Energy Committee, to learn about innovative solutions that Alaskans are coming up with. So today I am sure we are going to hear more from our local leaders here about the challenges that you face in Alaska's communities, not the least of which is the high cost of energy.

Alaskans are used to goods and services being more expensive than the Lower 48, anywhere from two to ten times more expensive. And as the Chair reminds us, for households in rural Alaska, half of the total expenses can go to paying energy bills. Nearly 90 percent of rural communities are dependent on diesel fuel for their primary energy needs, which can cost over $8 a gallon. So I do not need to tell anyone here in this room that oil price fluctuation can hurt Alaska communities, and that is why diversification and new solutions are being deployed across Alaska to help reduce the cost of energy and moderate the impact on these fluctuations.

Dozens of Alaskan communities are already diversifying their diesel microgrids with renewable sources of energy. The City of Kodiak combines wind turbines, fly wheels, battery storage, and hydropower. The cost of wind energy is $0.11 per kilowatt hour there compared to diesel generation, which is $0.29 per kilowatt hour.

Weatherization of homes is also critically important in Alaska, especially in communities where home heating oil costs $8 per gallon. So I argue that it is time to make sure that the weatherization program helps all citizens of our country, but particularly the Alaskans. In my home State of Washington, the Weatherization Assistance Program helps 2,700 homes every year, and makes a big difference to those families.

So transitioning electricity generation to renewable energy and improving our energy efficiency in Alaska's homes and buildings not only saves Alaskan communities millions of dollars, but it also helps mitigate the contribution to global climate change. As we all know, Alaska is disproportionately impacted by the devastating impacts of climate change. Alaska is warming at twice the rate of the rest of the country, which has a big infrastructure implication for a state 80 percent covered in permafrost.

Communities faced with melting sea ice or permafrost are being forced to decide between relocating or staying put in harsh storms and rising sea levels. And I can tell you, Madam Chair, that we have the same issue in Washington along our coast as it relates to several of our Native American tribes who are in the very process of moving to higher ground because of various challenging situations.

We know this too—cookie cutter solutions do not work in Alaska. The geographic isolation and limited local economies, cold climate, small and isolated grids present complicated challenges. The solutions that can be adopted in Alaska are not necessarily the exact same ones that are in other parts of the country, so we need to work on energy solutions developed by Alaskans for Alaskans with

the technical assistance and robust networks of our national labs, academia, and the private sector.

Now, I would say in closing, this is not of interest just to the Chair of this committee. A 2015 study showed that the Puget Sound area benefited from our Alaska trade relation with 113,000 jobs and $6.2 billion in wages. That is in freight and cargo, seafood, maritime, and health care. The report is titled, "The Ties that Bind Puget Sound and Alaska." We have been bound for a long time, and we plan to be bound for a long time in the future. In my opinion, helping Alaska work through its energy solutions is good for all of the economy of the Pacific Northwest.

I look forward to hearing from the witnesses about what your ideas are on how we can best help. Thank you for traveling to be here with us in our nation's capital.

The CHAIRMAN. Thank you, Senator Cantwell, and I appreciate the recognition at the end about the economic ties that our two states have. I can tell you that whether you are from King Cove or Anchorage or Nome or Sitka, all of these communities rely on goods that come through Washington. They are either coming out of the Port of Tacoma or the Port of Seattle or they are coming through by air out of Sea-Tac. So when you talk about ties that bind, our economies are inextricably tied. I appreciate you noting that as well.

With that, we will begin comments from each of you. I would ask that you try to keep your comments to about five minutes or a little bit less, if possible. Your full statements will be included as part of the record, but that will allow for an opportunity for us to go through the full panel and then be able to ask questions at the end.

Mr. Masterman, if you would like to kick off the panel here this afternoon. Welcome and thank you for being with us. I am looking forward to your perspective as our state's Geologist.

STATEMENT OF STEVEN MASTERMAN, STATE GEOLOGIST AND DIRECTOR, DIVISION OF GEOLOGICAL & GEOPHYSICAL SURVEYS, ALASKA DEPARTMENT OF NATURAL RESOURCES

Mr. MASTERMAN. Thank you for that. Chairwoman Murkowski, Ranking Member Cantwell, honorable members of the Senate Committee on Energy and Natural Resources, as you noted, my name is Steven Masterman. I am Alaska's State Geologist and Director of the Alaska Division of Geological and Geophysical Surveys. On behalf of Governor Bill Walker and DNR Commissioner Andy Mack, I thank you for this opportunity to testify today.

Today I will highlight the vast potential for energy and mineral development in Alaska, summarize the current state of infrastructure and resource information, and identify some of the areas in need of investment to spur development.

As you know, Alaska holds some of the world's most prospective areas for hydrocarbon and mineral discovery on the planet. Infrastructure needed to increase resource development is critical to supporting Alaska's future economy, and there is an important federal role to be played.

The focus of my testimony today is Alaska's mineral potential and its infrastructure needs. But before focusing on Alaska's mineral development needs, I want to stress the need to support devel-

opment of Alaska's oil and gas resources as they remain our economically most important natural resources.

Alaska has been working hard to develop what may be the largest infrastructure project in our nation's history, a large diameter natural gas line from Prudhoe Bay to south central and associated gas treatment and export facilities. This project would create thousands of jobs domestically supplying equipment, materials, and personnel and would inject billions of dollars into the state and national economy. The sale of this volume of gas would also meaningfully improve the United States balance of trade.

In addition to this project, new east-west roads on Alaska's North Slope would facilitate exploration and production, connect communities, and reduce the cost of living in the region.

Following recent North Slope oil discoveries, there is a need to improve knowledge of the region's petroleum geology and update oil and gas resource assessments.

Finally, federal investment in high-risk, high-reward research into Alaska's unconventional gas hydrates, heavy oil, and shale should be a national focus because these represent undeveloped national scale resources.

While there is no question that Alaska's mineral potential is immense, this potential is not yet realized. Alaska currently has five large operating metal mines. Western Australia, which is not even twice as large as Alaska, has 192. This underdevelopment can be measured in dollars. Mineral production in 2015 in western Australia was about $100,000 a square mile. In Alaska, it was less than $5,000.

Alaska has very little road access. While the state has 17 percent of the nation's land mass, we have less than one percent of the nation's roads. All the large mines in Alaska are located within 50 miles of existing roads or the coastline, and the majority of advanced projects and half of the state's 7,400 mineral prospects also fall within 50 miles of a road. Simply put, infrastructure facilitates mineral discovery and production.

For natural resource development, infrastructure not only means roads but also the foundation for all of development: information. Every step of the discovery and development of an oil or gas facility or a mine necessitates a comprehensive understanding of the geology and the surrounding environment to ensure that a project is executed in a safe and environmentally sound fashion.

The fundamental information required is mapping, the simple understanding of where things are. Unfortunately, Alaska's geological, geophysical, geochemical, topographic, and hazard maps are incomplete at a scale usable for mineral or infrastructure development. At the current rate, many of these map sets will take centuries to complete. There has never been a better time to acquire this information because satellite computing and communication technologies allow for rapid data acquisition and distribution.

There are numerous advanced mining projects that would benefit from physical infrastructure development in the form of roads, pipelines, ports, or processing facilities. These are detailed in my written testimony. Federal participation in these projects would move many toward development.

At a time when domestic infrastructure investment is a national priority, the United States is becoming more than ever dependent on foreign supplies of minerals. With infrastructure support, Alaska's storehouse of mineral wealth could be key to reversing this trend.

The potential national benefits from infrastructure development in Alaska are significant, increasing the domestic supply of minerals, increasing our competitiveness, strengthening America's position in the Arctic, boosting our economy, and improving our balance of trade. Through a federal partnership, we can build an information and infrastructure base that will promote Alaska's potential to lead the nation in mineral production and safeguard our economy and military from reliance on foreign supplies of minerals.

In summary, the more we provide access to Alaska's natural resources, the more employment, economic, and security benefits we expect to accrue to Alaska and the nation. With solid federal support, we look forward to filling Alaska's role as a storehouse for our nation's energy and mineral resources.

Thank you again for the opportunity to testify today.

[The prepared statement of Mr. Masterman follows:]

Testimony before the U.S. Senate
Committee on Energy and Natural Resources

Hearing on:

The Potential for Infrastructure Improvements to Create Jobs and Reduce the Cost of Living Through All-of-the-Above Energy and Mineral Production in Alaska

March 30, 2017

Submitted by:
Steven Masterman
State Geologist and Director
Division of Geological & Geophysical Surveys
Alaska Department of Natural Resources

I. Introduction

Chairwoman Murkowski, Ranking Member Cantwell, and honorable members of the Senate Committee on Energy and Natural Resources – my name is Steven Masterman and I am Alaska's State Geologist and Director of the Alaska Department of Natural Resources (ADNR) Division of Geological & Geophysical Surveys (DGGS). On behalf of Alaska Governor Bill Walker and ADNR Commissioner Andy Mack, I thank you for this opportunity to testify on the immense potential for energy and mineral production in Alaska and the important role federal infrastructure improvements play in developing these resources. We applaud your efforts to build our state and benefit our country as a whole by revitalizing the United States' energy and minerals supply chain, supporting well-paying jobs, and reducing our dependency on foreign supplies.

In my testimony today I will highlight the vast potential for all-of-the above energy and mineral development in Alaska, summarize the current state of infrastructure and resource information in our state, and identify some of the areas in need of improvement to spur investment and development. I will list examples of major infrastructure projects and conclude with a number of federal actions that can help make real economic and lifestyle improvements in our state. As I will mention throughout my testimony, Alaska's storehouse of natural wealth is truly a national asset, with national benefits if responsibly utilized. I very much appreciate your time and consideration.

II. Alaska's Immense Energy and Mineral Potential

Alaska holds some of the world's most prospective areas for hydrocarbon and mineral discovery on the planet. My fellow witness Kara Moriarty of the Alaska Oil and Gas Association is an excellent source of information on Alaska's oil and gas opportunities and infrastructure needs and, as her testimony focuses on these topics, my testimony will focus more on the role our mineral potential can play in providing jobs and stable livelihoods to Alaskans. However, I would be remiss if I did not highlight that Alaska's oil and gas is our most economically important natural resource. The

infrastructure improvements needed to continue their development will be critical to Alaska's economy in the future, and there is an important federal role to be filled. Oil and gas production from state lands has been our economic backbone for decades, and we hope – with additional investment and infrastructure development – it will continue to be a key part of our economy in the coming years as well. We are hoping to also see infrastructure build-out and energy development on adjoining federal lands of the North Slope, and appreciate your attention and leadership in this area.

To date, our state has brought to market approximately 17 billion barrels of oil and has played a critical role in meeting the United States' energy needs with reliable domestic supplies. Regarding natural gas, every day producers on Alaska's North Slope reinject a volume of natural gas so large that it could satisfy much of Canada's daily demand. If processed into liquefied natural gas (LNG) it could be shipped to the Pacific Rim in quantities that would measurably decrease our national trade deficit. However, utilizing this gas is dependent on exactly the topic under discussion today – major infrastructure development in the form of an international-scale natural gas pipeline and LNG liquefaction facility.

In addition to these known resources, Alaska remains a prime location for new discoveries and new projects. As has been widely reported, just this year the largest domestic onshore oil discovery in 30 years occurred on Alaska's North Slope at Armstrong and Repsol's Horseshoe/Pikka discovery. Both new explorers and longtime Alaskan producers continue to find huge, conventional, onshore oil fields in Alaska. Ongoing federal infrastructure support will be necessary to continue this kind of success and bring these finds to market.

I know that other witnesses here will be talking about infrastructure needs for some of Alaska's other natural resources, such as the transmission infrastructure needed to bring renewable power to market – from wind to hydropower and everything in between – and the benefits of distributed renewable generation. In southeast Alaska we need access to timber, and the associated infrastructure to move that timber to market. Along our coasts, we need port facilities, especially in the Arctic as international transit opportunities begin to open. Our fisheries, long one of Alaska's most valued and valuable renewable resources, are certainly a source of economic energy and an area for continued investment. I am glad that these other witnesses are here to provide details on these important topics.

The focus of my testimony is primarily Alaska's mineral potential and its infrastructure needs. There is little question that this potential is immense. Mining exploration companies routinely rank Alaska in the top 5 jurisdictions globally in terms of mineral potential, and the 2015 Fraser Institute Survey of Mining Companies ranked Alaska second worldwide for mineral potential, behind only Western Australia and ahead of Nevada. What we know of Alaska's geology, the scale of the finds that have been made, and the deposits that are already being produced tell us that Alaska contains abundant undiscovered and undeveloped mineral resources.

This point can be well illustrated by statistics on five metals that all have important applications in today's technologies and advanced industries: Copper, Lead, Zinc, Gold, and Silver. All of these metals can be found in abundance in Alaska – of the entire world's known resources defined by exploration drilling, Alaska contains 4%, 4%, 8%, 6%, and 4% of each respectively. The U.S.

Geological Survey (USGS) estimates that undiscovered resources may be several times the size of those already discovered. This places Alaska's mineral resources on a world stage.

III. Alaska is Underexplored and Needs Information and Infrastructure Investment

Resource potential generally translates into resource production. Investment in information and infrastructure must be put into the system to support exploration and, eventually, development. In almost every area of Alaska's resource potential there are numerous opportunities to support jobs by providing this information and infrastructure investment.

Productive but Underexplored Petroleum Systems

Before focusing on Alaska's mineral development needs, I wanted to reiterate the need to continue to support exploration and production of Alaska's hydrocarbon resources. Recent discoveries totaling 2.5 billion barrels of new North Slope oil highlight the region's remaining onshore potential, and we hope to see more of these successes. One key piece of information infrastructure the federal government can provide is updated USGS resource assessments recognizing these new discoveries. These new play types largely fall outside of current USGS assessments of undiscovered oil on the North Slope – not to mention they already exceed some of the predicted volumes of potential oil. Prior to updating these assessments, federal efforts are required to improve publicly available knowledge of the petroleum geology in these areas.

Despite recent discoveries, Alaska's North Slope remains underexplored, with 500 exploration wells on the North Slope compared to the State of Wyoming's approximately 19,000. Nor does the North Slope possess the vast network of distribution and collection infrastructure of other areas. While the recent discovery at Pikka is the largest onshore oil field discovered in North America in the last 30 years, there has been little exploration to the west of this discovery, an area with virtually no infrastructure for 200 miles. Federal support for additional east-west infrastructure in this region would facilitate exploration and production and could also connect communities and reduce the cost of living in the region.

Another area for potential federal partnership and support is locating adequate supplies of sand and gravel for infrastructure construction across the North Slope, especially in western areas around the National Petroleum Reserve – Alaska (NPR-A). These materials are in short supply in existing production areas and onshore and offshore sand and gravel resource assessments are critically needed to locate supplies for ongoing operations and future construction.

High-risk, high-reward research into developing Alaska's unconventional gas hydrates, heavy oil, and shale-hosted resources should be a national focus, because these resources represent an immense national asset. If technological advances allow economically viable production from any of these resource classes, it would change the United States role in the energy world.

New Infrastructure for Geologic Data Preservation

As Director of my Division, I also must take a moment to boast about our recently renovated and upgraded Geologic Materials Center (GMC). Our new facility allows us to host one of the largest repositories for geologic materials in the nation. The GMC in Anchorage makes decades of accumulated geologic materials and samples available for industry and academic research, and for Alaska's students. Continuing to preserve and add physical rock and drill samples as well as

archiving, digitizing and serving at-risk geologic data is a national benefit, and we have appreciated the assistance of the USGS. These materials are irreplaceable and an invaluable resource for current and future geologists and engineers. Increased federal support for geologic data preservation could facilitate future resource development by allowing tomorrow's explorers to build on prior work – especially as new federal areas in the NPR-A see their first production.

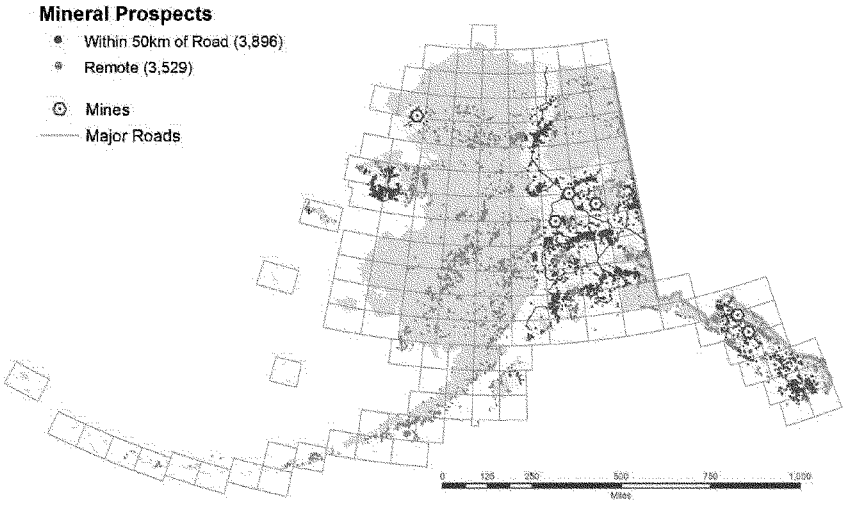
Untapped Mineral Potential

Alaska's mineral resources are dramatically underdeveloped compared to other jurisdictions. I mentioned above that Alaska ranked between Western Australia and Nevada for mineral potential – but our current production statistics could not be further apart. Alaska currently has five large operating metal mines. Western Australia, not even twice as large as Alaska, has almost *forty times* as many operating mines – 192. Nevada, less than a sixth of the size of Alaska, has 97 – almost *twenty times* as many. The impact of this underdevelopment on Alaska's economy can be measured in dollars – the gross value of mineral production per square mile of territory is $100,000 for Western Australia and $65,000 for Nevada. For Alaska, it is less than $5,000.

Limited Road Access

Alaska has very few roads. While the State has 17% of the nation's land mass and is by far the largest state, we have 0.4% of the nation's total lane-miles of road. The limited road system has real impacts on the cost of transportation of goods to communities throughout the state, and presents real challenges to the exploration and development of mineral resources. Mining operations often require a great amount of equipment and supplies to come to the mine site, and without road access additional transportation costs inhibit development in the many roadless areas of Alaska.

Many of the roads in Alaska today date back to prior infrastructure efforts to access mineral or energy resources, often gold. A quick look at the map below shows that half of Alaska's known mineral prospects lie within 30 miles (50km) of a road. All of the currently operating large mines in Alaska were within 50 miles, and 5 of the 6 were within 30 miles, of existing roads or the coastline at the time of their discovery. The majority of Alaska's advanced exploration or development projects also lie within 30 miles of a road or the coast. Simply put, road access facilitates mineral discovery, production, jobs, and local connectivity.



Outdated and Incomplete Mapping

However, for natural resource development, infrastructure does not only mean roads, ports, pipelines, and hard facilities. The foundation for all of these items is information. Every step in the discovery and development of an oil and gas field, large renewable resource project, and especially a mine must be grounded in a comprehensive understanding of the geology and the surrounding environment to ensure that the project is environmentally sound and safe in addition to being economic. The availability of water supplies, the hydrology and topography, the location of construction materials like sand and gravel, and the presence of natural hazards must all be understood before the design of a project can really begin. Comprehensive information can make millions of dollars of difference in the cost, and keep the workers safe in remote conditions. Conversely, the lack of information can add to construction costs and even mean that good projects never get off the ground.

A fundamental kind of information is mapping – the simple understanding of where things are. Unfortunately, Alaska is incompletely mapped for any geologic dataset at a useable scale for mineral or infrastructure development. If fact, we lag the nation in almost every kind of mapping. Many of our mineral resource assessments were completed before the advent of computers, cell phones, and Global Positioning System technology. In a world where new technology requires a broader suite of minerals and metals than ever before, we do not even know the mineral potential in many parts of Alaska.

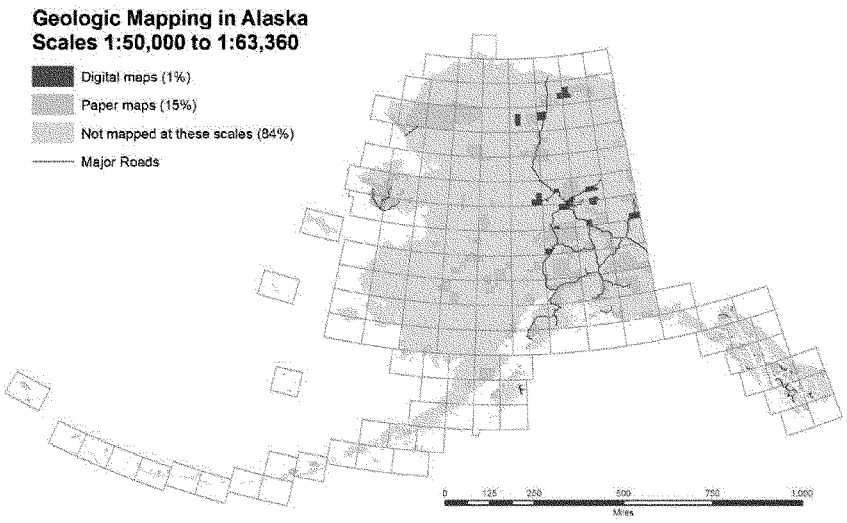
In the sections below, I will briefly summarize the different technical categories or "information layers" of mapping that are used in infrastructure development and mineral exploration, and

identify areas where Alaska is especially in need of investment and improvement. As you will see, across most of Alaska, these layers are incomplete, outdated, and unavailable in digital formats used by modern explorers. The primary information layers include geologic, geophysical, and geochemical, mineral resource assessments, topography, and hazards mapping.

Basic Geologic Mapping

Basic Geologic maps describe the fundamental geologic features of areas – such as the age of various rock formations, the different structures that are present, and the distribution of different rock types at the surface. This information forms the basis for initial mineral exploration by providing an understanding of what kind of minerals may be present. Without geologic information, explorers and infrastructure builders are working with a blank canvas.

Scale is important for adequate geologic mapping. Mapping for infrastructure and resource development all require relatively detailed information. Publicly available mapping in Alaska is only 16% complete at a scale appropriate for these activities. At our current mapping rates it will take at least an additional 400 years to completely map the state. Furthermore, only 1% of the state is covered by digital geology maps at this scale, leaving even the major mineral belts, and energy basins far from comprehensively mapped. Digital information is required by today's explorers. The figure below shows the current state of geologic mapping:



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Geophysical Mapping

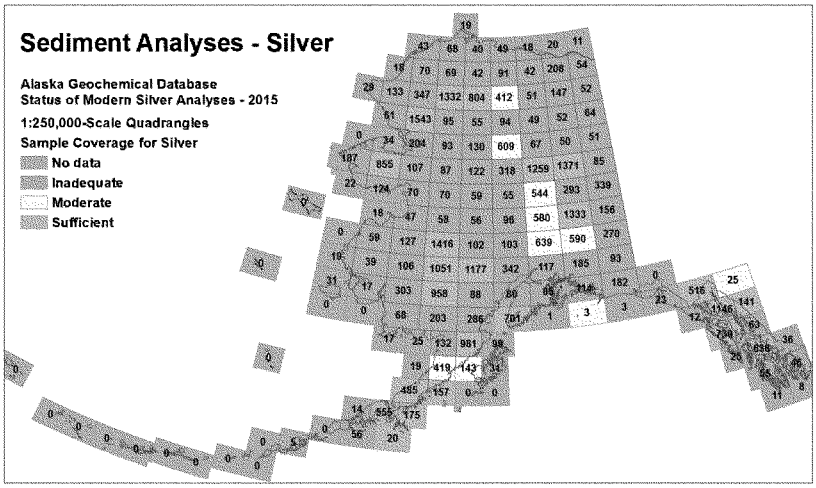
Geophysical maps display the electric, magnetic and radiogenic characteristics of rocks in an area, and often contribute to construction of geologic maps. Geophysical data allows geologists to "see" beneath dense tree or soil cover. Today, high quality information can be relatively quickly gathered using helicopter and airplane based tools. Alaska is about 4% mapped by high-quality airborne geophysical surveys. In addition to being a tool to better understand unexplored and undeveloped resources, geophysical mapping around existing infrastructure is important to identify permafrost, groundwater, sand and gravel resources, and geologic hazards.

When coupled with good geologic maps, geophysical information can be very valuable to explorers. This kind of data has already led to numerous mineral discoveries in Alaska, including gold that is currently being produced from the Pogo gold mine. As more geophysical mapping is completed we expect to see increased investment in exploration and production in several different prospective areas.

Geochemical Mapping

Geochemical mapping highlights mineral potential using chemical analyses of samples taken from the soil, rock, or stream sediments of a given area. Alaska does not have a modern, comprehensive geochemical dataset for a broad range of commodities. Improving Alaska's geochemical data coverage is essential for understanding Alaska's mineral-resource potential. In most of Alaska's 1:250,000-scale quadrangles, sample coverage is uneven, analytical methods are outdated, and sample density is insufficient to assess mineral resource potential with any certainty. As much of our data is historical, it varies in quality and was not analyzed for the suite of minerals explorers are seeking today.

Geochemical information is available in many regions of the world, and comprehensive soil geochemical coverage was recently completed for the contiguous United States. Unfortunately, extending this coverage to Alaska has not yet begun. Only 15% of Alaska's 1:250,000 scale



quadrangles have adequate stream sediment coverage and modern analyses for a metal as common as silver, and many other metals and minerals have much less information. Federal focus on soil geochemistry and stream sediment geochemical mapping will be critical to Alaska's infrastructure planning and future mineral development.

Mineral Resource Assessments

Mineral resource assessments are a compilation of different kinds of information that assess the quantity of a mineral or commodity likely to be present within a geographic area. Many of Alaska's energy and mineral resource assessments were conducted decades ago. Many of them are outdated or inaccurate to the extent that some single oil and mineral discoveries contain more resources than the assessment predicted for a specific petroleum play, or mineral model, in an entire region.

In general, these estimates of undiscovered resources have underestimated volumes, in some cases considerably, because they are based on historical or incomplete data. For a region as underexplored as Alaska, new technology and new data will likely show more potential than is currently recognized. These assessments need to be updated to reflect recent oil and mineral deposit discoveries. Additionally, for minerals such as rare earth elements that underlie advanced technology and modern military hardware, assessments that were begun with state funding, but due to recent budget constraints, have been suspended, need to be completed. The nation needs to update these assessments to understand its domestic supplies of critical and strategic minerals. However, to successfully do so the portfolio of geologic, geophysical, and geochemical information for these areas must be improved as well.

Topographic Mapping

Topography is the three dimensional surface of the earth, and an accurate understanding of it is critical to the planning and development of infrastructure. The USGS is the nation's principal civilian mapping agency, and is in the midst of a national effort to collect modern, highly accurate topographic data through its 3D Elevation Program. The result of this program will be coast-to-coast elevation data with far more detail than previously available. The elevation data collected by this program and resulting topographic maps will improve the usefulness of other geologic data and aid in the design of new infrastructure.

In Alaska, the USGS will soon complete the acquisition of interferometric synthetic aperture radar (IFSAR) data, which allows for high resolution contour mapping of the surface. This is a good first step to improved mapping in Alaska, but many additional geospatial layers need to be completed to have a full understanding of Alaska's complex topography. Light Detection and Ranging (LIDAR) data will need to be gathered to further understand topography in areas where IFSAR data is not high enough in resolution, and bathymetric data is needed to support maritime infrastructure development, coastal security, offshore oil and mineral resource assessments, and coastal hazards analyses. While Alaska has been making progress in this area, it has only come through dedicated federal focus and investment to move it forward in partnership with the State. We appreciate this collaborative partnership which has been led by the Alaska Mapping Executive Committee under the leadership of the Department of the Interior.

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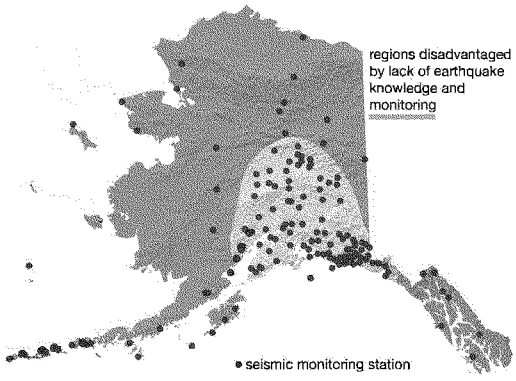
Hearing on the Potential for Infrastructure Improvements in Alaska

Geologic and Seismic Hazard Mapping and Monitoring

The same geologic richness and complexity that creates Alaska's abundant mineral resources has also created an environment ripe with geological hazards, including permafrost, landslides, active faults, 54 active volcanoes, and numerous areas prone to large earthquakes. Any infrastructure project must understand how these hazards impact safe and efficient operations before it can be undertaken.

When undertaking capital investment, risk is cost. And the best way to mitigate the risk and cost of geologic hazards is comprehensive information about their likelihood coupled with active monitoring.

Alaska's citizens and businesses have long understood the importance of design in mitigating the risk of earthquakes. Thorough understanding of past earthquakes and future planning allows facilities to be built for decades of safe operation. This understanding continues to be developed through long-term seismic monitoring. As there are more than 100 earthquakes reported every day in Alaska, there is a vast amount of data to use to continue to improve our knowledge of earthquakes. Even though almost all quakes are small, each one is a clue to understanding the active faults in our state that can, and occasionally do, produce catastrophic earthquakes.



In addition to its benefits in residential centers, sufficient earthquake information allows mineral, oil, and gas development companies to routinely make hundred-million-dollar engineering decisions based on the historical distribution, magnitude, and pattern of earthquakes. In the absence of robust earthquake information, prudence requires designing with overly conservative assumptions. Lack of knowledge disadvantages new construction with increased precautionary costs. This uncertainty also opens the door to lawsuits during environmental review with all parties unable to substantiate claims using sound science. Understanding the hazard upfront through long-term seismic monitoring and geological mapping can mitigate the need for costly retrofits and can help streamline permitting in Alaska by removing the specter of uncertainty.

Large portions of Alaska, representing about 10% of the total area of the United States, are uniquely devoid of the basic monitoring assets taken for granted elsewhere in the nation. The National Science Foundation's USArray project presents a one-time opportunity to address this imbalance in 2018. If, with federal support, Alaska can adopt a sufficient portion of this facility into its earthquake monitoring program, the ability to provide earthquake awareness for infrastructure projects could, in a single stroke, be brought up to par with the rest of the nation.

Alaska's 54 active volcanoes also present unique challenges, both for local infrastructure and international and military aviation safety. Volcanic ash from eruptions presents a threat to military aircraft engaged in national defense and in military training exercises, and to passenger and freight flights between North America and the Far East. In fact, over 90% of air traffic between North America and Asia crosses airspace that can be affected by Alaska's volcanoes. Improvements to maintain functional geophysical monitoring networks at high threat and very high threat volcanoes under new digital standards required by the National Telecommunications and Information Administration (NTIA) are unattainable at current funding levels. Especially in the context of the State's current fiscal circumstances, federal support will be critical to keep the national interests in hazard mapping and monitoring progressing to current standards and levels.

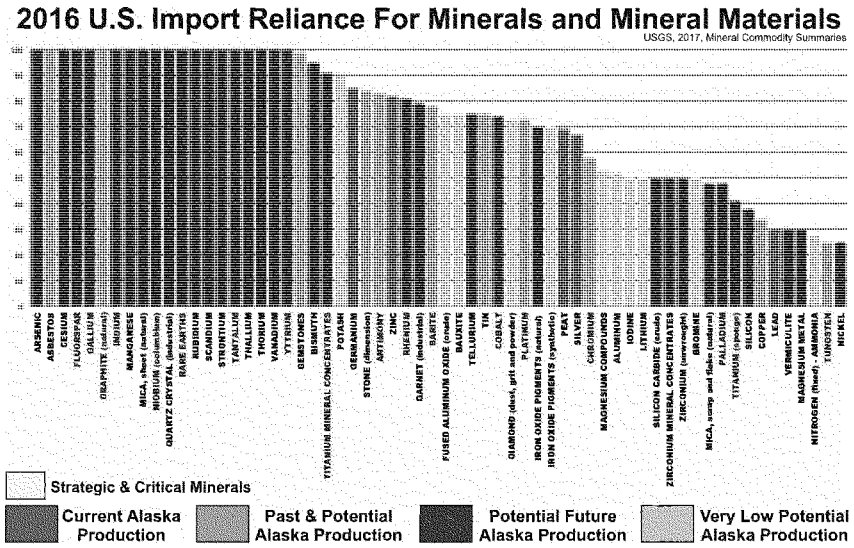
Materials and Construction Supplies Identification

Finally, improvements in the resource information above can have an important practical benefit to infrastructure projects – identifying soil conditions suitable for construction and identifying the presence of sand and gravel, armor stone, and railroad ballast along transportation corridors. In Alaska this kind of information is only very sporadically publicly available, and additional information about it would increase competition and drive down costs for these challenging projects.

IV. Alaskan Infrastructure Improvements Will Promote Local Economies and Benefit the Country as a Whole

Energy and minerals investment are cornerstones of Alaska's state economy, through employment and economic activity during the exploration phase and the additional royalty and tax revenue benefits when prospects are brought into production. Infrastructure built to support projects can also decrease the cost of living by providing energy supplies to communities, increasing public access, and lowering the price of goods and services. For projects that occur in remote areas, they can often be a significant source of well-paying jobs that bring a community together. For a mine like Red Dog in Northwest Alaska, it can be an economic engine for an entire region. However, Alaska's resources are also a national level asset, and their development and production yields national benefits.

One significant national contribution Alaska's mineral resources could provide is supply security. In 2016, the United States imported 100% of 20 mineral commodities and was dependent on foreign sources for over 50% of its usage for an additional 51 mineral commodities. This reliance has increased from just two years ago in 2014, when the USGS reported 19 mineral commodities were 100% imported and 41 were over 50% imported. At a time when domestic infrastructure investment is a national priority, the United States is becoming even more dependent on foreign supplies of minerals rather than producing domestic supplies. With federal infrastructure support, Alaska's storehouse of mineral wealth could be key to reversing this trend. As shown in the chart below, almost all of these minerals are historically, currently, and potentially available from Alaskan deposits.



Alaska and the United States are competing with countries all around the world to produce minerals and receive the associated economic and security benefits. In many of these countries or states, governments support their domestic industry through the same kind of infrastructure projects we are discussing today - baseline resource information and national road, airport, and sea port investments. In the United States, geological data collection and distribution has long been recognized as a key investment and responsibility for federal and state governments through their geologic surveys.

Without a federal partnership for resource infrastructure, Alaskan supplies and Alaskan projects will be at a disadvantage in the international marketplace, and the national trend of increasing reliance on imports of minerals and metals may continue. Only those large companies that can bear the cost of collecting the raw data and developing their own infrastructure portfolios will be able to do business, exploration costs will be higher, and competition will suffer. The remote regions of Alaska that may have the most potential, may see very little exploration at all.

However, with federal leadership and partnership, we can build an information and infrastructure base that will promote Alaska's potential to lead the nation in mineral production, and safeguard our economy and military from reliance on entirely foreign supplies of materials. There has never been a better time to develop natural resource information, as computing and communications

technology allow more data to be gathered in a day than a team would do in a season when Alaska's resource information was initially developed. In summary, the more we know about Alaska's natural resources, the more well-designed and economically important infrastructure we will be able to put into place, resulting in more employment and economic benefits accruing to Alaska and the United States.

V. Alaska's Numerous Significant Potential Development and Infrastructure Projects

In addition to the general infrastructure issues and benefits summarized in my testimony so far, I wanted to provide highlights of a number of significant ongoing resource and infrastructure development projects in Alaska. This list is by no means exhaustive, but all of these projects could benefit, along with their associated economic and employment opportunities, from the information and infrastructure investments I have presented. I will also summarize the work of the Alaska Industrial Development and Export Authority (AIDEA), which functions as a state infrastructure support fund.

The Alaska Natural Gasline Project

Alaska has been working hard to develop what may be the largest infrastructure project in our nation's history – an 800 mile large diameter natural gas line to bring Alaska's immense natural gas resources to market. Over $600 million has already been spent to date on engineering, design, and regulatory permitting for the main three components of the project:

- A gas conditioning plant on the North Slope
- An 800-mile gas pipeline
- A liquefaction plant and port at tidewater

The potential gas supply for this project are the massive volumes of natural gas that are daily reinjected back into the North Slope oil fields to provide the additional pressure needed to extract more oil. Much of that gas is no longer needed for pressurization and is now available to be sold in world markets. This volume of gas is significant enough to provide almost twice Korea's demand and up to 80 percent of Japan's, two of the world's largest consumers of LNG.

This project's scope and impact would be analogous to the construction of the Trans Alaska Oil Pipeline, which created over 70,000 constructions jobs, across the United States supplying equipment, materials, and personnel. In addition to the job growth and economic stimulus within Alaska and the United States, the international sale of this volume of LNG, primarily throughout Asia, could reduce the United States' trade deficit by up to 20 percent.

Additionally, development begets development. Building this pipeline would vastly improve the potential economics of oil exploration across the North Slope, because it would provide a way to take associated natural gas finds to market in addition to oil finds. This enhanced natural gas availability could strengthen the development of other industries in Alaska - such as mining and industrial products development - and support the U.S. military's Alaska-based Arctic operations. The virtuous cycle of growth from all of this additional development would boost employment, promote trade that puts U.S. interests first, and strengthen the United States' strategically important position in the Arctic and Pacific theaters. Marketing these vast amounts of Alaskan LNG

to the Pacific Rim would also have a huge geopolitical impact - allowing our nation's allies to cut their dependence on energy supplies from our potential adversaries and economic competitors.

AIDEA – The State's Vehicle for Financing Infrastructure Development

AIDEA is a state government entity that provides innovative financing for mineral and infrastructure projects to lower project capital and borrowing costs. Expended funds are repaid by the development over the course of its operation. Similar use of federal funds for major project infrastructure elements has been used to reduce capital costs and incentivize development of national energy and mineral resources, and the State would be happy to explore and further describe this work with federal partners.

AIDEA, as a public corporation of the State of Alaska, has a mission to promote the health, security, and general welfare of Alaska through increasing job opportunities and otherwise encouraging the economic growth of the state, including the development of its natural resources, through support for manufacturing, industrial, energy, export, and small business enterprises. AIDEA provides various means of financing, including through partnership with other financial institutions, private sector enterprises, economic development groups, and guarantee agencies, to advance these kinds of projects. AIDEA has assisted Alaskan companies in industries across the state for 50 years and has facilitated more than $12 billion in export and investment activity. More than 90 percent of AIDEA's customers are small and medium-sized companies, and a substantial amount of its annual activity brings jobs and cost of living benefits in Alaska's rural areas.

A frequently cited example of a successful AIDEA project is the "Red Dog Road", formally titled the DeLong Mountains Transportation System. It was opened in 1989 by AIDEA to facilitate the Red Dog mine development with a 50-year repayment period. As of 2026, the bonds that financed the road will be paid down by the mine and the transportation system will operate at a profit. Many of the projects enumerated in my testimony could explore similar infrastructure partnerships with AIDEA or potential federal partners.

Ambler Mining District Industrial Access Project (AMDIAP)

The Ambler Mining District in northern Alaska contains numerous prospects for copper, gold, lead, zinc, and silver production. The U.S. Congress has previously recognized the mineral potential of the area and the role access could play to support its economic development. The AMDIAP project could provide all-weather surface access to the Ambler Mining District to facilitate development of several of these deposits, and enable further exploration and characterization of the area's resources. The 225-mile road is modeled on AIDEA's successful DeLong Mountain Transportation System.

The Donlin Gold Project

The Donlin Gold project, currently going through permitting and National Environmental Policy Act (NEPA) review, has gold reserves and resources in excess of 40 million ounces. It is a remote project in western Alaska that requires significant new infrastructure: a power generation plant, mill, wastewater treatment plant, conveyor systems, warehouses, truck shop and offices, a port site on the Kuskokwim River, and a 30-mile long access road from port to the mine. In addition, a new airstrip, camp and port near Bethel will be built. Power required for the mining operations is

proposed to be produced from an on-site natural gas-fired generation facility, with natural gas supplies from the Cook Inlet basin via a 312-mile long, 14-inch diameter steel pipeline. As an example of the local cost-of-living benefits, this pipeline will also serve as a new energy source for the surrounding villages, reducing their power costs.

The Graphite Creek Project

Located on the Seward Peninsula, approximately 50 miles from Nome, this is the largest graphite deposit in the United States and could supply the nation's graphite needs for decades. Natural graphite is a "Supply Critical Mineral", and currently there is no domestic production. Infrastructure needed for the project is anticipated to include a 16-mile, all-season access road and a power generating facility. In addition, the project is exploring opportunities to locate their graphite reprocessing facility in Alaska, which, with infrastructure and financing support, would be an additional boost for local employment and economics.

The Palmer Project

Located approximately 35 miles from Haines in Southeast Alaska, Palmer is a high-grade copper-zinc deposit with tremendous expansion potential. Future infrastructure needs would include a 15 mile access road and a power generating facility. Development of this project would be a new economic engine in a region that has lost its significant timber industry in the last several decades.

Bokan Mauntain

The Bokan property on Prince of Wales Island is the largest heavy rare earth deposit in the U.S. Approximately 40% (by weight) of the rare earth elements contained on the property are heavy rare earths elements – which are especially useful in advanced technology and military applications. Infrastructure required includes road development and a processing facilities, either at the mine site or in Ketchikan approximately 35 miles away. The Alaska State Legislature has already approved AIDEA support for the project in recognition of its local and national importance.

The Niblack Project

The Alaska Legislature has also authorized AIDEA to support the Niblack Project, a copper-gold, zinc-silver deposit on Prince of Wales Island. The construction and operation of a mineral processing mill, dock, and loading facilities at the Gravina Island Industrial Complex in Ketchikan would, like the previous two projects, provide a jobs boost and a new economic center in Southeast Alaska.

Information Gathering to Address Coastal Community Challenges

Many coastal communities in Alaska are situated in dynamic locations exposed to natural ocean processes and events. These communities are challenged by a lack of construction materials, and continuous erosion from large storms. Many communities do not have safe, reliable transportation routes to shelter and evacuation areas in the event of large storms or tsunamis. Continued federal support for ongoing federal-state collaborative community resilience, water level, coastal mapping, and storm surge modelling efforts are all needed to strengthen at-risk coastal communities around Alaska's western and northern shores.

Western Alaska Access Roads

The Road to Tanana officially opened in late August 2016. The road project brings significant benefits to the community of Tanana by reducing freight and cargo costs, reducing travel costs for residents and visitors, and increasing access to mineral exploration in the Interior. The $13.7 million-dollar project involved constructing 20 miles of new road and upgrading 14 miles of existing road.

Continuing this road effort west to the Seward Peninsula would expand these demonstrated economic benefits to a larger area; provide a transportation link to a broad geographic region that is currently constrained by remote access, and improve access to mineral-rich areas along the route.

Kotzebue to Cape Blossom Road

The Cape Blossom Road project would construct a new 12 mile two-lane, gravel road connecting Kotzebue to a potential port site at Cape Blossom. This would improve transportation efficiency and reduce the cost of shipping freight between cargo barges and the Northwest Arctic Borough communities.

VI. Conclusion – the Continued Need for Federal Support

As presented above, one of the key roles the federal government can play in supporting mineral development in Alaska is to strengthen its longstanding role and responsibility of developing information infrastructure about Alaska's resources and geologic characteristics. Whether for identifying new prospects or designing the infrastructure needed to develop known prospects, this kind of information is a critical foundation. The federal government would be well served in collecting this information for the international-level resource opportunities in Alaska.

The national interests in infrastructure development in Alaska are significant – increasing domestic supply security of our mineral portfolio, increasing our competitiveness, strengthening America's position in the Arctic, boosting our economies, and potentially reducing the nation's trade imbalance. These are the kind of benefits that should be recognized in a new chapter of federal partnership and investment in Alaska. With solid federal support, we look forward to fulfilling Alaska's role as a storehouse for our nation's resource wealth – and the jobs and cost-of-living benefits utilizing these resources will bring.

The CHAIRMAN. Thank you, Mr. Masterman.
Mr. Potrzuski.

STATEMENT OF HON. BOB POTRZUSKI, DEPUTY MAYOR, CITY OF SITKA, ALASKA

Mr. POTRZUSKI. Good afternoon, Chairman Murkowski, Ranking Member Cantwell, and members of the committee. My name is Bob Potrzuski, and I am fortunate enough to be the Deputy Mayor for the City and Borough of Sitka, Alaska. I have served on the assembly since 2015, and as a retired social studies teacher, I am beyond thrilled to be testifying today.

Besides this amazing opportunity to personally be involved in our democracy, I am here to encourage Congress and the Trump Administration not to forget the funding of renewable energy projects in the development of any national infrastructure package.

Located in southeast Alaska, Sitka is the United States' largest city, comprising 4,811 square miles of land and water. The city exists on approximately 14 miles of road on the western side of Baranof Island, completely surrounded by the beautiful Tongass National Forest. Accessible only by boat or plane, Sitka is certainly rural Alaska. Our town is home to the largest commercial fishing port in southeast Alaska and ranks as the 11th largest seafood port in the entire United States.

Sitka has also found a niche as the regional hub for health care, and as with many southeast communities, cruise ships visit our port between the months of May and September. In addition, we are proud to be home to Coast Guard Station Sitka, with over 200 personnel stationed locally. Sitka is a robust, hardworking, and independent community.

Sitka also has an extremely mild climate. With our oceanfront proximity, we receive abundant rainfall. The average annual precipitation is over 131 inches, making hydroelectric power an obvious solution for our community.

However, at the turn of the century, demand for electricity was outstripping our generating capacity, affecting our ability to diversify and develop our economy. The Blue Lake Hydroelectric Project was originally licensed in 1958 and operates in conjunction with the Green Lake hydroelectric licensed in 1979.

Between 2002 and 2008, fuel prices in Sitka skyrocketed from $0.71 a gallon to $3.24 per gallon. Electric power became cheaper than fuel, and many residences and businesses switched to electric heating. In 2006 and 2007, Sitka experienced significant load increases. About half of this growth resulted from increased use of electricity for heating, the other half from expansion of Sitka's seafood processing industry. Annual hydro generation shortages as great as 10,000 megawatts were projected by 2012, and with the then-cost of diesel fuel, this would have cost taxpayers and ratepayers an additional $3.3 million per year, equivalent to an electric rate increase of 30 percent.

In 2007, the city began feasibility studies to determine how to meet these dramatic load increases. The studies evaluated hydro, diesel, wind, tidal, and geothermal energy. Generally, hydroelectric generation was considered the best alternative. It is great for the environment as hydro produces no carbon, does not contribute to

ocean acidification, a leading concern of our fishermen, and is clean with no negative impacts on wildlife.

In October 2010, the public voted in favor of the Blue Lake Expansion and Modernization Project. In late 2012, general construction bid costs came in at $145 million, which was shockingly higher than the $49 million engineers had estimated in 2008. As with many capital projects, the original estimate likely did not adequately consider the cost of work in southeast Alaska or the difficult access, constraints, and unique construction methods required for the project.

Thankfully, the State of Alaska did provide grants to lower the debt service, but there was no federal assistance for the project. Construction crews raised the dam by 83 feet and built a new powerhouse. In total, this project increased electrical capacity by over 27 percent. Construction of the largest public works project in the city's history was completed in November 2014.

Now Sitka is faced with other electrical needs: rebuilding an electric substation, rebuilding a major transmission line, overhauling the Green Lake Hydro Project, and rebuilding our emergency diesel backup system. These necessary projects come with a price tag of over $14 million, all at a time when Sitkans are paying for a new dam.

The support of the community has been tested as electrical rates continue to rise; however, the significant community investment has ensured an environmentally responsible and renewable energy source for Sitka's future.

Sitka and other Alaska communities are currently similarly placed as many rural communities in the Lower 48 were in the 1930s and 1940s when the TVA brought electricity to Appalachia and the Bonneville Project helped electrify the Northwest. Though we are blessed with abundant natural resources such as rain and wind, the barriers to harnessing these sustainable energy sources are the staggering upfront capital costs. Federal assistance investing in renewable energy infrastructure or adding energy to the national infrastructure package is essential for future economic development and the success of our small rural communities.

Thank you so much.

[The prepared statement of Mr. Potrzuski follows:]

City and Borough of Sitka
100 Lincoln Street • Sitka, Alaska 99835
Coast Guard City, USA

Senate Committee on Energy and Natural Resources
Testimony by Robert Potrzuski
Sitka, Alaska

Thank you, Senator Murkowski, for holding this hearing on an important topic for Alaska's future. I'm Robert Potrzuski, Deputy Mayor of Sitka, Alaska. I'm in town today to kick off the observances marking the 150th anniversary of the United States purchasing all of Alaska's 365 million acres from Russia, completing the westward expansion of America from "sea to shining sea."

It was 150 years ago that William H. Seward signed the treaty purchasing Alaska for about 2 cents per acre – a very good deal for America, indeed. I'm here because the transfer actually took place in October of that year in my hometown of Sitka, where the transfer officially occurred at Castle Hill, overlooking Sitka's harbor. I hope you will join us at the top of the hill this October on Alaska Day.

Over the past 150 years the federal government has played a major role in Alaska. It largely allowed Pacific Northwest interests to deplete our salmon stocks in the 1930s. It allowed industrialists to mine our minerals, and in some cases built infrastructure that supports Alaska to this day. It fueled a major military buildup during WWII and the Cold War that strengthened Alaska's economy. Given events in East Asia and the Arctic today, Alaska's strategic position may well prompt additional federal military spending in our state.

But the federal government has had a more checkered history in funding other vital infrastructure development in Alaska. The state, the equivalent of one-fifth of the lower 48 states, has too often been late to the party when federal funding was being handed out. While Alaska has received "extra" funding for years to help build a surface transportation network, it still has only .1 percent of as many road "lane" miles as the top six states with the same total acreage. While Alaska has received some "extra" help in building safe drinking water and sanitation sewer systems, there are more than 30 villages in Alaska without running water and more without flush toilets. Thankfully Sitkans have not used "honeybuckets" since the days of Russian ownership.

But I'm here today to talk solely about energy infrastructure and why federal assistance is so vital to my city, my region and throughout the entire State of Alaska.

While the lower 48, as we call it, benefitted greatly from the Rural Electrification Program, that funded electricity installations to homes and farms in the 1930s, early 40's, 50's and 60's, Alaska only entered the Union in 1959, and somewhat missed out on the aid. To offset the downturn in REA funding, two separate, but clearly not equal programs were established for Alaska. The High Energy Cost grant and loan program was created in the Rural Utility Service in the 1990s, but funding, never robust, has ebbed in recent decades and today barely provides Alaska between $5 million and $7 million a year.

While the federal government paid for large-scale power projects in the Lower 48: Hoover Dam, the Tennessee Valley Authority in the Southeast, the Bonneville Power Authority that bought clean, cheaper hydropower to the Pacific Northwest, Alaskans only received assistance in the late 1960s through establishment of the Alaska Power Administration, predecessor to today's Alaska Energy Authority. And it built only two projects, the Eklutna hydro project near Anchorage, that largely powered the Elmendorf AFB and the Army's Fort Richardson; and the Snettisham hydroelectric project to power the Capital of the state, Juneau. Funding for the agency disappeared after those lone projects, even though the U.S. Forest Service in a study in the late 1940s identified upwards of 200 sites, largely in Southeast Alaska, that could have provided clean renewable hydro energy to state communities. The APA was bought out by the State of Alaska, when the federal government wanted to get out of the business of providing power assistance during the Clinton Administration.

The State of Alaska during times of high oil revenues certainly has tried to replace the void left by the general federal pullout in power assistance. In the early 1980s, the state funded hundreds of millions of dollars to build hydro projects that has provided lower-cost power to many in urban Alaska, such as the Blue Lake and Green Lake projects in my City of Sitka, the Tyee Lake project for Wrangell and Petersburg, the Swan Lake project for Ketchikan, the Terror Lake project for Kodiak, and the Bradley Lake project for Homer. Alaska has studied, on several occasions, the huge Susitna River-Watana hydro project to help power Southcentral Alaska. The state again early in this decade funded the Alaska Renewable Energy Fund, which has provided just over $200 million in assistance for construction of renewable energy projects, largely wind and hydro projects in more than two dozen towns and villages.

Alaska has stepped up when it could. Between fiscal years 2011-2013, Alaska funded $1.219 billion in energy projects, at a time when the federal government provided a total of $21 million to Alaska projects through the Rural Utility Service's High-Cost grant and loan programs, and when the federally-funded Denali Commission energy funding, first created by Congress in the Energy Policy Act of 2005 (then authorized at $55 million a year), had provided another roughly $30 million.

Congress in the past – at least the Alaska Delegation -- has tried to help, especially in my region. Senator, your father Frank Murkowski, won passage of legislation in 2000 (PL. 106-511) of an authorization to provide 80% of the $480 million cost of building an intertie transmission line throughout Southeast Alaska to allow electricity to be generated by large hydro projects and then distributed to the smaller villages in the region. That is important because while Juneau, Ketchikan, Wrangell, Petersburg and Metlakatla have benefitted from federal or state-funded hydroelectric projects, many towns in the region have not.

While Juneau residents pay about 13 cents per power, Ketchikan about 14 cents, and Sitkans used to pay 11 cents in 2014, the villages of Angoon, Hoonah and Klukwan last year were paying 59 cents, before the state Power Cost Equalization subsidy cut that cost to residential customers to "just" 36 cents per kWh. Conditions have improved in the past year because of lower diesel fuel prices for electricity generation, but still the cost is far too high to promote economic development. While Congress actually appropriated about $60 million of the now 17-year-old intertie authorization for my region – enough to partially fund a single phase of the power line between Swan Lake and Ketchikan – and spent a bit more on engineering of a Kake to Petersburg line and some for a Ketchikan to Metlakatka line -- about $320 million of the authorization remains on the books – likely to never be fulfilled. With the demise of federal funding, the state began to look toward biomass and other renewables to make power more accessible to the "stranded" electrical systems in the region.

Senator, I know you have tried mightily to aid. In the 2007 Energy Independence and Security Act, you created a Renewable Energy Deployment grant program to provide 50% matching grants to build all types of renewable energy in Alaska, and also geothermal energy projects in High-Cost regions of the nation. It was and still is a great idea. Unfortunately it was never backed by the White House and thus never funded by Congress. You also have worked to have all forms of hydroelectric generation considered as renewable energy that would have opened hydro projects to tax-related assistance such as the Production and Investment Tax Credit programs and the Clean Renewable Energy Bonds program (CREBS). I know you had such a provision in last year's Energy bill. I am hopeful that such a bill will soon be resurrected and hopefully passed to provide vital financial, licensing and regulatory assistance to construction of renewable energy projects nationwide, and especially in Alaska.

Actually I'm here today to encourage this Congress to take some steps to get back into the game and to help Alaskans secure renewable energy.

Alaskans on average pay nearly the highest costs for energy in the nation, averaging nearly 21 cents per kilowatt hour, about 40% higher than the nation as a whole. But rural Alaskans: those living in small villages in Southeast, and those in western, northern and southwestern Alaska, pay the absolute highest amounts in the nation. Alaska, as I just mentioned, has a program that helps to subsidize energy costs in rural areas—the Power Cost Equalization Program. While Sitkans don't qualify for such aid, more than 190 communities, where 83,000 people live, do.

Last year they had energy costs that averaged 57 cents per kilowatt hour – nearly six times the national average. Worse, most rural villagers, outside of Southeast Alaska, last year paid more than 60 cents per kilowatt of electricity – far too many are paying 70, 80 or even over $1 per kilowatt hour. No wonder that studies by the University of Alaska have found that rural Alaskans often have to pay up to 49% of their disposable incomes just for energy, compared to 3 to 6% on average for residents in the Lower 48.

How can residents survive at such costs, and how can economic development, or new natural resource activities compete in the global market place given such costs? There are numerous examples of businesses that have had trouble surviving or starting in Alaska because of power costs. In nearby Hoonah, the town's café started to turn off its refrigeration units and leave the doors open at night to keep their food cold to save on power. The new mines proposed at Niblack and Bokan Mountain on Prince of Wales Island, south of Sitka, have had to deal with high energy costs in developing their mine financial plans. Seafood processing plants have had to wrestle with high electricity costs in determining how much they can pay the region's fishermen for their catch. Up north, the leading factor supposedly delaying construction of the proposed Donlin Creek gold mine is the costs involved in building a natural gas pipeline to fuel electricity for the mine. The lack of plentiful low-cost electricity has kept Alaska from cracking the industries of the 21st century, such as being the location of internet server "farms" – even though Alaska's colder climate, much like Iceland's, would be perfect for such high-tech businesses in the future.

I am here to encourage Congress and the Trump Administration not to forget the funding of renewable energy projects in development of any national infrastructure package. Sitka is a great example.

The Blue Lake hydro project, first licensed in 1958, along with the smaller Green Lake project in 1979, provided Sitka the power that its former timber mill and the town's Coast Guard Base and native boarding school needed for decades. The town recently totally financed the $140 million expense of raising the height of the Blue Lake dam by 83 feet so it could general another 16.9 megawatts of power or an additional 33 gigawatt hours a year. We have never received a penny of federal assistance for the project, although thankfully Alaska State government did provide grants to help lower the debt servicing on the project. It is great for the environment as hydro produces no carbon, does not contribute to ocean acidification – a leading concern of our fishermen – and is clean with no negative impacts on wildlife. That is why the Sitka Conservation Society and all environmental groups so strongly backed the Blue Lake project expansion. But Sitkans are paying heavily at the moment for the expense of this project, partially as a downturn in our economy produced a surplus in our power generation – paying roughly half of the per kilowatt hour cost towards debt associated with the Blue Lake project, for our assembly's decision to protect the environment – something we were encouraged to do by our former President.

Now Sitka has other electrical needs. We need to rebuild a 40-year old electrical substation, a project that will cost $3.9 million. We need to rebuild the 40-year old transmission line that serves 95% of the community, another $4 million cost. We need to overhaul the 40-year old Green Lake hydro project, another $4.2 million expense. And we need to rebuild the 40-year-old emergency fuel-backup power systems in the event of low rainfall years – another $2.2 million expense – all at a time when Sitkans are paying for their new hydro generation.

New federal assistance would be helpful.

But Sitka is not the only place in Alaska in need of energy aid. Just in Southeast Alaska, looking at the grant requests made to the Alaska Energy Authority last year for aid under the state's formerly better funded Renewable Energy Fund, Metlakatla is seeking $10 million for a submarine cable to gain power from Ketchikan, or $26 million to build a new hydro project at Triangle Lake. Kake needs $5.7 million to build a hydro project on Gunnuk Creek. The village of Angoon needs $12 million to build the Thayer Creek hydro project. The village of Tenakee is seeking $5.5 million to build a hydro project on Indian River. The village of Hoonah needs $7 million to build a hydro project on Water Supply Creek and the tiny village of Elfin Cove needs $3.7 million for a hydro plant on Elfin Cove Creek. The National Park Service needs $5 million for a power line to tap into the existing Falls Creek hydro project at Gustavus, which will get the park off noisy and costly diesel-fired generation. Klukwan is seeking $9.4 million for the Walker Lake hydro project, and Yakutat needs $8 million to build a wave marine hydrokinetic power plant. And Juneau needs aid with a geothermal-inspired heat pump based distributive heating system proposal involving construction of more hydro power, either at Sweetheart Lake or at Lake Dorothy. All of these are largely shovel-ready, sound projects – they just need some federal assistance to make them more economic to proceed.

Across Alaska, there are dozens more projects from Crater Lake hydro project in Cordova to the Old Harbor creek hydro project in Prince William Sound, from the Yerrick Creek hydro project at Tok to the Cosmo Hills hydro project at Ambler. Ignoring the "big ticket" hydro projects, the state could properly spend $1.2 billion on renewable energy projects tomorrow – projects that would finally bring the state's electric infrastructure into the 21st Century, while promoting economic development and job recreation – all goals of our new President. Alaska today finds hydro projects providing the state with 24.9% of its total energy needs. Towns like Kodiak and Sitka are nearly totally powered by renewable energy. We need to expand that trend statewide.

The Alaska Energy Authority back in 2010 completed a statewide energy planning effort. The plan called for Alaska to improve energy efficiency and conservation by 20% by 2020, and to be dependent on renewable energy for 50% of the state's total electricity consumption by 2025. It estimated that Alaska, just in the Railbelt – the urban communities between Homer and Fairbanks – would need to spend $7.3 billion on energy generation and distribution till 2030. And the plan projected that the rest of the non-Railbelt portions of the state will need $5 billion in upgrades by 2030 – a nearly $13 billion price tag. But we have to do more now, not sometime in the future.

I know a later witness, Mr. Chris Rose of the Renewable Energy Alaska Project, will talk more about the importance of renewable energy - all forms of renewable energy - and energy infrastructure spending and the need to fund sound projects. Alaska has a lot of infrastructure needs, from the Ambler mining district road to a road to Umiat to promote oil development in the National Petroleum Reserve Alaska, from access to proposed mines in Southeast, from a natural gas pipeline to bring Alaska's North Slope natural gas to tidewater, to perhaps a gas line to power electrical generation from a central power plant to energize dozens of villages in the Bethel region of Southwest Alaska with cheaper, cleaner energy.

But I'm from a town that backs hydroelectric development. For my money power is everything. To paraphrase a line from the movie Apollo 13, "Energy is everything, without electricity, nothing else matters." That is especially the case in our internet, information-powered society. And for my money the best use of funds is to build clean, renewable hydroelectric energy, not necessarily by damming streams, but by tapping mountain lakes and diverting a bit of water from streams through penstocks. Sitka's experience proves that hydro is clean, non-carbon energy that should be utilized to the greatest extent possible when it can be done without harm to wildlife or the environment. We Sitkans care about fish.

Please help Alaska – especially now that the state's oil wealth is currently ebbing. Finance construction of an electrical and energy infrastructure that will put the state on a sound footing for the decades ahead. Adding energy to a national infrastructure package and perhaps implementing the decade-old Renewable Energy Deployment grant program, would both be good steps. Thank you.

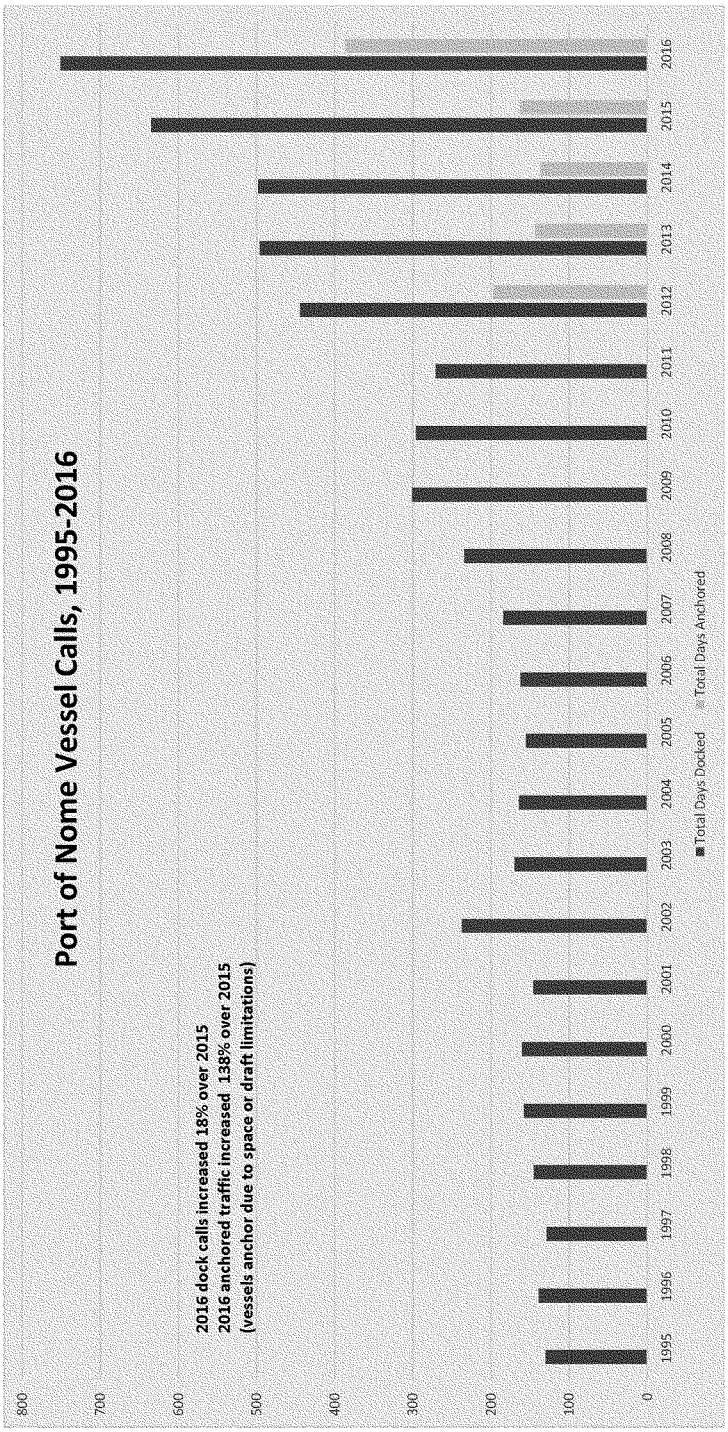
The CHAIRMAN. Thank you. I so appreciate that testimony.
Joy Baker, welcome.

STATEMENT OF JOY BAKER, PORT DIRECTOR, NOME, ALASKA

Ms. BAKER. Thank you, Chairman Murkowski, Ranking Member Cantwell, and members of the committee. My name is Joy Baker, and I want to thank you for the opportunity to appear before you today. I am the Port Director in Nome, Alaska, where I have worked for the past 25 years. My testimony today is based on the experience I have gained while working to expand the port's capabilities to meet increased vessel traffic and support economic development in the region.

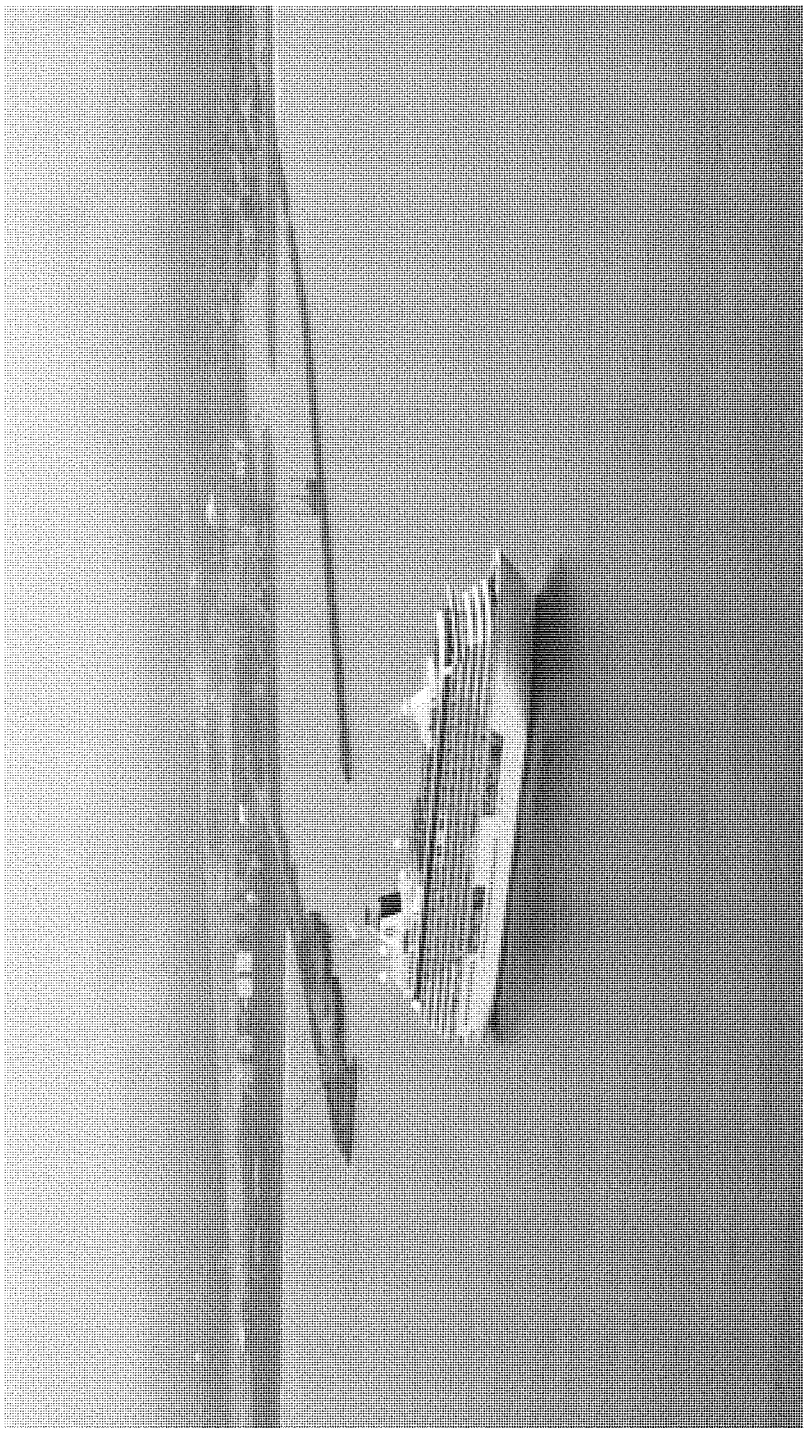
There are really only three ways to get to Nome, to quote our illustrious Mayor Beneville: by boat, by plane, and of course, by dogsled. Today I will focus on Alaska's ports and highlight the opportunities specifically presented in Nome for the near-term development of an Arctic deep draft port.

[The information referred to follows:]


Port of Nome Vessel Calls, 1995-2016
2016 dock calls increased 18% over 2015
2016 anchored traffic increased 138% over 2015
(vessels anchor due to space or draft limitations)
800
700
600
500
400
300
200
100
0
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
Total Days Docked
Total Days Anchored

Ports are the lifeblood of Alaska. It is that simple. There are no statewide major land transportation links to the Lower 48, and it cannot all come in by air. It is the 125 ports scattered along 44,000 miles of Alaska's coastline that provide the lifeline for commodities coming in from the outside or for resource exports from the state. The vast majority of cargo coming into Alaska flows through the Port of Anchorage, with significant exports moving through ports in Valdez, oil; Seward, coal; Unalaska, seafood; Nikiski, LNG; and of course, Red Dog, minerals. The network of ports in Southeast and South Central also make it possible for the cruise ship industry to bring more than one million tourists a year to Alaska's shores.

[The information referred to follows:]



The Port of Nome is located just below the Arctic Circle, and it is a regional transshipment hub for more than 54 western Alaska communities. These communities rely on the port for movement of heating oil and gasoline, construction supplies, nonperishable foods, gravel, and other cargo. It is also the staging ground for operations north of the Bering Strait, as vessels prepare for the ice-free season and consequently serves as their demobilization center in the fall.

[The information referred to follows:]

OUTER HARBOR DEVELOPMENT

Despite the overall importance of ports to the state, the American Society of Civil Engineers 2017 Infrastructure Report gave Alaska's ports a grade of D. This is a sobering message and underscores the need for action.

As this hearing is focused on energy and mineral production opportunities, I will highlight how Nome is well positioned to support both. Mining has played a vital role in Nome's development and will continue to do so in the years to come. The world-class Graphite Creek prospect near Nome has been characterized as the best graphite deposit in the country. The Port of Nome will play a key role in supporting its development and exporting the raw material.

According to the USGS, the area north of the Arctic Circle has an estimated 90 billion barrels of undiscovered, technically recoverable oil and more than 1.6 trillion cubic feet of technically recoverable natural gas.

While Shell's exploration of the Burger Prospect led to a spike in vessel activity in the Chukchi Sea region, the reality is that vessel traffic at the Port of Nome continues to grow significantly post-Shell. The bulk of the 2016 increase is directly related to more foreign fuel tankers, research vessels, domestic and foreign government vessels, gravel, and cargo. Nome also hosted the largest cruise ship to transit the Northwest Passage for a very successful port call last August.

The increased maritime activity brings much needed economic opportunity to the region, but also great risks without the infrastructure to support the needs of the larger vessels. We need to expand our port facilities to minimize the number of ship-to-ship fuel transfers and reduce waste discharge in Arctic waters capable of harming cultural subsistence hunting and fishing.

The time is now to move ahead with the development of an Arctic deep draft port in Nome, and Nome stands ready.

After extensive evaluation of numerous sites in 2015, the Army Corps selected the Port of Nome as the preferred site. This decision was based on the Port of Nome's overall ability to meet the mission operations criteria, the geographical advantages, and the presence of active commercial port operations, as well as existing shore-based infrastructure, including a fuel tank farm, a fuel service hospital, and an airport with two 6,000-foot runways.

The development of an Arctic deep draft port in Nome is critical to the long-term viability of the community, the region, and the Arctic. Yes, there is need for development of additional port capacity in northwest Alaska, and Nome will be the first step of many.

In conclusion, here are my recommendations: secure strong federal funding for Alaska's ports, including dredging, maintenance, and construction; support the timely development of an Arctic deep draft port in Nome; accelerate hydrographic charting in Alaska, especially in the Arctic; and support the designation of Nome as an Arctic strategic port.

While Alaska has made significant progress since statehood, the next few years will make a big difference, and support from Congress is absolutely necessary to achieve that goal.

Thank you again for the opportunity to appear before the committee, and I am happy to answer any questions you may have later. And I would like to request that my full written statement

be included as part of the record, along with several supporting documents.

[The prepared statement of Ms. Baker follows:]

P.O. Box 281 • Nome, Alaska 99762

Written Testimony of Joy Baker
Port Director, Nome, Alaska
Before the U.S. Senate Energy and Natural Resources Committee
Hearing to examine the potential for infrastructure improvements to create jobs and reduce the cost of living through all-of-the-above energy and mineral production in Alaska

March 30, 2017

1. Introduction

Chairman Murkowski, Ranking Member Cantwell, and members of the Committee, thank you for this opportunity to appear before you as you consider potential infrastructure improvements to create jobs and lower the cost of living in Alaska. My name is Joy Baker and I am the Port Director in Nome, Alaska. I have worked for the Port for the past 25 years, and my testimony here today is based on the experience I have gained while working to expand the Port's capabilities to meet increasing vessel traffic, and planning for the development of an Arctic Deep Draft Port (ADDP) in Nome.

The 45th Iditarod Trail Sled Dog Race just finished earlier this month, which I believe highlights the logistical difficulties in Alaska and especially in the Northwest and Arctic regions of the state. There really are only three ways to get to Nome, to quote our illustrious Mayor Beneville: by boat, by plane, and of course by dogsled. I will be focusing on Alaska's ports, and highlighting the opportunities specifically presented in Nome for the development of an Arctic Deep Draft Port.

2. Alaskan Ports

Ports are the lifeblood of Alaska. It is that simple. There are no major land transportation links to the Lower 48, no viable highway and no railroad. And it cannot all come in by air. It is the 125 ports scattered along the 44,000 miles of Alaska's coastline that provide the lifeline for commodities coming in from outside and for resource exports from the state. The vast majority of cargo coming into Alaska flows through the Port of Anchorage, with significant exports moving through the ports in Valdez (oil), Seward (coal), Unalaska (seafood), Nikiski (natural gas), and Red Dog (minerals). The network of ports in Southeast and South Central also made it possible for the cruise ship industry to bring more than 1 million tourists to the shores of Alaska in 2016. Finally, many of Alaska's ports support robust commercial, subsistence and recreational fisheries, including 6 of the top 10 commercial fishing ports in the country.

Despite the overall importance of ports to the state, the 2017 American Society of Civil Engineers (ASCE) gave Alaska's ports a report card grade of D for infrastructure conditions and

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needs. The report recommends continued efforts to leverage state and federal grants, and acknowledges that new federal statutory provisions included in the Waterways Infrastructure Improvement for the Nation Act (the WIIN Act) should help provide better access to federal funding for Alaska's ports. From my perspective, continued investment of state and federal funds in the development and expansion of Alaska's ports is critically necessary to allow for the development of Alaska's energy resources. This will not only help improve our economy, but will also lead to lower energy costs across the state, especially in rural and remote areas.

3. Nome

Nome is home to about 3800 residents and is strategically situated on the south-facing shore of the Bering Sea near the southern end of the Seward Peninsula. The cost of living in Nome is elevated relative to state and national levels. Groceries cost 60% more in Nome than in Anchorage and a gallon of gas often exceeds $5.00. The average home spends almost $8500.00 per year for heating; more than triple the cost of an average Anchorage home, and costs are even higher in more rural areas.

a. .Background on the Port and its operations

The Port of Nome, located just south of the Arctic Circle, is strategically positioned to serve national, state, regional, and local needs. Nome is the regional transshipment hub for more than 54 Western Alaska communities that rely on the port for movement of heating oil and gasoline, construction supplies, non-perishable food, gravel, and other cargo. It is also the staging ground for operations north of the Bering Strait as vessels prepare for the ice-free season. In the fall, it serves as the demobilization center for companies operating in the Arctic.

While the ice-free season is gradually increasing, Nome's port is typically closed for almost 6 months of the year. Consequently, the ice-free period between June and December is very busy, with vessels bringing goods to be used in Nome or transshipped to communities throughout the region. Nome's port facilities serve a wide variety of customers, including subsistence and commercial fishermen, gold dredgers, regional shippers, tourism operators, public research and enforcement vessels, and vessels engaged in operations north of the Arctic Circle, such as Prudhoe Bay. Nome's role in maritime vessel support extends to ships transiting both the Northwest and Northeast Passages, frequently serving as the last stop before, and first stop after, transiting Arctic waters that hold no commercial port infrastructure.

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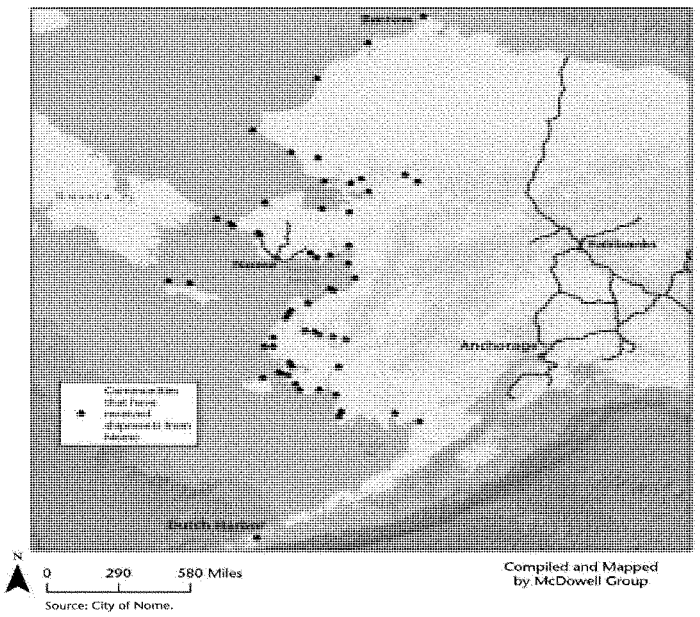
Communities Connected to the Port of Nome



Improvements have been made to the Port of Nome for nearly a century. Construction of Nome's original jetties began in 1919 and was complete by 1923. A seawall protecting Nome was constructed early in the 1950s and the 3000 foot armor stone causeway was built in 1985. Two sheet pile docks located on the causeway were operational by the early 1990s, currently providing a basin depth of -22 feet at mean lower low water (MLLW). The addition of the east breakwater in 2006 significantly increased port capabilities by decreasing the number of days port operations were limited due to weather. Completion of the 210 foot Middle Dock in 2015 added much needed moorage space.

In general, the outer harbor is used for incoming cargo, fuel and equipment, and outgoing gravel products, as well as ship resupply and refueling. The inner harbor facilitates the redistribution of these commodities and other supplies to outlying communities. The Army Corps of Engineers conducts annual dredging of the navigation channel and maneuvering basins,

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while the City of Nome is responsible for dredging the berthing areas along docks and transfer ramps.

b. Mining activity

Mining has played a vital role in Nome's development and will continue to do so in the years to come. Since 1880, the Nome mining district has produced the state's third largest quantity of gold behind only Fairbanks and Juneau. In addition to current placer mining in the region, there are a number of mining prospects that could stimulate shipment of equipment, supplies, and construction materials through the port when they progress to advanced exploration and production. The world-class Graphite Creek prospect near Nome has attracted significant interest and it has been characterized as the largest and highest grade large flake graphite deposit in the U.S. Its development is very close and the Port of Nome will play a key role in both in supporting its development, and exporting the raw material for refining in Alaska or in the Lower 48.

Elsewhere in the region, the Kugruk Prospect has produced more than 500,000 ounces of placer gold. Exploration is underway for potential significant gold mineralization, as well as zinc, lead, and silver prospects. There is also continued interest in the Bluff and Council Prospects, primarily for gold deposits.

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c. Oil and gas development

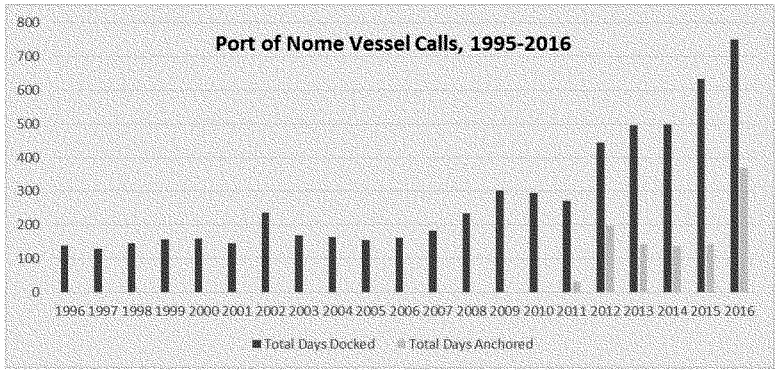
According to the U.S. Geological Survey, the area north of the Arctic Circle has an estimated 90 billion barrels of undiscovered, technically recoverable oil, 1,670 trillion cubic feet of technically recoverable natural gas, and 44 billion barrels of technically recoverable natural gas liquids. These resources account for 22% of the undiscovered, technically recoverable resources in the world. The Chukchi Sea is believed to hold approximately 15 billion barrels of recoverable oil and almost 76 trillion cubic feet of recoverable natural gas.

During Shell's multi-year mobilization for operations at the Burger Prospect, the Port of Nome played a key role in supporting the fleet of vessels engaged in the effort. When offshore oil and gas exploration and development activities return to the Chukchi Sea, the number of vessels making port calls in Nome will increase dramatically, above and beyond the increases already occurring, and there also will be an increase in cargo and construction materials flowing through the port.

d. Recent vessel traffic trends

Arctic vessel traffic demand has shown a significant increase from 2011-2016:

Bering Strait Transits	+155%
Port of Nome Dock Calls	+177%
Nome Anchored Traffic	+1130%



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The Port's 2016 statistics demonstrate a significant increase, all of which is post-Shell departure. Dock occupancy reached 92% in July 2016, which includes the recent addition of a 3rd dock built in 2015. The bulk of the 2016 increase is directly related to more foreign fuel tankers, research vessels, domestic and foreign government vessels, gravel and cargo. The increased maritime activity brings much needed economic opportunity to the region, but also great risks without the infrastructure to support the needs of the larger vessels. Expanded facilities will minimize the number of offshore ship-to-ship transfers and reduce waste discharge in Arctic waters capable of destroying cultural subsistence hunting and fishing.

The Crystal Serenity's successful voyage through the Northwest Passage will further change the dynamic of traversing the Arctic by generating more commercial interest in the Arctic, which will bring not only more pleasure vessels, but the commercial shipping industry as the option for this reduced cost route becomes more prevalent.

Foreign-flagged vessel traffic has increased exponentially at Nome since 2011, with routine calls by research and government vessels from Korea, Japan, Russia, and Canada, in addition to cruise vessels. The largest increase in foreign-flagged traffic at Nome has been in the oil tanker category which drives a large portion of the anchored traffic, with some effect on dock calls.

Clearly one of the greater risks with increased traffic centers around maritime incidents and accidents triggering marine pollution, which drives the need for expanded oil spill response

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capacity in the region. The USCG's Alternative Planning Criteria network, which is currently responsible for the Western Alaska region, relies on large mobilizations of assets and resources from the Anchorage area by air, but does not really provide for timely response to remote locations. Response times can be significantly reduced by the staging of assets within the region that can be more quickly mobilized to the site by contract vessels already working the coastline. This gap must be addressed in order to adequately prepare to respond to an incident in Western Alaska and the Arctic.

There is a growing need for shore-based waste reception facilities along the Arctic coastline. Recent changes in MARPOL and increased vessel traffic highlight the imperative for establishing a waste reception facility north of Dutch Harbor to allow ships to discharge large volumes of black and grey water, regulated galley waste, and oily bilge water. Although some of the newer vessels have increased capacity and treatment mechanisms for managing ship waste, there are challenges for the older vessels. Intentional or unintentional discharges into Arctic waters can be minimized by the presence of a waste reception facility in the region that can accommodate both the medium-draft and deep-draft fleets transiting the Arctic.

4. The Need for an Arctic Deep Draft Port

> "*The lack of a deep-water Arctic port is a barrier to providing the infrastructure necessary to develop Alaska resources and to carry out national strategic goals in the region.*"
>
> "[*An Arctic Deep Draft Port*] *would provide local and regional economic development opportunities (resource extraction, tourism, and research); decrease Arctic region operating costs; provide protected dockage to support offshore oil and gas endeavors, fishing fleet, and resource extraction vessels; and provide vessel repair and maintenance support as well as facilities for emergency response and assistance vessels. It would improve international relationships and increase U.S. exports, optimize the aforementioned benefits while preserving natural resources; raise awareness of U.S. as an Arctic nation; and provide upland support to vessels operating in the region (fuel, water, electricity, food, medical, and storage, laydown/staging for resource extraction).*
>
> 2017 ASCE Alaska Infrastructure Report Card

The City believes the development of an Arctic Deep Draft Port in Nome is critical to the long term viability of the community, the region, and the U.S. Arctic. Expanding Nome's existing facility to a depth of -36' MLLW will achieve the intended goal of reducing maritime operating costs which will result in lower transportation costs for commodities into Nome and throughout the region. An ADDP will also make it feasible to provide the infrastructure capacity to support assets for strategic and non-strategic missions. Development can be achieved on a

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reduced timeline by expanding an existing facility that is strategically located to base the U.S. Arctic fleet in support of national security, life safety, oil spill response, resource protection and icebreaking within the region. The staging of SAR and OSR assets closer than Dutch Harbor is critically necessary to ensure the response capacity is in place in the event of a maritime incident or accident, in order to mitigate loss of life and damage to the coastline as risks continue to elevate with increased traffic.

a. Alaska State DOT-USACE ADDP Studies

Beginning in 2011, the U.S. Army Corps of Engineers and the Alaska Department of Transportation initiated formal studies on the need for and preferred location for an Arctic Deep Draft Port. This evaluation process focused on the infrastructure necessary to support offshore oil and gas development, search and rescue operations, and oil spill response capabilities. The studies evaluated port location options from the mouth of the Kuskokwim River to the northern border with Canada. The area covered included 3626 miles of coastline, a distance 1500 miles greater than traveling from Maine to Key West.

After extensive evaluation of numerous sites, in 2015, the Army Corps selected the Port of Nome as the preferred site for an Arctic Deep Draft Port. This decision was based on Port of Nome's overall ability to meet the mission criteria, geographical advantages, and the presence of active commercial port operations and existing shore-based infrastructure, including a fuel tank farm, a full service hospital, and an airport with two 6000+ foot runways. The Port is actively working with the Army Corps to refine the study scope and design of the ADDP project, with further actions expected in 2017.

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Finally, as public-private partnerships (P3s) will clearly have a definitive role in Arctic development, the Port of Nome and Sitnasuak Native Corporation (SNC) have entered into a P3 agreement that will allow SNC to contribute funds and resources, as well as provide input into the development of an ADDP in Nome. This represents the kind of private investment and project support that stands behind the ADDP in Nome and the importance of this project to a key stakeholder in the region.

b. Recent Congressional actions

The Water Infrastructure Improvements for the Nation Act (WIIN Act) included two provisions that will benefit the development of an Arctic deep draft port in Nome: 1) an expanded scope for the "Remote and Subsistence Harbor" provision that now covers the region, not just a single community benefitting from the project (Sec. 1105 of the Act); and 2) a new provision that authorizes consideration of "national security benefits associated with an Arctic deep draft port" (Sec. 1202(c) of the Act).

The FY17 National Defense Authorization Act (NDAA) includes a provision requiring the Departments of Defense and Homeland Security to evaluate potential ADDP sites and authorizes the designation of a Strategic Arctic Port which should further help justify the development of an Arctic deep draft port (Sec. 1095 of the Act).

The 2014 Water Resources Development Act established a mechanism to allow non-federal public entities to contribute funds to the Army Corps for the "development, construction, operation and maintenance of channels, harbors, and related infrastructure" associated with deep draft ports for the purpose of Arctic development or national security purposes.

5. The need for accurate navigational charts in Alaska

I also want to address an important issue related to the successful development of Alaska's offshore and onshore resources. As I have discussed, ports are key components of the state's infrastructure that make resource development possible. It is also critical that we have up-to-date and accurate hydrographic charts, especially since only 2.5% of the Arctic has been surveyed with modern standards. I will provide two recent examples of just how important safe navigation is in Alaska.

First, I want to highlight the impact that one vessel's grounding can have on a project. In July 2015, the MV Fennica struck an uncharted rock in Unalaska's harbor. This was unfortunate on many levels, but most importantly because the MV Fennica was a required support vessel for Shell's drilling activities in the Chukchi Sea. The resulting damage necessitated repairs in the Lower 48, which delayed Shell's operations by more than a month.

Second, on June 24, 2016, the chemical tanker MV Champion Ebony ran aground on an uncharted shoal near Nunivak Island in southwest Alaska. She was carrying more than 14.2 million gallons of fuel products, and fortunately was able to refloat without a spill.

P.O. Box 281 • Nome, Alaska 99762

Both of these incidents underscore the considerable risks associated with maritime commerce in areas without adequate navigational charts. The negative impact of a maritime casualty in Alaskan waters remains a painful memory, and the potential risk for another incident must be minimized. A large-scale spill in the Bering Sea, Chukchi Sea or Beaufort Sea would be devastating to the communities that depend on the ocean for cultural and economic needs. This risk needs to be mitigated with an aggressive charting program. This will help reduce the potential for a spill or loss of life, and will better protect the interests of subsistence hunters and fishermen, the growing tourism trade above the Bering Strait, and safeguard the future of resource development activities.

6. How can Congress help?

I will keep my recommendations straight forward. Alaska has many needs to secure its future, and everything that the Alaska Delegation and Congress can deliver is greatly appreciated.

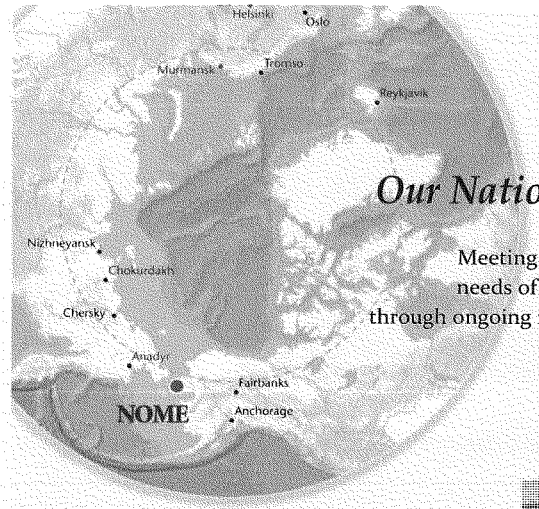
I urge you to consider the following:

- *Secure sufficient federal funding to maintain the functionality of Alaska's ports, including dredging, maintenance and construction;*
- *Provide continued support for the timely development of an Arctic Deep Draft Port in Nome;*
- *Accelerate hydrographic charting in Alaska, and especially in the Arctic; and*
- *Support the designation of Nome as a strategic port in the Arctic.*

7. Conclusion

I have dedicated my career to advancing the development of the Port of Nome to support the community, the region, and the state. While we have made significant progress, the next few years will truly make a difference and support from Congress is absolutely necessary to achieve our goals.

Thank you for providing me with this opportunity to appear before the Committee. I would be happy to discuss specific issues in more detail and answer any questions you may have.



Nome

Our Nation's Arctic Port

Meeting the resupply and staging needs of the Arctic maritime fleet through ongoing infrastructure expansion.

Benefits of the Deep Draft Port

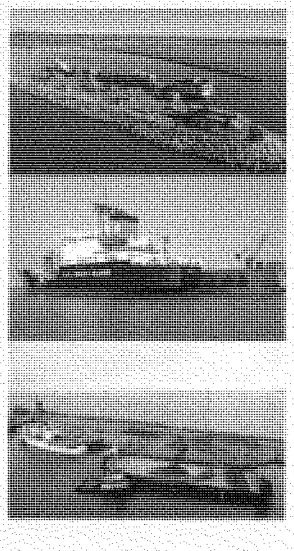
National Security: Strategically located near the Bering Strait and the Arctic Ocean, Nome's Deep Draft Port will enable the United States to respond to the increasing foreign presence in the Arctic, including accelerated Russian development of the Northern Sea Route.

Life Safety: Bering Strait traffic nearly doubled since 2009. The Deep Draft Port allows the Coast Guard to maintain a material presence and fulfil its mission of protecting the public, environment, and national economic interests.

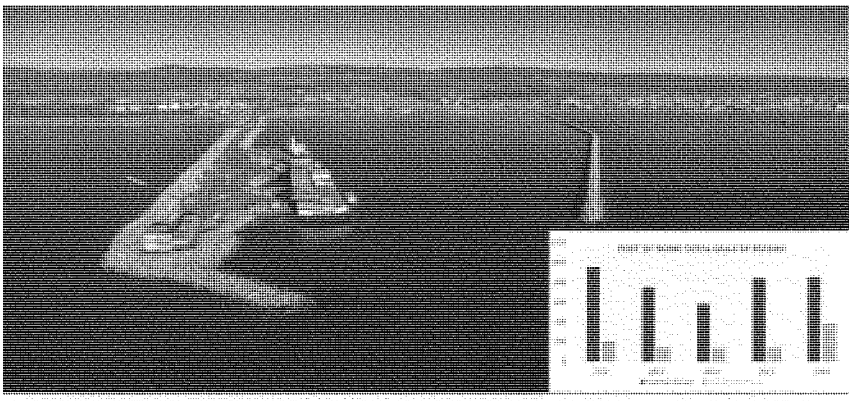
Environmental Protection: An expanded port is needed to accommodate vessels in distress, minimize impacts to environment, and provide protected moorage for vessels seeking repair and service.

Economic Viability: The port will facilitate economic development and ensure that vital food, fuel, and supplies reach residents of America's and Alaska's Arctic and sub-Arctic in a cost-effective way.

Sustaining Culture: Alaska Natives comprise half of Nome's 3,800 residents, and about 75 percent of residents in nearby communities. Stabilizing the cost of living, while maintaining environmental standards will help to ensure that traditional food gathering and other culturally important activities continue.



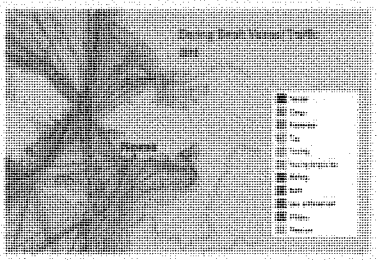
Sources: U.S. Army Corps of Engineers; Port of Nome Strategic Plan (McDowell Group, 2016); U.S. Census Bureau.

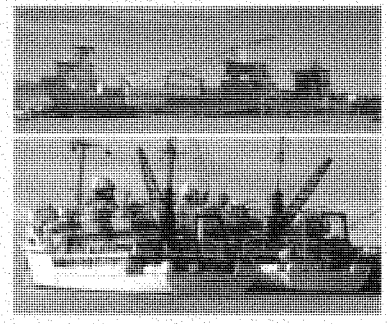


Nome: A Regional Hub

Nome has served as a critical hub for western Alaska and the Arctic for more than a century.

- Nome was established in 1901 by gold seekers; mining remains an important aspect of the economy today.
- Services include a level-four trauma center, fire department, telecommunications, daily jet service, and a 230-mile road system.
- Nome's aviation services supplied 64 domestic and international locations in 2016.





Port Activity

- Groceries, construction supplies, gravel, and other goods are shipped to 60 communities from Unalaska to Barrow – more than 1,300 miles.
- Port traffic increased from 162 vessels in 2006 to 751 in 2016. Additionally, a growing number of commercial and private vessels transit nearby Bering Strait.
- From 2012-2016, the Port averaged 54,170 tons of rock, sand, and gravel; 39,300 tons of cargo; and 11.3 million gallons of refined petroleum products.
- The port supports 450 seafood harvesters and processors and is home to Norton Sound Seafood Products.
- In 2016, Nome hosted the 820-foot Crystal Serenity, with 1,700 passengers and crew, illustrating a growing interest in Arctic cruising. Additionally, several smaller cruise ships regularly sail between Nome, Greenland, Russia, Norway, and other global destinations. The Serenity will return in 2017.

Support for an Arctic Deep Draft Port at Nome to -36' MLLW through $1.6M in Design Funds

The Bering Straits Leadership Team requests support from the Alaska Legislature, the State of Alaska, the Congressional Delegation, and various federal agencies that drive US Arctic Policy[1] and the State of Alaska's Arctic Policy Commission's recommendations[2], to authorize and fund the design and construction of an Arctic Deep Draft Port at Nome, as part of a larger maritime infrastructure system in the U.S. Arctic. This project would extend the existing Causeway structure to a depth of -36' MLLW, provide a deep water dock and multiple mooring positions, extend the utilities, and deepen the navigational channel and maneuvering basin at the Port of Nome. Based on the existing community and marine infrastructure in place at Nome, the timeline for bringing an Arctic Deep Draft Port online is reasonably short, with construction potentially occurring as soon as 2021 if the project is authorized and funded in 2017. The Bering Straits Leadership Team seeks to adhere to this timeline by requesting $1.6M in funds from the State of Alaska to carry the project through completion of the design phase, allowing for a construction-ready project to be presented to Congress for authorization and funding.

The newly amended language of Section 2006 of the Water Infrastructure Improvements for the Nation Act of 2016, which allows for consideration of the long-term viability and welfare of communities in a *region*, as well as a project's social and cultural value to

[1] President's National Strategy for the Arctic, the Department of Defense's Arctic Strategy, The Committee on Marine Transportation's US Arctic Marine Transportation Priorities, the US Coast Guard's Arctic Strategy, NOAA's Arctic Vision and Strategy, the Alaska Arctic Policy Commission's Recommendations and the Arctic Council's Arctic Marine Assessment Report 2009 Recommendations for Arctic infrastructure.

[2] Alaska Arctic Policy Commission, Final Report and Implementation Plan January 30, 2015

regional communities, is a major factor in justification of navigation improvements at Nome. There are dozens of communities in the Norton Sound and the Bering Strait region that rely heavily upon the Port of Nome as a transshipment point for fuel, equipment and supplies, and many of them are legitimately threatened by the high price of fuel and goods. Enabling larger vessels to call on Nome would lead to lower costs of commodities, a savings that could be passed on to the residents of these surrounding communities, many of whom are Alaska Native and practice a subsistence-based way of life. Nome has the opportunity to change the standard for the delivery of goods and services in the region.

Additionally, the newly amended language in Section 1095 of the National Defense Authorization Act of 2016 concerning Strategic Arctic Ports outlines the requirement that the national security role of these facilities be thoroughly investigated during any project study, and shows a clear opportunity to highlight those growing capabilities at Nome. The results of this effort will provide for the additional justification needed to further develop an expanded Arctic Port facility at Nome. The Port of Nome stands ready to move forward in a cost-share agreement with the Army Corps of Engineers to investigate these additional criteria in our joint pursuit for an Arctic Deep Draft Port.

The Port of Nome, due to its geographic location, is a strategic transportation hub that meets the needs of US Arctic Policy by strengthening the Arctic Marine Domain Awareness system as well as search and rescue capabilities through an expanded port. The USCG study[3] concurs that a deep-draft port in the Arctic will provide benefits, including economic development, intermodal transit, energy independence, national security, and marine safety. The increase in vessel traffic seen over recent years will be compounded in the near future as demand of global markets for resource development in the Arctic continues to rise, and foreign cargo companies increase the shipment of commodities through the Arctic routes.

In August 2015 in Seward, Alaska, the President of the United States emphasized the need for port infrastructure north of Dutch Harbor, and followed that statement with action that will assist in facilitating the pursuit of an additional icebreaker, estimated to be online by 2020. This accelerated pace of normal ship procurement highlights the urgency for developing vital Arctic infrastructure to ensure the United States maintains a critical role in the Arctic. The Port of Nome would embrace the possibility to be the homeport for the new icebreaker and serve as its regional base of operations.

No other medium or deep draft port infrastructure capabilities exist from Northwest Alaska (Nunivak Island) to the Canadian border. Nome's existing 3,162' Causeway is dredged to -22.5' MLLW with a 3,025' protecting breakwater to the east. Extending the causeway to -36' MLLW will accommodate fuel tankers and line haul barges, ice breakers, USCG National Security Cutters, Navy ships, NOAA and foreign scientific research vessels, oil and gas support vessels, as well as larger cruise ships, support tugs, sailboats and yachts.

[3] US Coast Guard, "Feasibility of Establishing an Arctic Deep-draft Seaport", Report to Congress February 11, 2014.

As the opening of the Arctic continues, the increase in ocean vessel traffic through the Bering Strait and Nome provides economic development opportunities in resource development, international and domestic scientific research, and tourism. Transit data from the Marine Exchange of Alaska and Port of Nome clearly depict the increase:

	2010	2011	2012	2013	2014	2015	2016
Transits recorded through the Bering Straits	430	410	480	440	340	540	485
Port of Nome Vessel Calls	296	271	444	496[4]	498	635	751

As a Port of Refuge, Nome is located close to designated shipping lanes, and provides intermodal transportation connections through jet service to Anchorage, and commuter flights to coastal communities, as well as emergency services for crew and passengers. The Bering Straits Leadership Team believes this to be a national priority for the United States and State of Alaska, and wishes to have Nome serve the country and state in this capacity to significantly improve mariner safety and enhance protection of the environment. Built in 2012, the Norton Sound Regional Hospital is a state-of-the-art facility constructed to provide medical care to the region's 10,000 residents spread across 44,000 square miles. The 150,000-square-foot facility allows intermediate medical care without traveling to Anchorage.

As world events continue to demonstrate a heightened need for expanding U.S. military strategies abroad, the increased Arctic activity by Russia and China demands equal attention in order to protect the U.S. Arctic coastline, its residents, and the natural resources that are at risk. The Bering Straits Leadership Team respectfully requests continued support from the Alaska Congressional Delegation for the pursuit of federal authorization of an Arctic Deep Draft Port at Nome, as well as a federal funding appropriation for construction that will reduce the non-federal cost-share to a level manageable for a rural Alaska municipality.

Although the Army Corps' decision to pause the Arctic Deep Draft Port study was based on Shell's decision to suspend exploration activities in 2015, industry experts have indicated it is only a matter of time before the oil and gas markets and new discoveries dictate the development of the deposits known to be located in the Arctic waters. In the meantime, the Washington decision makers must take immediate action to ensure the accelerated development of Arctic maritime infrastructure to protect national security, environmental protection, resource conservation, mariner safety, and scientific research, as well as international cooperation with the global community. Russia and Canada are establishing Emergency Response Centers along their coastline, while the U.S. has not begun planning for any Emergency Response Center in the U.S. Arctic. Nome can serve as the United States' Emergency Response Center in the Arctic, and mitigate maritime risks to life safety and the environment.

The Bering Straits Leadership Team supports infrastructure development across the entire Arctic region. To that end, the Port of Nome seeks to demonstrate the effectiveness and efficiency of development dollars in this region by continuing to solicit P3 investments in the Port facility, touting the significant cost-saving mechanism for the

[4] 143 vessels waited at Road Stead to dock, 39 had drafts deeper than -22'.

private sector's operations in saving several days of sailing for commodity movement and resource development. An immediate and vital benefit of this investment will be the increased efficiency in logistical support throughout the Bering Sea and Arctic Ocean.

Nome is poised to play a critical role in ensuring the United States is a leader in the Arctic in national security, international trade, and geopolitical influence. As the only existing marine trade center in the Arctic, expansion of the Port of Nome is critical to ensure the timely development of an Arctic deep draft port as a support facility for military assets. A deep draft port in Western Alaska will not only serve the country's national interests, but expand on an existing logistics hub for many Alaskan coastal communities, creating an intermodal transit point for global commerce. This will assist in providing the energy independence needed in the Arctic and Northwest Alaska, to effectively reduce the cost of living and create economic opportunity throughout Alaska and the Pacific Northwest.

A Ten-Year Prioritization of Infrastructure Needs in the U.S. Arctic

National Strategy for the Arctic Region Implementation Plan Task 1.1.2

April 15, 2016

Prepared By

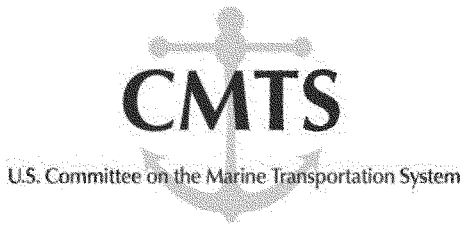
The U.S. Committee on the Marine Transportation System
Arctic Marine Transportation Integrated Action Team

For the

U.S. Department of Transportation

This report was developed by the U.S. Committee on the Marine Transportation System's Arctic Marine Transportation Integrated Action Team, which includes representatives from:

- National Oceanic and Atmospheric Administration
- U.S. Coast Guard
- Maritime Administration
- U.S. Department of Transportation, Office of the Secretary
- Department of State
- Environmental Protection Agency
- U.S. Army Corps of Engineers
- U.S. Navy
- National Maritime Intelligence Integration Office
- Department of Energy
- Bureau of Ocean Energy Management
- Bureau of Safety and Environmental Enforcement
- U.S. Transportation Command
- Executive Office of the President, Office of Science and Technology Policy
- Executive Office of the President, National Security Council



1200 New Jersey Avenue, SE W21 328
Washington, DC 20590
202-366-3612
www.cmts.gov

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EXECUTIVE SUMMARY

This document, "A Ten-Year Prioritization of Infrastructure Needs in the U.S. Arctic" (Prioritization Framework), presents a framework to address Arctic infrastructure gaps by identifying needs that are considered to be critical requirements for a safe and secure U.S. Arctic Marine Transportation System (MTS) over the next decade.

This report by the U.S. Committee on the Marine Transportation System (CMTS) fulfills directive 1.1.2 under the White House National Strategy for the Arctic Region (NSAR) 2014 Implementation Plan objective to "Prepare for Increased Activity in the Maritime Domain." The deliverable for 1.1.2 is to "Deliver a 10-year prioritization framework to coordinate the phased development of Federal infrastructure through Department and Agency validated needs assessment by the end of 2016." Transportation Secretary Anthony Foxx tasked this action to the CMTS in a May 2014 memorandum.

Using the CMTS 2013 report U.S. Arctic Marine Transportation System: Overview and Priorities for Action (CMTS 2013 Arctic Report) definitions, this Prioritization Framework organizes the U.S. Arctic MTS into five core components:[1]

- *Navigable Waterways*
- *Physical Infrastructure*
- *Information Infrastructure*
- *Response Services*
- *Vessels*

The recommendations set forth for consideration in this report are grouped into three categories under each of the five primary components: (1) infrastructure considerations that require both near-term planning and implementation; (2) infrastructure considerations requiring near term planning for mid- to long-term implementation; and (3) infrastructure considerations requiring long-term planning and implementation. This categorization facilitates the discussion of many coordinated infrastructure needs while acknowledging planning and funding requirements and limitations.

Over the past five years, with the continuing trend in diminishing Arctic sea ice, discussions and projections for the Arctic as a new international trade route have increased. Some vessels, particularly smaller recreational vessels, currently operating in the Arctic are neither designed

[1] U.S. Committee on the Marine Transportation System (2013). U.S. Arctic Marine Transportation System: Overview and Priorities for Action. A Report to the President. Available at: http://www.cmts.gov/downloads/CMTS%20U%20S%20%20Arctic%20MTS%20Report%20%2007-30-13.pdf as of December 2015.

nor equipped for hazardous Arctic conditions.[2] As sea ice retreats, the lack of U.S. Arctic infrastructure to support increased maritime activity grows more apparent. Limited nautical charts, aids to navigation, communication, emergency response, and rescue capabilities make operations difficult and potentially dangerous. Other elements contributing to accident risks in the Arctic include inadequate maritime infrastructure and environmental and economic uncertainties, all major challenges identified in the CMTS 2013 Arctic Report.

To address some of these risks, a number of studies have examined the gaps and potential infrastructure needs of the U.S. Arctic MTS. These needs include not only physical infrastructure such as ports, support vessels, and communication networks, but also the informational infrastructure enabling mariners to operate safely, such as nautical charts and electronic aids to navigation. The NSAR Implementation Plan (IP) identifies separate actions related to Arctic communications and aviation infrastructure [Objectives 1.2 Sustain and Support Evolving Aviation Requirements; and 1.3 Develop Communication Infrastructure in the Arctic]. This report synthesizes existing information on Arctic MTS infrastructure and gaps in order to distill requirements for future infrastructure needs over the next decade.

There are 43 recommendations put forward in this report for necessary elements of a comprehensive Arctic MTS. This framework necessarily involves elements of the traditional definition of infrastructure, but also includes communication, planning, management, environmental policies, regulatory implementation, and the human element, all of which are required for safe, secure, and successful maritime transportation.

Of the total list of recommendations, 25 are near-term recommendations to address the current gaps in U.S. Arctic infrastructure.

[2] Mooney, C. (April 8, 2015). *The Arctic has lost so much ice that now people want to race yachts through it.* The Washington Post. Available at: https://www.washingtonpost.com/news/energy-environment/wp/2015/04/08/the-arctic-has-melted-so-much-that-people-want-to-race-yachts-through-the-northwest-passage/ as of February 2016.

Near-Term Recommendations	
Navigable Waterways	Designate Port Clarence as an Arctic Maritime Place of Refuge.
	Review Port Clarence facilities to assess whether adequate support facilities are available at Port Clarence or in the region for a ship in need of assistance.
	Support Arctic Waterways Safety Committee efforts to bring stakeholders together.
	Leverage existing data-sharing frameworks, such as Data.gov, the Alaska Regional Response Team, and Alaska Ocean Observing System, to facilitate waterways planning and response to environmental emergencies.
	Leverage international partnerships supporting waterways coordination.
	Work with stakeholders to coordinate research efforts to de-conflict research within commercial and subsistence use areas.
	Designate M-5 Alaska Marine Highway Connector to connect the Arctic Ocean and the western section of the Northwest Passage.
Physical Infrastructure	Prioritize the need for Arctic port reception facilities to support international regulatory needs and future growth.
	Expand Arctic coastal and river water-level observations to support flood and storm-surge warnings.
	Review U.S. Arctic maritime commercial activities to identifying major infrastructure gaps that should be addressed to promote safe and sustainable Arctic communities.
	Co-locate new Continuously Operating Reference Stations and National Water Level Observation Network stations to significantly improve the Arctic geospatial framework with precise positioning and water levels.
Information Infrastructure	Improve weather, water, and climate predictions to an equivalent level of service as is provided to the rest of the nation.
	Implement short-range, sea-ice forecasting capability.
	Place hydrography and charting of the U.S. maritime Arctic among the highest priority requirements for agency execution.
	Advance Arctic communication networks to ensure vessel safety.
	Finalize the Port Access Route Study for the Bering Strait and continue efforts to provide routes for vessel traffic in the U.S. Arctic.
	Expand partnerships to provide new satellite Automatic Identification System (AIS) capabilities for offshore activity information.
MTS Response Services	Continue collaboration with State and local authorities to ensure readiness of Arctic maritime and aviation infrastructure for emergency response and Search and Rescue (SAR).
	Continue coordination through international fora to provide significant opportunities for engagement across the Federal Government and the international Arctic response community.
	Support Pan-Arctic response equipment database development, best practices recommendations, and information sharing for continued development of guidelines for oil spill response in the Arctic.

	Develop a plan to transport critical response equipment from the contiguous U.S. into the Arctic area in the event of a catastrophic event.
	Evaluate facilities currently available on the North Slope for use as seasonal staging areas by those engaged in readiness exercises or research.
Vessel Operations	Expand U.S. icebreaking capacity to adequately meet mission demands in the high latitudes.
	Update domestic law to implement the mandatory provisions of the Polar Code and the Convention on Standards of Training, Certification and Watchkeeping for Seafarers.
	Examine existing training and safety standards applicable to the U.S. fishing fleet with respect to the new Polar Code requirements.

The CMTS recommendations in this report cover the five core MTS components and provide a path for Federal activities needed to preserve the mobility and safe navigation of U.S. military and civilian vessels throughout U.S. Arctic waters.

As sea ice retreats, the United States must recognize the importance of providing infrastructure to support increased domestic and international maritime activity. The current limitations in nautical charts, aids to navigation, communication, emergency response, and rescue capabilities make operations difficult and potentially dangerous, hindering U.S. maritime activities in the Arctic. The priorities and recommendations presented in this document create an actionable framework to improve the U.S. Arctic MTS and facilitate responsible activity and growth in the region for a safe and secure Arctic over the next decade and beyond.

INTRODUCTION

The U.S. Committee on the Marine Transportation System (CMTS) is a Federal Cabinet-level, inter-departmental committee chaired by the Secretary of Transportation. The purpose of the CMTS is to create a partnership of Federal departments and agencies with responsibility for the Marine Transportation System (MTS). In 2010, the CMTS was directed by statute to coordinate transportation policy in the US Arctic for Safety and Security. The National Strategy for the Arctic Region (NSAR) Implementation Plan (IP) directs the U.S. Department of Transportation to execute the tasks under the objective Prepare for Increased Activity in the Maritime Domain. These tasks were delegated to the CMTS by the Office of the Secretary in 2014.

This report by the CMTS fulfills directive 1.1.2 under the NSAR IP 2014 objective to "Prepare for Increased Activity in the Maritime Domain." The deliverable for 1.1.2 is to "deliver a 10-year prioritization framework to coordinate the phased development of Federal infrastructure through Department and Agency validated needs assessment by the end of 2016."

The CMTS completed its first deliverable under NSAR Line of Effort 1 with the delivery of a report, *10-Year Projection of Maritime Activity in the U.S. Arctic,* to the White House National Security Council in December of 2014 (Action 1.1.1).[3] The CMTS is also charged with developing recommendations for pursuing Federal public-private partnerships in support of the needs assessment and identifying prioritized activities (1.1.3) planned for delivery later in 2016.

This 10-year prioritization framework to coordinate the phased development of Federal infrastructure under 1.1.2 builds on the 2013 CMTS Report to the President, *U.S. Arctic Marine Transportation System: Overview and Priorities for Action*, which produced scenario based projections of potential U.S. Arctic maritime activity in 2025.[4] Action 1.1.2 is the next step in making recommendations for developing, improving, and maintaining infrastructure in support of Federal maritime Arctic activities, national security, navigation safety, and stewardship of natural resources.

[3] Azzara, A. J., Wang, H., Rutherford, D., Hurley, B., and Stephenson, S. (2015). *A 10-year Projection of Maritime Activity in the U.S. Arctic Region.* A Report to the President. U.S. Committee on the Marine Transportation System, Integrated Action Team on the Arctic, Washington, D.C., 73 p. Available at: http://www.cmts.gov/downloads/CMTS_10-Year_Arctic_Vessel_Projection_Report_1.1.15.pdf as of December 2015.

[4] Committee on the Marine Transportation System (2013). *U.S. Arctic Marine Transportation System: Overview and Priorities for Action.* A Report to the President. Available at: http://www.cmts.gov/downloads/CMTS%20U%20S%20%20Arctic%20MTS%20Report%20%2007-30-13.pdf as of December 2015.

Using the CMTS 2013 Arctic Report definitions, this 2016 report organizes the U.S. Arctic Marine Transportation System (MTS) into five core components:

- Navigable Waterways
- Physical Infrastructure
- Information Infrastructure
- MTS Response Services
- Vessels

The recommendations set forth for consideration in this report are grouped into three categories under each of the five primary components: (1) infrastructure considerations that require both near-term planning and near-term implementation; (2) infrastructure considerations requiring near-term planning for mid- to long-term implementation; and (3) infrastructure considerations requiring long-term planning and implementation. This categorization facilitates the discussion of many coordinated infrastructure needs while acknowledging planning and funding requirements and limitations.

BACKGROUND

The United States is an Arctic Nation, with 33,900 miles of shoreline in Alaska, including the Aleutian Islands.[5] [6] Three Arctic seas bound the State of Alaska: the Bering, the Chukchi, and the Beaufort (Figure 1). Historically, these seas are frozen for more than half the year. The general Arctic maritime season typically lasts only from June through October, and unaided navigation occurs within a more limited time frame. However, this pattern appears to be rapidly changing as ice-diminished conditions become more extensive during the summer months. On September 16, 2012, Arctic sea ice reached its lowest coverage extent ever recorded, paving the way for the longest Arctic navigation season on record.[7] In the 2015 Arctic Report Card, the September 2015 Arctic sea ice minimum extent was the fourth lowest value in the satellite record (1979-2015) and January 2016 was a new record low for winter ice extent in the Arctic.[8] [9] While loss of sea ice may increase the time available for navigation in the Arctic, marine transportation

[5] This report uses the U.S. Arctic Research Policy Act of 1984 to define the Arctic, including all waters subject to U.S. jurisdiction: The U.S. Exclusive Economic Zone, U.S. territorial sea, and internal navigable waters in Alaska.
[6] Facts about Alaska, Official State of Alaska Website. Available at: http://alaska.gov/kids/learn/facts.htm as of January 2016.
[7] McGrath, Matt (2012). Gas tanker Ob River attempts first winter Arctic crossing, BBC News. Available at: http://www.bbc.co.uk/news/science-environment-20454757.
[8] M. O. Jeffries, J. Richter-Menge, and J. E. Overland, Eds., (2015): Arctic Report Card 2015, Available at: http://www.arctic.noaa.gov/reportcard as of February 2016.
[9] National Snow and Ice Data Center, Arctic Sea Ice News and Analysis available at: http://nsidc.org/arcticseaicenews/ as of February 2016.

in the region will continue to be challenging and potentially hazardous, particularly due to variability of sea ice from year to year. Although transiting across Arctic waters has greatly improved due to increasing summer ice retreat, there are still unpredictable ice floes, inclement weather (e.g., extreme cold, heavy fog, severe storms), and seasonal accessibility based on variation in ice location.[10]

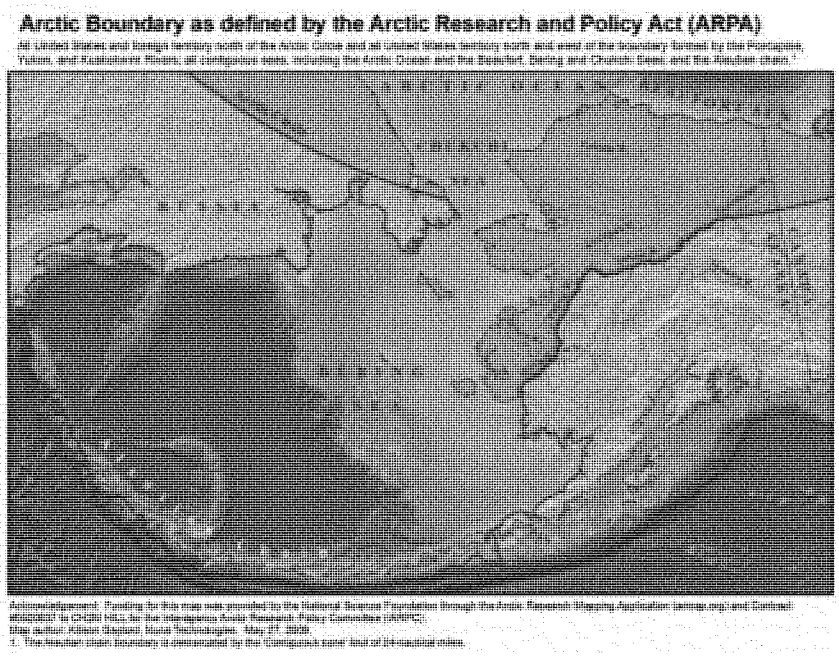

Figure 1. The geographic area covered by this report consists of all U.S. territory north of the Arctic Circle and all U.S. territory north and west of the boundary formed by the Porcupine, Yukon, and Kuskokwim Rivers; all contiguous seas including the Arctic Ocean and the Beaufort, Bering, Chukchi Seas and the Aleutian Island chain, as defined in § 112 of the Arctic Research and Policy Act of 1984 (ARPA). Source: U.S. Arctic Research Commission.

[10] Committee on the Marine Transportation System (2013). *U.S. Arctic Marine Transportation System: Overview and Priorities for Action*. A Report to the President. Available at: http://www.cmts.gov/downloads/CMTS%20U%20S%20%20Arctic%20MTS%20Report%20%2007-30-13.pdf as of December 2015.

As sea ice retreats, the lack of U.S. Arctic MTS infrastructure to support increased maritime activity in shipping, mining, oil and gas exploration, fishing, and tourism grows more apparent. Limited nautical charts, aids to navigation, communication, emergency response, and rescue capabilities further challenge these difficult and potentially dangerous operations. Currently, the U.S. Government has surveyed and charted less than two percent of navigationally significant U.S. Arctic waters to modern standards for accurate water depths and hazards to navigation.[11]

Over the past five years, with the continuing trend in diminishing Arctic sea ice, discussions and projections for the Arctic as a new international trade route have increased. Between 2011 and 2013, transits through the Bering Strait increased from 410 to 440, and transits through the Northern Sea Route increased from 36 to 71, as compared to only 4 in 2010. Despite a dip in activity in 2014, Russia's Northern Sea Route Administration granted more than 650 permits to transit the Northern Sea Route in 2015, demonstrating sustained interest in the region.[12] [13] Transit statistics for the 2015 season support this continued interest with 300 unique vessels and 540 vessel transits through the Bering Strait, an increase over 2012 activity (Figure 2).

Despite this quantifiable growth in vessel traffic, some vessels currently operating in the Arctic are neither designed nor equipped for the ice conditions that they could potentially encounter. Other elements contributing to risk of accident in the Arctic include inadequate maritime infrastructure and environmental and economic uncertainties, all major challenges identified in the CMTS 2013 Arctic Report, and in risk reports such as *Arctic Openings: Opportunity and Risk in the High North*, published in 2012 by Lloyd's and Chatham House.[14]

To address some of these challenges, a number of studies have examined the gaps and potential infrastructure needs of the U.S. Arctic MTS. These needs include not only physical infrastructure such as ports, support vessels, and communication networks, but also the informational infrastructure enabling mariners to operate safely, such as nautical charts and electronic aids to navigation.

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[11] Committee on the Marine Transportation System (2013). U.S. Arctic Marine Transportation System: Overview and Priorities for Action. A Report to the President. Available at: http://www.cmts.gov/downloads/CMTS%20U%20S%20%20Arctic%20MTS%20Report%20%2007-30-13.pdf as of December 2015.

[12] The Northern Sea Route spans the Arctic waters between the Barents Sea and the Kara Sea, along the northern Russian coast.

[13] Northern Sea Route Information Office, transit statistics. Available at: http://www.arctic-lio.com/nsr_transits as of December 2015.

[14] Lloyd's and Chatham House (2012). *Arctic Opening: Opportunity and Risk in the High North*. Available at: http://www.chathamhouse.org/publications/papers/view/182839 as of December 2015.

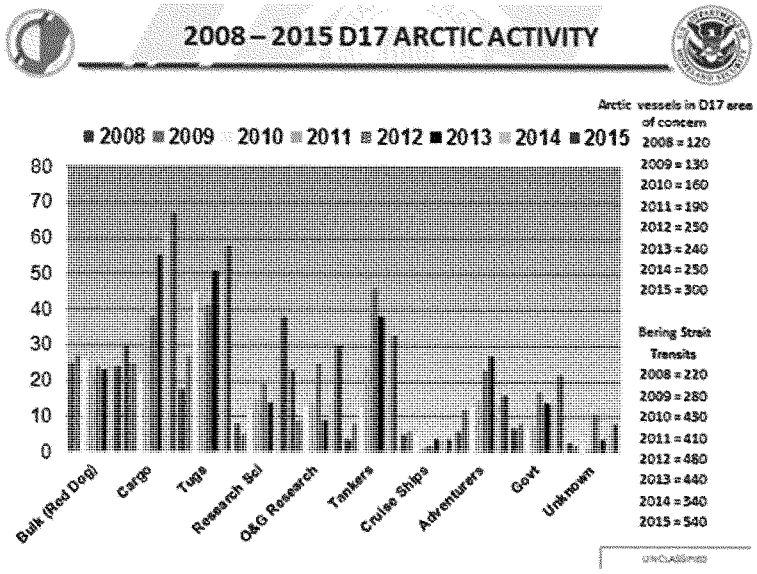

Figure 2. Arctic traffic in the USCG District 17 area of concern and transits of the Bering Strait, 2008 to 2015.

As part of the first CMTS deliverable for the NSAR IP, projection scenarios for vessel activity in the U.S. Arctic were developed. The vessel activity projections are separated into three general categories of growth reflecting (1) estimated growth in global trade; (2) the assumption that some international vessel traffic will divert from the Suez and Panama Canals in favor of Arctic shipping routes; and (3) various oil and gas exploration and production scenarios for the next decade. For each type of growth, scenarios were explored. The scenarios span a range (i.e. low, medium, and high) of intentionally conservative assumptions to less conservative development patterns with higher rates of vessel diversion enabled by increased accessibility to the Arctic. A conservative estimate of the number of unique vessels operating in the Bering Strait and U.S. Arctic in 2025 is 420, resulting in approximately 877 transits through the Bering Strait, or a doubling over 2013 transit levels. These conservative estimates assume no increase in oil and gas activity over 2011 levels. The transit statistics from 2015 support the general projections in the report and showed an increase of 50 unique vessels over the 2012 numbers. The various

growth possibilities developed by the projections helped to inform the range of infrastructure needs evaluated in the current report.

This report synthesizes existing information on Arctic MTS infrastructure (Table 1) and gaps in order to distill requirements for future infrastructure needs over the next decade.

PREVIOUS WORK IDENTIFYING INFRASTRUCTURE NEEDS

In 2009, the Arctic Council's Protection of the Arctic Marine Environment Working Group published the *Arctic Marine Shipping Assessment* (AMSA).[15] This report detailed 17 recommendations for maritime safety and marine environmental protection in the Arctic. The AMSA report addressed the infrastructure deficit for supporting Arctic maritime safety, environmental protection, and sustainable development. AMSA recommendations specifically noted the need for Arctic states to support continued development of a comprehensive Arctic marine traffic awareness system, as well as to invest in hydrographic, meteorological, and oceanographic data to support safe navigation and voyage planning.

The May 2013 NSAR and subsequent January 2014 Implementation Plan (IP) elevated the national conversation about the U.S. Arctic, placing specific agencies in charge of assessing the current state of Arctic infrastructure and its future needs. The IP reflects the reality of a changing Arctic environment and the desire to promote national interests for safety, security, and environmental protection.

The CMTS 2013 Arctic Report highlighted the risks and opportunities of increasing maritime activity. It presented a vision of a U.S. Arctic MTS capable of meeting the safety, security, and environmental protection needs of present and future Arctic stakeholders. The report included sixteen issue papers discussing elements of the U.S. Arctic MTS, including gaps currently inhibiting safe U.S. Arctic marine transportation and necessary physical and informational infrastructure improvements to support U.S. Arctic commerce and security. Table 1 is drawn from the CMTS 2013 Arctic Report. Updated for 2016, Table 1 illustrates the current state of U.S. Arctic MTS infrastructure. The subsequent sections in this report are intended to identify significant gaps and provide recommendations to address national interests for safety, security, and environmental protection in the U.S. Arctic.

[15] Arctic Marine Shipping Assessment (2009). *Protection of the Arctic Marine Environment Working Group, Arctic Council.* Available at: http://www.arctic.noaa.gov/detect/documents/AMSA_2009_Report_2nd_print.pdf as of December 2015.

Additional reports published by a variety of sources continue to highlight the need to address various MTS infrastructure issues in the Arctic.[16] These include the 2014 U.S. Government Accountability Office report, *Maritime Infrastructure: Key Issues Related to Commercial Activity in the U.S. Arctic over the Next Decade*. In January 2015, the Alaska Arctic Policy Commission published a strategy and implementation plan using similar language and priorities to the NSAR for safe and secure navigation and development in the Arctic.

Priority areas identified in U.S. reports include acquiring new heavy icebreakers, improved nautical charts and communications capabilities, better weather forecasting and modeling, construction of a deep-draft U.S. Arctic port(s), and developing community and regional emergency response networks in preparation for vessel and aircraft accidents and environmental damage related to increased ship traffic and industry.

[16] For a more comprehensive discussion of Arctic reports, please see Table 1: *Arctic Policies and Recommendations Reviewed for MTS Focus or Investment. U.S. Committee on the Marine Transportation System* (2013). U.S. Arctic Marine Transportation System: Overview and Priorities for Action. A Report to the President. Available at: http://www.cmts.gov/downloads/CMTS%20U%20S%20%20Arctic%20MTS%20Report%20%2007-30-13.pdf as of December 2015.

Table 1. Current Status of U.S. Arctic MTS Infrastructure

MTS Components	MTS Element	Current Status for the U.S. Arctic
Navigable Waterways	Places of Refuge for Ships	- Currently no official Maritime Place of Refuge in the U.S. Arctic - State of Alaska has identified 13 sites along the North Slope as potential places of refuge - Sufficient number of ports and natural harbors available in the Aleutian Island Chain - Areas near the Bering Strait being studied by U.S. Army Corps of Engineers include Savoonga, Gamble, Cape Darby, and Port Clarence
	Areas of Heightened Ecological Significance	- Currently three areas identified: St. Lawrence Island, portions of the Bering Strait and the Chukchi Beaufort Coast - May 2015 Subarea Contingency Plan for the Aleutian Islands was completed by the Federal/State Alaska Regional Response Team, including maps showing environmentally sensitive areas. Subarea Contingency plans for other Arctic areas are scheduled for cyclic updating: North Slope (2017), Northwest Alaska (2016), Western Alaska (2018) and Bristol Bay (2018) - Biological Important Areas for Cetaceans have been developed for Gulf of Alaska, Aleutian Island and Bering Sea Region, and the Arctic Region
Physical Infrastructure	Ports and Associated Facilities	- Ten U.S. port facilities exist south of the Bering Strait: Port of Nome, St. Michael Harbor, Port of Bethel, St. Paul, St. George, Dillingham, Port of Bristol Bay, Dutch Harbor/Unalaska, Adak, and King Cove - One U.S. port facility exists north of the Bering Strait: Port of Kotzebue
	Geospatial Infrastructure	- Ten National Oceanic and Atmospheric Administration (NOAA) Continuously Operating Reference Stations (CORS) Network sites along the Aleutian Chain - Ten CORS Network sites in Arctic coastal areas of the Bering Sea - Three CORS Network sites near two North Slope coastal areas
MTS Information Infrastructure	Hydrographic Surveys	- 4330 square nautical miles (nm^2)of 42,400 nm^2 identified by NOAA as navigationally significant waters - Two 48-year old ice-strengthened hydrographic survey vessels, *Rainier* and *Fairweather*
	Shoreline Mapping	- 33,900 official shoreline miles of Arctic Alaskan coastline (measured by NOAA from 1:80,000 scale), only 12,882 of which have been mapped since 1988 using contemporary methods
	Aids to Navigation (ATON)	- 222 ATONs located throughout the Bering Sea and Aleutian Islands - Eight ATONs, mostly in Kotzebue Sound

MTS Components	MTS Element	Current Status for the U.S. Arctic
MTS Information Infrastructure		- Eleven privately maintained aids along the North Coast (near oil and gas facilities at Prudhoe Bay)
	Communications	- Line of Sight (LOS) and satellite communications (SATCOM) architecture sufficient to support voice and data communication needs in the Bering Sea - Limited LOS communications above 65°N - Limited SATCOM above 70°N
	Marine Weather and Sea Ice Forecasts	- The NOAA National Weather Service (NWS) Alaska Sea Ice Program provides a 5-day sea ice forecast every Monday, Wednesday, and Friday throughout the year in both a text and graphical format. The sea ice forecasts focus on changes to the main ice pack, marginal ice zone, shorefast ice, and sea-ice free waters. - NWS operates three Weather Forecast Offices (WFOs) in Anchorage, Fairbanks, and Juneau, which operate 24-hours-a-day, 7-days-a-week, 365-days-a-year. The WFOs produce daily wind, wave, freezing spray, and swell (both direction and height) forecasts in support of marine activities. The forecasts are available in text and graphical formats. - NOAA's National Centers for Environmental Prediction provides forecast guidance from operational atmosphere, ocean, and wave model four times daily. NCEP also provides forecast guidance for sea-ice motion, daily to day 16. The global operational Real-Time Ocean Forecast System is run once per day. The National Ice Center (NIC) provides year-round Arctic-wide sea ice analysis, seasonal sea ice outlooks, and special product support for USG vessels operating near or within the sea ice. - The U.S. Navy operational Arctic Cap Nowcast/Forecast System, transitioning to their Global Ocean Forecast System v3.1, provides1-7 day forecasts of Arctic ice concentration, ice thickness, ice velocity, sea surface temperature, sea surface salinity, and sea surface velocities used operationally by the NIC.
	Real-Time Oceanographic Information	- Nine NOAA National Water Level Observation Network (NWLON) tidal stations located at Unalaska, Nikolski, Atka, Adak, Port Moller, Village Cove, Nome, Red Dog, and Prudhoe; 21 gaps identified
	Automatic Identification System (AIS)	- 36 land-based AIS receiving stations operated by the Marine Exchange of Alaska; 11 are north of the Bering Strait
MTS Response Services	Federal Icebreaking and Emergency Response Assets	- USCG/National Science Foundation vessels are used primarily to support science missions and emergency response (SAR, Oil Spill Federal on Scene Coordinator, etc.) - USCGC *Polar Star* – Heavy Icebreaker (60,000 HP); Currently used in the Antarctic

MTS Components	MTS Element	Current Status for the U.S. Arctic
MTS Response Services (cont.)	Federal Icebreaking and Emergency Response Assets	- USCGC *Healy* – Medium Icebreaker (30,000 HP); Currently used in the Arctic - USCG vessels and aircraft have historically operated in the Bering Sea year round. Operation Arctic Shield extends operational area farther north during ice free summer months to test capabilities. - *Nathaniel B. Palmer* – National Science Foundation leased science support vessel (Light Icebreaker - 12,720 HP)
	Environmental Response Management	- All federally permitted oil and gas activities require operators to have approved oil spill contingency plans, which includes tank and non-tank vessel response plans requiring owner/operators to maintain oil spill response equipment and trained personnel both on-site and able to respond within specified timeframes based upon their operating environment and proximity to land. Closest Oil Spill Removal organizations (pollution response contractors) capable of responding to a pollution event are Dutch Harbor, Kodiak, and Anchorage (1000, 820, and 635 nautical miles away from Alaska's Northern Slope, respectively) - Aerial Dispersant Delivery System (ADDS) staged in Anchorage - U.S. Navy spill response equipment (SUPSALV) staged in Anchorage - State of Alaska has seven response equipment sites south of the Bering Strait (Nome, Unalakleet, Toksook Bay, Bethel, Dillingham, King Cove, and Dutch Harbor) and one north in Kotzebue. Two Emergency Towing Systems (ETS), located at Dutch Harbor and Cold Bay - USCG District 17 maintains four Spilled Oil Recovery Systems (SORS) equipped on 225' buoy tenders home-ported in Alaska (*Spar, Maple, Sycamore* and *Hickory*), and one Vessel of Opportunity Skimming System (VOSS) split between Anchorage and Ketchikan - USCG District 17 maintains 51 caches of Coast Guard-owned response equipment in 18 cities/ villages throughout Alaska. Ten of these caches are in C-130 compatible containers, located near Anchorage, for deployment to Arctic locations. In addition, three of the caches are located in the Alaskan Arctic towns of St. Paul, Unalaska, and King Cove. - Arctic Environmental Response Management Application (ERMA) GIS for common operating picture in event of incident (web version and stand-alone version) - All four Oil Spill Response Organizations that service the North Slope, Western Alaska, and the Aleutian Islands have only a little or no open-ocean capability, very limited wildlife response equipment and limited experience responding to Arctic spills
		- Limited SAR infrastructure and air support in the region

MTS Components	MTS Element	Current Status for the U.S. Arctic
MTS Response Services (cont.)	Search & Rescue (SAR)/ Emergency Response	- USCG forward deploys surface and aviation assets to Arctic regions based on activity levels (commonly highest during the summer season) - The nearest USCG air station is in Kodiak, 820 nautical miles from Point Barrow (northernmost point of land) - The 11th Air Force has three rescue squadrons capable of providing refuelable H-60s, C-130s, and pararescuemen throughout Alaska - The closest refueling site to Alaska's North Slope for vessels is Dutch Harbor, which is 1,000 nm away - USCG currently forward deploys helicopters from Air Station Kodiak to Cold Bay, and to St. Paul Island, in support of the red king crab and opilio crab fisheries, respectively, to ensure adequate SAR response - USCG maintains seasonal forward operating locations for H-60 helicopters on the North Slope: Barrow in 2014, Deadhorse in 2015, and Kotzebue is planned for 2016 - NOAA Search and Rescue Satellite Aided Tracking satellites relaying distress signals from emergency beacon contributions appear satisfactory - The North Slope Borough Search and Rescue Department has a Critical Care Air Ambulance Service performing medevac, SAR and emergency missions throughout the North Slope Region - All federally permitted oil and gas activities require operators to have approved contingency plans and maintain capabilities for emergency response, including SAR
Vessels	Mandatory Polar Code/Voluntary Polar Guidelines	- International Maritime Organization (IMO) has adopted an International Code for Ships Operating in Polar Waters (Polar Code) that includes mandatory and voluntary provisions that will enter into force January 1, 2017 through amendments to the International Convention for the Safety of Life at Sea and the International Convention for the Prevention of Pollution from Ships - The Polar Code builds upon previous IMO recommended guidelines including "Guidelines for ships operating in Arctic ice-covered waters" (2002) and "Polar Waters" (2009), which are available for vessels not subject to the Polar Code - The International Standards Organization Technical Committee 67 has developed design and materials standards for offshore oil and gas structures in ice-covered waters
	Crew Standards/	- Crew standards and training are found in the IMO's International Convention on Standards of

MTS Components	MTS Element	Current Status for the U.S. Arctic
	Training	Training, Certification and Watchkeeping for Seafarers (STCW) - The United States has worked closely with U.S. industry through the Merchant Marine Personnel Advisory Committee and with other IMO Member States to develop amendments to the STCW that provide for a standardized training regime for personnel employed on vessels subject to the Polar Code - These amendments will be adopted in May 2016 and will enter into force on January 1, 2018 - USCG plans to promulgate an interim policy letter in 2016 and regulations in the future to implement these STCW amendments into the U.S. domestic credentialing regime

FORWARD-LOOKING U.S. ARCTIC MTS REQUIREMENTS: THE NEXT 10 YEARS

This section of the report presents U.S. Arctic MTS infrastructure requirements over the next 10 years. Using the CMTS 2013 Arctic Report definitions, this section discusses the U.S. Arctic MTS in five primary components: Navigable Waterways, Physical Infrastructure, Information Infrastructure, MTS Response Services, and Vessel Operations.

For each of these components, recommendations for consideration will be made within three categories:

1) *Near-Term (2016-2018):* Includes recommendations suited for near-term planning and near-term implementation such as specific infrastructure needs that have been identified as mission critical for safe navigation in Arctic waters and require immediate investment and action.
2) *Mid-Term (2018-2022):* Includes recommendations suited for near-term planning for mid-term implementation such as infrastructure needs that require longer planning stages and the potential for multiple budget cycles to secure funding through some combination of Federal appropriations and/or the establishment of partnerships to secure the necessary funding, permits, or other critical components. Although these recommendations will require longer periods of time to complete and implement, it is imperative that planning begin as soon as possible.
3) *Long-Term (2018-2025):* Includes recommendations suited for long-term planning such as infrastructure elements requiring extensive financial planning or that include cooperative planning and coordination of efforts. In addition to physical infrastructure, these elements form the stakeholder engagement, communication, and cooperative planning frameworks needed to support the physical infrastructure components of an Arctic MTS.

The ordering of infrastructure in this report is not intended to create a hierarchy of most to least important, but rather to demonstrate the necessary sequence to create the strongest foundation for U.S. Arctic infrastructure supporting current and future needs. By categorizing based on near-, mid-, and long-term needs, we can recognize interdependencies (e.g., to have accurate charts, we must first have good geodetic control and tidal data, along with accurate shoreline mapping and hydrographic survey data), and break critical infrastructure projects into components. These components, if integrated over time, support the establishment of a stronger, more resilient U.S. Arctic MTS.

Navigable Waterways

In the Arctic, diminishing ice has led to the seasonal opening of navigable waterways that are sufficiently deep and wide for vessels to pass. In the U.S. Arctic, this means additional traffic through the Bering Strait and along the North Slope of Alaska, driven by potential maritime traffic increases along the Northern Sea Routes and Northwest Passage (Figure 3).

These Arctic navigable waterways are used to transport mineral, agricultural and bulk products, as well as other trade goods and passengers to, from, and within the United States. They connect the U.S. Arctic region to the rest of the Nation and contribute to the movement of global commerce.

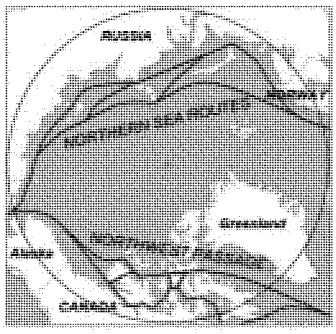

Figure 3. Northern Sea Routes and Northwest Passage. Source: Office of Naval Intelligence

Harbors of Refuge

An integral part of waterways and marine transportation system management is the availability of places of refuge for ships transiting U.S. waters. A "Harbor of Refuge" is defined as "a port, inlet, or other body of water normally sheltered from heavy seas by land and in which a vessel can navigate and safely moor." [17] Port Clarence, just south of the Bering Strait, is a known port of refuge on the Alaskan coast, has historically been used as such by fishing and whaling vessels, and is often used as such by commercial and government vessels. Section 5.1.2.2 of the United States Army Corps of Engineers' 2015 *Alaska Deep Draft Port System Draft Integrated Feasibility Report and Environmental Assessment* states, in the analysis of Port Clarence, that the location would be used as a deep-water anchorage during storms or other inclement weather.[18] While Port Clarence is situated near deep water at Point Spencer, it would require a significant amount of upland development in order to adequately support the range of maritime missions required of a commercial port. Currently, there are no navigation improvements planned for the area to address this gap in facilities support, although the Coast Guard Authorization Act of 2015 included language that transfers real property ownership to the local stakeholders, which could

[17] Under 46 CFR 175.400.
[18] United States Army Corps of Engineers' Alaska Deep Draft Port System: Draft Integrated Feasibility Report and Environmental Assessment (2015). Alaska District, Pacific Ocean Division, February 2015. Available at: http://www.poa.usace.army.mil/Portals/34/docs/civilworks/arcticdeepdraft/ADDMainReportwithoutappendixes.pdf as of March 2016.

potentially spur planning for future private investment and development particularly given the proximity of Point Spencer to Teller and Nome (approximately 70 miles by road).[19] The CMTS recommends that Port Clarence be designated an Arctic Maritime Place of Refuge and that a review of the port's capabilities be undertaken to ensure adequate support exists, singularly or in coordination with other Arctic ports should a ship or other vessel require assistance.

Marine Areas of Ecological Significance

Ecologically significant marine areas also fall under navigable waterways management. The 2009 AMSA, Section II-C under the "*Protecting Arctic People and the Environment*" theme recommended "that the Arctic states should identify areas of heightened ecological and cultural significance . . . and, where appropriate, should encourage implementation of measures to protect these areas from the impacts of Arctic marine shipping . . . ."[20]

The Interagency Arctic Research Policy Committee's five-year research plan took the need for identification of Areas of Ecological Significance one step further, recommending baseline Arctic research to better understand ecosystem-level dynamics, habitats, and species populations.[21] Because the Arctic is a dynamic environment consisting of eighteen Large Marine Ecosystems, (LMEs), each of which support unique food webs as well as commerce and subsistence economies, greater research and understanding is critical.[22] Developing coherent and comprehensive management plans for Areas of Ecological Significance is imperative for successful management of the region, including waterways use. To support coordinated use and protection of the LMEs, the CMTS recommends: supporting and coordinating Federal science programs and "science of opportunity" research on National Oceanic and Atmospheric Administration (NOAA), National Science Foundation (NSF), U.S. Coast Guard (USCG) flights and icebreaker deployments, and other private or commercial vessels; collecting and sharing of observations of physical, meteorological, oceanographic, geological, and biological observations and data; leveraging existing data sharing frameworks, such as Data.gov, and the Alaska Ocean Observing System (AOOS), to facilitate interdisciplinary research and policy development; and

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[19] Coast Guard Authorization Act of 2015 (H.R. 4188). Available at: https://www.gpo.gov/fdsys/pkg/BILLS-114hr4188enr/pdf/BILLS-114hr4188enr.pdf as of February 2016.

[20] AMAP/CAFF/SDWG (2013). Identification of Arctic marine areas of heightened ecological and cultural significance: Arctic Marine Shipping Assessment (AMSA) IIc Available at: http://www.amap.no/documents/doc/identification-of-arctic-marine-areas-of-heightened-ecological-and-cultural-significance-arctic-marine-shipping-assessment-amsa-iic/869 as of January 2016.

[21] Arctic Research Plan: FY2013–2017 (2013) Executive Office of the President
National Science and Technology Council. Available at:
https://www.whitehouse.gov/sites/default/files/microsites/ostp/2013_arctic_research_plan.pdf as of January 2016.

[22] Large Marine Ecosystem (LMEs) of the Arctic area—Revision of the Arctic LME Map, 15th of May 2013, PAME Working Group of the Arctic Council. Available at: http://www.pame.is/index.php/projects/ecosystem-approach/arctic-large-marine-ecosystems-lme-s as of January 2016.

working with stakeholders to coordinate research efforts with commercial and subsistence uses within fisheries and subsistence harvest areas. These data-sharing and collaborative partnerships should directly inform policy decisions for management of the U.S. Arctic MTS, including port and waterways planning and vessel routing requirements.

Managing Arctic Waterways

In managing Arctic waterways, it is practical to develop overarching frameworks and cooperative bodies to deal with day-to-day issues as they arise. These bodies should be interdisciplinary and serve to represent issues and concerns raised by stakeholders from the maritime arena. One recent development in this area was the formation of the Arctic Waterways Safety Committee (AWSC) in October of 2014. Incorporated as a non-profit organization, AWSC has a membership that includes representation from all five subsistence co-management groups in the region, regional government, and maritime industry. The AWSC is, in essence, a "Harbor Safety Committee" under the national MTS framework. Thus the AWSC has the potential to act as a conduit to relay regional concerns to Federal MTS agencies and the CMTS.[23] In addition, consideration should be given to international waterways coordination and leveraging international partnerships, as appropriate, among Arctic States to better respond to emerging Arctic maritime and commercial requirements. These partnerships should be leveraged where possible to increase maritime domain awareness and readiness, and to protect the Arctic environment.

As an example, the USCG is engaged in a Port Access Route Study (PARS) for the Bering Strait and has published possible routing measures such as recommended two-way routes and areas to be avoided for vessel traffic in the Bering Strait (Figure 4).[24] Although these will be recommended measures and not mandatory, the United States should continue to collaborate with Russia on the Bering Strait PARS and consider appropriate IMO implementation of ship routing measures for the Bering Strait. The forward-looking action of establishing these ship routing measures in advance of any vessel collision or incident should continue to be a priority. Early identification of Arctic shipping corridors will also help to prioritize the acquisition of hydrographic survey data.

[23] The AWSC was established in October 2014 as a self-governing multi-stakeholder group focused on creating or documenting best practices to ensure a safe, efficient, and predictable operating environment for all users of the arctic waterways. Available at: http://www.arcticwaterways.org/home.html as of February 2016.

[24] Overview of USCG Proposed Routing in Vicinity of Bering Strait. USCG-2014-0941. Supporting and Related Material. Available at: https://www.regulations.gov/#!documentDetail;D=USCG-2014-0941-0002 as of March 2015.

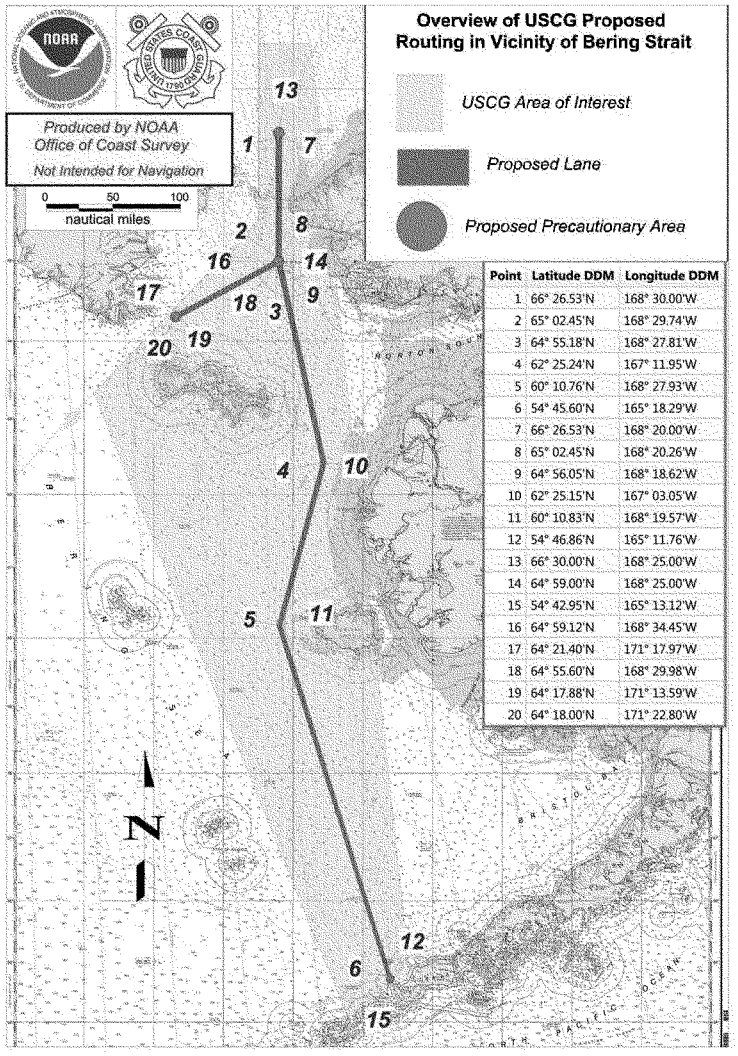

Figure 4. Proposed Arctic Routing from Bering Strait Port Access Route Study.

Marine Highways

The America's Marine Highway (AMH) System consists of over 29,000 nautical miles of navigable waterways including rivers, bays, channels, the Great Lakes, the Saint Lawrence Seaway System, coastal, and open-ocean routes. The AMH program works to further recognize and incorporate the nation's waterways into the greater U.S. transportation system, especially where marine transportation services are the most efficient, effective, and sustainable transportation option. The AMH is not currently reflective of the commercial shipping along the Arctic areas of the west and north coasts of Alaska. The closest route is the M-5 Alaska Marine Highway Connector that currently consists of the Pacific Ocean coastal waters, including the Inside Passage. The M-5 connects commercial navigation channels, ports, and harbors from Puget Sound to Unalaska in the Aleutian Islands, spanning British Columbia, lower Alaska and connects at the Canadian border north of Bellingham, WA (Figure 5).

Adding an AMH connector to the Arctic formally recognizes the importance of the region and the increasing shipping and cargo operations. Adding an extension leg to the current M-5 Connector going north from the Aleutian Islands along the west and north coasts of Alaska would connect the Bering, Chukchi, and Beaufort Seas, and link the route to the Arctic Ocean and the western section of the Northwest Passage. This extension supports shipping and cargo movements occurring north of the Aleutians including Port Clarence, Cape Romanzof, Dillingham, Bethel, Egegik River, Port Heiden, Togiak Bay, Arctic Ocean-Off Northern Alaska, Bering Sea Off Western Alaska, Port Moller, St. Paul Island, Pribilof Islands, Hooper Bay, Nunivak Island, Nome, St. Lawrence Island, Tin City, Shishmaref, Kivalina, Point Hope, Cape Lisburne, Point Lay, Wainwright, Barrow, Kaktovik, and Prudhoe Bay. Recognizing the navigational challenges in the region, this action to designate the M-5 addition should be fully supported and is anticipated for completion in the near-term.[25]

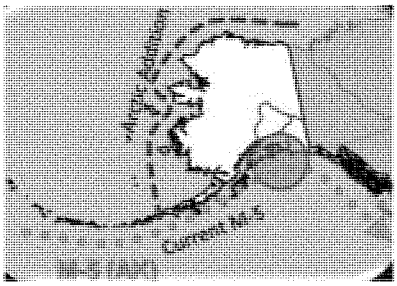

Figure 5. Current and proposed route for the extension of the M-5 Alaska Marine Highway Connector

[25] America's Marine Highway Program, U.S. Maritime Administration. Available at: http://www.marad.dot.gov/ships-and-shipping/dot-maritime-administration-americas-marine-highway-program/ as of January 2016.

Recommendations

Navigable Waterways	Recommendations	Implementation Timeline
Place of Refuge	Designate Port Clarence as an Arctic Maritime Place of Refuge.	Near-Term
Place of Refuge	Review Port Clarence facilities to assess whether adequate support facilities are available at Port Clarence or in the region for a ship in need of assistance.	Near-Term
Managing Arctic Waterways	Support Arctic Waterways Safety Committee efforts to bring stakeholders together.	Near-Term
Areas of Ecological Significance	Leverage existing data-sharing frameworks, such as Data.gov, the Alaska Regional Response Team Ocean.gov, and AOOS, to facilitate waterways planning and response to environmental emergencies.	Near-Term
Managing Arctic Waterways	Leverage international partnerships supporting waterways coordination.	Near-Term
Marine Highways	Designate M-5 Alaska Marine Highway Connector to connect the Arctic Ocean and the western section of the Northwest Passage.	Near-Term
Areas of Ecological Significance	Support and coordinate collection and sharing of observations and data for waterways management and vessel routing requirements.	Mid-Term
Managing Arctic Waterways	Continue to collaborate with Russia on the Bering Strait Port Access Route Study.	Mid-Term
Managing Arctic Waterways	Consider appropriate IMO implementation of ship routing measures for the Bering Strait.	Mid-Term
Place of Refuge	Explore the need for maritime infrastructure to support vessels seeking refuge to build in redundancy into Alaska's Arctic MTS infrastructure.	Long-Term
Areas of Ecological Significance	Continue to identify areas of heightened ecological and cultural significance requiring waterways management in the Arctic and western Alaska.	Long-Term

Physical Infrastructure

Shore-based marine transportation infrastructure generally includes those land-side components that allow for quick and efficient transportation of cargo and passengers. Physical infrastructure for the MTS encompasses:

- Ports
- Terminals
- Piers
- Berths
- Intermodal connections and linkages to road, rail, and airport access routes and facilities
- Cargo handling and passenger/crew facilities
- Port Reception Facilities as required by the International Convention for the Prevention of Pollution from Ships MARPOL Annexes I, II, V, and VI [and sewage as required by U.S. Environmental Protection Agency (EPA) regulations] to receive and dispose of all ship generated wastes in an environmentally sound manner, and the
- Geospatial infrastructure and Continuously Operating Global Positioning System Reference Stations supporting accurate positioning, navigation, and development.

Physical infrastructure in the U.S. Arctic MTS is critical but lacking in many areas. This is due in part to small populations scattered across the landscape, and in part to the fact that the Arctic has not needed substantial MTS infrastructure until now with the new reality of diminishing sea ice. Improving infrastructure in the Arctic is more difficult than in the contiguous United States because of the narrow seasonal windows available for field work and high mobilization costs to remote Arctic areas, particularly with new challenges associated with shorelines and grounds that were once frozen permafrost, and can now no longer support conventional construction. The majority of existing road and rail infrastructure is concentrated in the south central region of the State; 82 percent of Alaska's communities are not connected by road and residents rely, in part, on snow machine, pick-up truck, and dog sleds in the winter to travel over land and sea ice.[26] Primary modes of commercial transportation are air and barge services supported by 400 general aviation airports and a network of small ports and harbors along the north and west coasts. This makes the delivery of life-sustaining resources, such as fuel, to many Alaskan communities expensive and restricted for many months of the year.

One major infrastructure consideration is the need for an Arctic deep-draft port (or ports), and associated evaluation of possible locations that could support fishing fleets, oil and gas development, mining, natural resources development, and ports of refuge. Additionally, these

[26] Aviation-Alaska's Lifeline (2012). Federal Aviation Administration and State of Alaska Transportation and Public Facilities. Available at: http://www.alaskaasp.com/media/1013/lifeline_video_fact_sheet_2012.pdf as of January 2016.

ports will need to provide reliable and economical delivery of goods to Alaskan communities and take into consideration the sustainable energy needs of a large port isolated for much of the year.

As noted previously, the U.S. Army Corps of Engineers (USACE) undertook a study in 2011 to determine options for an Arctic deep-draft port. After considering a number of options, including Kotzebue, Teller, Prudhoe Bay, St. Paul, Cape Darby, and Barrow, the draft report released in February 2015 identified the Port of Nome, Alaska, as the most suitable location for a deep-draft Arctic port.

Nome and surrounding communities are rural and remote, located off the continental road system. They are not connected to the power grid. Nome is served by regular, scheduled jet service, as it cannot be reached by road from Anchorage or other population centers of Alaska. Nome is a hub for more than 50 communities along the western shore of Alaska. Freight is shipped to Nome where it is then shipped via smaller barges to communities, where they often offload directly onto beaches or sand spits. These communities rely on barge shipments of fuel for electrical generators, among other things. Improvements to navigation in the area, therefore, would not only contribute to the well-being and sustainability of the residents and community—58 percent of whom are Alaska Native—but also the surrounding communities.

The USACE Port of Nome expansion proposal would construct a 2,150-foot-long causeway extension and a 450-foot dock, while deepening the harbor to 28 feet mean lower low water (MLLW). The project is designed to minimize risks to both the environment and navigation over the long term, while working towards sustainable communities throughout the region. However, with the cessation of oil and gas exploration efforts in the Chukchi Sea, the Nome project, as currently configured, does not exhibit an adequate cost-benefit analysis (i.e. > 1:1). USACE analysis for implementing infrastructure projects is justified based on efficiency gains measured in monetary terms. While this benefit calculation framework works well for gauging enhancements to commercial navigation, it is much more difficult to account for benefits to other types of navigation needs, logistical support, oil spill or other disaster response, and locations of vessel refuge that are not as easily converted to monetary terms. Therefore, an alternate method of justifying infrastructure investment to Arctic ports may be required to account for non-commercial navigation needs that are known to exist but that USACE has difficulty utilizing for project justification.

To adequately address all of these non-commercial navigation needs, a depth of at least 36 feet MLLW would be required at any deep-draft port. Based on feedback from Alaska Governor William Walker, U.S Special Representative for the Arctic Admiral Robert Papp, and many other notable speakers during the Conference on Global Leadership in the Arctic: Cooperation, Innovation, Engagement and Resilience (GLACIER) in Anchorage, Alaska during August 2015, it is short-sighted to build a deep-draft port with a limiting depth of 28 feet as it would not meet

Arctic requirements to provide northernmost bases and facilities for the United States. A deep-draft port at 36 feet water depth provides a logistics port in the Arctic Region for USCG icebreakers and cutters, U.S. Navy and NOAA vessels, and any other commercial or government ships that require a minimum depth of 35 feet. The vessel currently with the deepest anticipated draft in this fleet is the USCG heavy icebreaker *Polar Star*. In discussions, USCG stated that an icebreaker requires at least a depth of 35 feet for the vessel to safely enter a harbor to anchor or moor.

A deep-draft port in the Arctic could expedite attaining and meeting goals for strengthening marine environmental protection and response and completing tasks such as hydrographic charting.

The initial focus of a deep-draft port should be to establish a viable location of logistics support or viable staging area of operations in a location that has established infrastructure, such as a hospital, fueling facilities, and airport. As this port would be primarily used to reduce risk to commercial operations, a cooperative agreement must be made with that community and industry to share the use of the port to provide a center of logistics support for Federal Government and commercial activities in the Arctic region. A deep-draft port advances U.S. security interests and reflects a commitment to stewardship of the Arctic region.

Consideration should also be given to whether future, limited MTS infrastructure would be valuable at other sites outside of Nome, not only to support vessels seeking refuge, but to build redundancy into Alaska's Arctic infrastructure and critical community supply chain network. As commercial interest in the Arctic increases, the discussion of activity and infrastructure must expand to uses other than oil and gas exploration and development. Despite announcements in the fall of 2015 related to the cessation of oil exploration in the Chukchi for the near future, the United States must focus on other commercial uses such as transshipment, mining, resupply, fisheries, and tourism—all viable enterprises. There are also additional energy sector priorities relevant to marine transportation, such as renewable energy development, expanded distribution of North Slope natural gas, and the shipment of natural gas resources through the Arctic. While energy exploration companies are required to provide much of their own support capacity, other maritime activities rely more on Federal, State, and local infrastructure for emergency response, shelter, weather forecasting, and search and rescue. These enterprises also support national and regional economic development and provide important services to Alaskan communities. Exploring the support needs of these commercial activities and identifying major infrastructure gaps is an important step in supporting continued safe and sustainable communities as prioritized

by the U.S. agenda for the Arctic Council chairmanship and the priority to improve economic and living conditions in Arctic communities.[27]

International Convention for the Prevention of Pollution from Ships Port Reception Facilities at Ports Servicing Arctic Shipping

As international marine transportation in the Arctic has increased, so has the need to monitor possible environmental impacts and support voluntary and legal requirements. The International Convention for the Prevention of Pollution from Ships (MARPOL) applies in the Arctic just as it does elsewhere around the globe. Additionally, the IMO recently adopted the International Code for Ships Operating in Polar Waters (Polar Code). The Polar Code is a ship-specific set of requirements to raise the safety and environmental protection standards for ships operating in the Arctic and Antarctic. As the United States plans for Arctic deep-draft ports and increased maritime operations, consideration should be given to the infrastructure necessary to address new international pollution prevention regulations, including port reception facilities (PRF), as well as the duty to protect the Arctic from environmental disasters as a result of increased use.

U.S. ports in the Arctic such as Nome, which does have adequate reception facilities for the seasonal shipping that currently uses the port, may face additional challenges as ship traffic increases and ice-free conditions last longer. Consideration should be given to the arrival of larger cruise ships, which will also require greater capacity and use of port reception facilities.

The established near-Arctic U.S. ports (e.g., Anchorage) and U.S. ports that regularly service ships heading for Alaska (e.g., Seattle-Tacoma) have adequate port reception facilities (PRF) for MARPOL wastes and could expand capacity to receive increased shipping to and from the Arctic region. The Arctic Council's Protection of the Arctic Marine Environment Working Group has considered waste management challenges facing both ship operators and existing and potential ports that are located in Arctic waters.[28] These waste management challenges include:

- Difficulty in constructing new infrastructure due to remoteness or geological characteristics of the port
- Changing ice conditions that would prevent practical use or siting of reception facilities

[27] U.S. Chairmanship of the Arctic Council. Available at: http://www.state.gov/e/oes/ocns/opa/arc/uschair/index.htm as of January 2016.
[28] Arctic Council Protection of the Arctic Marine Environment Working Group, Technical Report—Phase I of The Assessment of existing measures for port reception facilities for ship-generated waste and cargo residues (2006). Available at: http://www.pame.is/images/02_Document_Library/Reports_to_Ministers/05_AC_Meeting/technicalreport-port-receptionfacilitiesthepameregion.pdf as of March 2016.

- Landside environmental concerns regarding waste processing and disposal facilities sited in Arctic ports located adjacent to environmentally sensitive areas, and protected habitats, designated refuges, or culturally sensitive areas; and
- PRFs in logistically challenging remote areas (seasonally or year round) or complete inability to operate at some PRFs during winter months due to seasonal ice conditions.

Accurate Positioning

An underlying aspect to physical infrastructure development is the need for accurate maritime positioning information. There are two major components to this kind of reference information: spatial reference (through geodetic datums) and vertical water-level reference (through tidal datums). Because the U.S. Arctic has been relatively inaccessible until recently, it lacks the same basic geospatial infrastructure NOAA has provided to the rest of the Nation (Figure 6). For example, elevations relative to sea level can be off by more than a meter in the Arctic, whereas the rest of the Nation benefits from centimeter-level positioning accuracies.

Meter-level positioning errors can impact infrastructure siting and construction, sea-level change data, erosion accuracy, energy development, and storm-surge modeling. To improve positioning in all three dimensions, NOAA must continue to collect gravity data and to add Continuously Operating Reference Stations (CORS) and National Water Level Observation Network (NWLON) stations. Currently there are very few CORS stations serving the Alaskan Arctic, with only ten sites along the Aleutian Chain, ten in Arctic coastal areas of the Bering Sea, and three serving the North Slope. Similarly, NOAA operates only nine long-term NWLON stations in the Arctic, with a minimum of twenty-one more stations needed. Co-locating new CORS with NWLON stations would significantly improve the extremely limited coverage in northern and western Alaska for precise positioning and water levels, thus improving the Arctic geospatial framework. This framework is critical as it not only supports physical infrastructure development, but is also the foundation for other key MTS safe navigation needs such as nautical

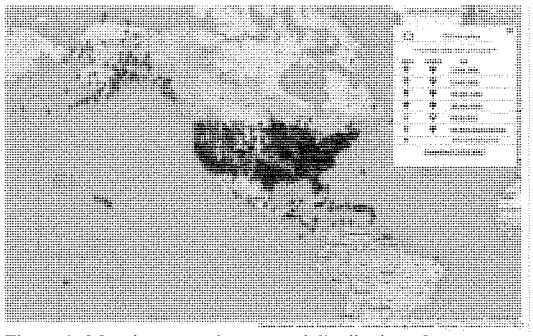

Figure 6. Map demonstrating unequal distribution of Continuously Operating Reference Stations between Alaska and the contiguous United States

charts, depths, and shoreline mapping. Additional coastal and river water-level observations also support flood and storm-surge warnings, which should be considered priorities given the rapidly changing Arctic environment and future impacts on Arctic communities.

Recommendations

Physical Infrastructure	Recommendations	Implementation Timeline
Environmental Infrastructure	Prioritize the need for Arctic port reception facilities to support international regulatory needs and future growth.	Near-Term
Accurate Positioning	Expand Arctic coastal and river water-level observations to support flood and storm-surge warnings.	Near-Term
Commercial Arctic Uses	Review U.S. Arctic maritime commercial activities to identifying major infrastructure gaps that should be addressed to promote safe and sustainable Arctic communities.	Near-Term
Accurate Positioning	Co-locate new CORS and NWLON stations to significantly improve the Arctic geospatial framework with precise positioning and water levels.	Near-Term
Arctic Deep-Draft Port	Review requirements for port investment to determine alternative methods for justifying Arctic ports to account for non-commercial navigation needs not currently utilized in USACE project justifications.	Mid-Term
Supply Chain Infrastructure	Explore additional options for limited port infrastructure to support Alaska's critical Arctic supply chain framework.	Mid-Term
Arctic Deep-Draft Port	Consider options for Federal deep-draft port facilities with cooperative agreements for dual use with local communities and facilities to meet multiple requirements.	Long-Term

Information Infrastructure

Information is an essential component of any MTS, especially in the Arctic, where conditions are often hazardous due to the harsh and changing environment. These information services require dynamic inputs and are relied on by mariners and other MTS users for situational awareness and safe, secure, and efficient marine transits. MTS information infrastructure includes, but is not limited to, the following:

- Nautical charts built on updated hydrographic and shoreline mapping, water level and geodetic positioning data
- Channel delineation and dredge data
- Aids to navigation (ATONs)
- Accurate marine weather and sea ice forecasts
- Real-time global positioning and water levels
- Automatic Identification System (AIS), and
- Communications capabilities

Automatic Identification System Framework

AIS is an automatic tracking and location system used on many vessels. The AIS device is a transponder used to communicate with other ship, shore, or satellite receivers. AIS works with vessel traffic systems to communicate critical information about vessels transiting an area such as name, identification number, speed, heading, and port of origin and destination. The system allows the ship-to-shore and ship-to-ship communication of positions that is critical for navigation and maritime situational awareness. It can also be used in a shore to ship mode to transmit information to ships from shore to make them aware of Notices to Mariners (NTM) about changes to aids to navigation, changes in charts, or other hazards that may affect their voyage.

IMO's International Convention for the Safety of Life at Sea (SOLAS) requires AIS to be carried by all international vessels 300 gross tons or larger, and by all passenger ships regardless of size including those operating in the Arctic. USCG also requires approved AIS class A devices on vessels 65 feet and longer engaged in commercial service, including towing vessels greater than 26 feet, among others.[29] [30]

[29] 33 CFR part 164.46. Available at: http://navcen.uscg.gov/?pageName=AISRequirementsRev as of March 2016.

Currently, USCG has a cooperative agreement with the non-profit Marine Exchange of Alaska (MXAK) to obtain AIS positional information from their shore-based receivers (Figure 7). Because the network is owned and operated by MXAK, the USCG is a consumer of the output of that service. It may be possible to augment the current system to track vessels operating further offshore. In addition, the existing system does not capture smaller vessel (e.g. hunting and fishing) that are not equipped with AIS capabilities.

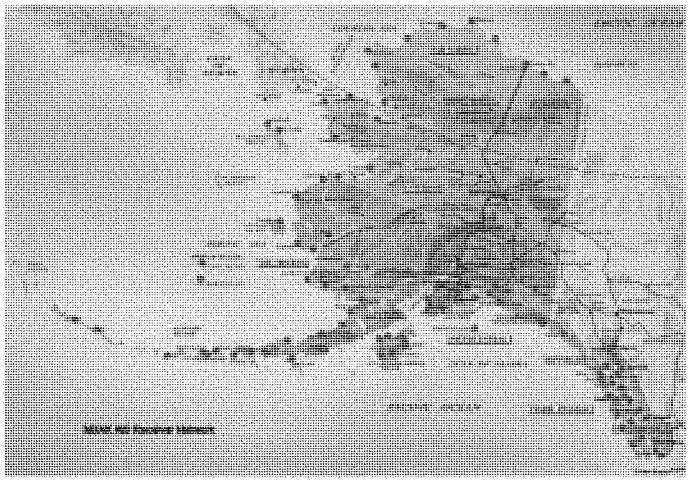

Figure 7. Marine Exchange of Alaska shore-based, Automatic Identification System receiver network.

[30] AIS class A device is shipborne mobile equipment intended to meet the performance standards and carriage requirements adopted by IMO. Class A stations report their position (message 1/2/3) autonomously every 2-10 seconds dependent on the vessel's speed and/or course changes (every three minutes or less when at anchor or moored); and the vessel's static and voyage related information (message 5) every 6 minutes. Available at http://www.navcen.uscg.gov/?pageName=typesAIS as of March 2016.

Communications

Communication in the Arctic is critical but difficult because of an inherent lack of communications architecture and the challenging polar environment. Advancements have been made to improve communications by the Federal Government and other private partners. For example, the Department of Defense's Mobile User Objective System (MUOS), a Navy-acquired narrowband, beyond-line-of-sight satellite communications system with space, ground, and waveform architectural components is scheduled to achieve full operational capability in 2016 with a 10-fold increase in capacity. Additionally, NOAA is in the process of conducting deep-water baseline assessments necessary for any fiber optic cable or other communications cables to be lain on the sea floor, and the National Telecommunications and Information Administration is assessing telecommunications services above the Arctic Circle in support of additional task items within the NSAR IP. The Arctic Council's Task Force on Arctic Telecommunications Infrastructure will also publish a comprehensive assessment of the telecommunications infrastructure needs across the circumpolar North, including in the U.S. Arctic, in 2017. The Iridium Push-to-Talk system, a commercially provided solution, uses distributed tactical communications and the Iridium constellation to provide global access. For example, Quintillion Subsea Holdings, LLC (formerly Quintillion Networks), is currently constructing a submarine cable system designed to connect Arctic Alaska, Canada, the United Kingdom, and Japan. Phase one, the Arctic Alaska portion of this project, will extend from Prudhoe Bay to Nome, with landings in the communities of Barrow, Wainwright, Point Hope, and Kotzebue. Each of these landings will have an initial capacity of 100 Gbps. This effort will provide telecommunications services to 26,000 Alaskan residents living on the North Slope and is scheduled to be operational in 2017.

Advancing communications and exchange of information is critical when sailing through such a dynamic environment, particularly when access to route, chart, weather, and ice information is critical for navigation safety and compliance. Traditional broadcast notices to mariners may not provide information in a timely enough manner to reflect changes in the Arctic, such as weather warnings.

The development of Arctic communication systems is critical to maritime safety and situational awareness. Of particular importance is the ability to communicate with ships regarding the presence of other, smaller vessels in the area or potential conflicts in use. In the Arctic, where fishing and subsistence harvesting are regular practices, the need for vessels to communicate positions and other information is paramount. An advanced communication network ensures the safety of all vessels operating in U.S. Arctic waters.

Aids to Navigation

A related communication issue is the ability to communicate specific chart or ATON information to vessels transiting the area. Timely notification of seasonal hunting and fishing areas allows vessels to take precautions while transiting the area or avoid it all together. Currently, there are no federally maintained aids along the North Slope. To assess Arctic marine traffic risks, the USCG completed a Waterway Analysis and Management System assessment in 2014 looking at the types and extent of ATON needed along the north and west coast of Alaska. Given the challenges with deploying physical ATON, the use of AIS-based Electronic Aids to Navigation (e-ATONs) may be used to augment the physical aids to navigation constellation. In addition, AIS technology can be leveraged to broadcast Enhanced Marine Safety Information (e-MSI) that will provide the mariner critical information for safe navigation. The Coast Guard is currently engaged in a Cooperative Research and Design Agreement (CRADA) with the MXAK to ensure that the ability to transmit e-ATON and e-MSI is available to the commercial industry for future implementation.

The ability to share information over the AIS data network enables rapid communication between critical agencies and vessels. Augmenting this communication using e-MSI facilitates a more situationally aware crew on the bridge. Transmitting traditional Notice To Mariners, including weather and charting information, and e-ATON changes, also relies on a robust communication network. Arctic maritime safety and enhanced situational awareness should include discussions of near-term development that can further support these types of communications.

Nautical Charting

Nautical charts based on modern hydrography and at adequate scales are essential for voyage planning, safe navigation, and safe marine operations. To illustrate, a contributing cause to the M/V *Fennica's* grounding near Dutch Harbor, Alaska, in 2015 was a shoal rock in an area last surveyed in 1933 with lead lines and sextants. Although over half of U.S. Arctic waters are classified as navigationally significant (242,000 square nautical miles), only about 4,300 square nautical miles of this navigationally significant area (less than 2 percent) has been surveyed with modern multibeam technology. In fact, most charted Arctic waters were surveyed with obsolete technology, some dating back to the eighteenth century. The incident involving the *Fennica* highlights not only current Arctic data gaps but also the need for modern hydrographic surveys to accelerate charting updates as vessel activity increases and sea bottoms change. NOAA is working to leverage Federal, State, and private partners to enhance charting capabilities. In 2015, NOAA ships *Fairweather* and *Rainier* worked with the USCG icebreaker *Healy* to acquire

roughly 12,000 linear nautical miles of trackline depth measurements along the Coast Guard's proposed transit route between the Bering Strait and Dutch Harbor. The NOAA survey ships and a contractor also conducted several full bottom hydrographic survey projects, acquiring more than 500 square nautical miles of data in coastal areas along western Alaska.

The need for modern and adequate nautical charts is an urgent priority for safe navigation identified in nearly every Arctic MTS-related report since 2009. However, the total requirement to survey a minimum of 500 square nautical miles a year in U.S. Arctic waters far outweighs the resources NOAA has available and the capacities of NOAA's two 48-year old survey vessels. NOAA's Hydrographic Services Review Panel Federal Advisory Committee recommended that hydrography and charting of the U.S. maritime Arctic be among NOAA's highest priority requirements for program execution. Accurate nautical charts will also facilitate any future designation of subsistence use areas, marine protected areas, seasonal migration routes and other ecologically relevant areas. Moreover, the data supports Arctic coastal community resilience, as it feeds into storm surge models, erosion assessments, and sea level change studies.

Weather and Sea Ice Forecasting

The ability to transmit timely weather information and sea ice forecasts depends heavily on the ability to predict inclement weather and changes in currents or ice cover and extent. One side effect of an ice-diminished Arctic is a reduction in the dampening effect of ice on waves. As spring and fall storms intensify, wave action increases due to a lack of ice cover. Evidence of this is apparent in the rate of coastal erosion from the intensity of the breaking waves against the shores as well as an increase in wave conditions for vessels at sea. Thus, early warning of impending storms is that much more important, for both ships and coastal communities.[31] Loss of sea ice also changes ice floes and the speed and density of those floes. Being able to detect, track, and report locations of ice means better safety information, particularly for smaller fishing and hunting vessels most vulnerable to poor weather conditions. The NSAR IP specifically tasks the Department of Defense and NOAA with improving sea ice forecasts and predictions at a variety of spatial and temporal scales, echoing the importance of this issue.

Currently, Arctic weather forecasts and sea ice predictions are only accurate two to three days in advance, compared with five- to seven-day predictive capabilities for the rest of the United States. A key factor in the accuracy of weather model predictions is the consistency of the initial conditions. Insufficient real-time in situ meteorological observations in U.S. Arctic waters and in Alaska hamper NOAA's forecasting accuracy (e.g. spring and fall sea storms). Likewise there

[31] Sea Level Rise and Storm Surge, Sea Grant Alaska Advisory Program (2014). Available at: https://seagrant.uaf.edu/map/climate/docs/sea-level.php as of January 2016.

is a need for high spatial and temporal scale observations from satellite platforms to accurately predict weather three to seven days in the future.

At present, low-Earth orbiting weather satellites cover the entire Earth, but in the Arctic region they provide data for any given spot only a few times per day. The Joint Polar Satellite System (JPSS) will help to partially address this gap. A collaborative effort between NOAA and NASA, JPSS represents significant technological and scientific advancements in severe weather prediction and environmental monitoring. It will help advance weather, climate, environmental, and oceanographic science, including for the Arctic region. NOAA and NASA are on track for the launch of the second satellite in the JPSS program in early 2017. To supplement JPSS, the CMTS recommends reinvigorating discussions with Canada on the proposed Canadian Polar Communication and Weather (PCW) highly-elliptical orbit satellite mission to contribute needed observations for Alaskan and Arctic weather prediction. The PCW's increased spatial and temporal resolution of weather observations every five to ten minutes would enhance the consistency of initial conditions that are used in weather and climate models and will lead to improved accuracy of weather model predictions.

To increase in situ observations for better understanding and prediction of changes in Arctic sea ice and weather, a number of Federal agencies are engaged in various initiatives to address the need for greater density of meteorological and ocean observations to feed the models. For example, in 2014 the Office of Naval Research supported the deployment of nearly 100 instrumented platforms on, in, and under the sea ice to observe the marginal ice zone (MIZ), where the frozen ocean meets the open ocean in the Beaufort Sea north of Alaska. The MIZ observing array measured the weather at the ice surface; the temperature, surface characteristics, thickness and drift of the sea ice; ocean properties (salinity, temperature, and density), stratification, and mixing below the ice; and ocean surface waves and their propagation into the ice cover. The MIZ field experiment demonstrated the potential for long-duration, under-ice deployment of seagliders (unmanned underwater vehicles) to collect data supported by acoustic communications and navigation services over distances of hundreds of kilometers.

The Naval Research Laboratory, in collaboration with the National Snow and Ice Data Center and the NASA Goddard Space Flight Center, has developed a technique to blend passive microwave satellite sea ice concentration products with National Ice Center's Interactive Multisensor Snow and Ice Mapping System ice analysis for assimilation into the Navy's ice forecasting systems. These advances have provided significant improvements in the ice edge

location forecast by the operational Arctic Cap Nowcast/Forecast System and pre-operational Global Ocean Forecast System, expected to be operational in 2016.[32]

NOAA's sea-ice operations have expanded to seven days per week and include detailed sea ice analysis. They provide a five-day forecast three days each week in both text and graphical formats. They also provide seasonal outlooks directed primarily at coastal communities and industry for insight into freeze-up and break-up for purposes of safe and efficient maritime operations. As part of the effort to improve sea ice forecasts, Federal agencies are involved in the development and regulation of unmanned aerial vehicles (UAV). The use of UAVs is expected to significantly increase over time, assisting in all areas of remote-sensing capabilities and other important earth observation systems used throughout the Federal Government for safety, security, and infrastructure development. The use of UAVs to assist in navigation, voyage planning, and sea ice and weather prediction for maritime shipping will continue to grow.

Increasing in situ and autonomous observations (e.g., sub-surface temperature, salinity, and ocean-current observations), along with integrated modeling throughout the Arctic, will inform and improve seasonal ice and weather forecasting and understanding of the atmosphere-ice-ocean-waves system. Such forecasting improvements are crucial for safe navigation and maritime operations in the Arctic and should be considered a high priority for near-term information infrastructure goals.

[32] The overall ice edge error in the Pan-Arctic region was reduced by 36% for a year-long time period, while a decrease of 56% occurred during the summer melt season, compared to results using ice concentration derived from the older SSMI and SSMIS satellite sensors. The results of this work are available in "The Cryosphere" (Posey et al., doi: 10.5194/tcd-9-2339-2015, http://www.the-cryosphere-discuss.net/9/2339/2015/tcd-9-2339-2015.html).

Recommendations

Information Infrastructure	Recommendations	Implementation Timeline
Weather and Sea Ice Forecasting	Improve weather, water, and climate predictions to an equivalent level of service as is provided to the rest of the nation.	Near-Term
Weather and Sea Ice Forecasting	Implement short-range, sea-ice forecasting capability.	Near-Term
Charting	Place hydrography and charting of the U.S. maritime Arctic among the highest priority requirements for agency execution.	Near-Term
Communication Systems	Advance Arctic communication networks to ensure vessel safety.	Near-Term
Vessel Routing	Finalize the Port Access Route Study for the Bering Strait and continue efforts to provide routes for vessel traffic in the U.S. Arctic.	Near-Term
Automatic Identification System	Expand partnerships to provide new satellite AIS capabilities for offshore activity information.	Near-Term
Weather and Sea Ice Forecasting	Sustain and increase in situ and autonomous observations and integrated modeling throughout the Arctic Ocean to improve seasonal ice and weather forecasting and expand Federal/international/other supporting partnerships.	Mid-Term
Charting	Survey a minimum of 500 square nautical miles a year in U.S. Arctic waters.	Mid-Term
Automatic Identification System	Explore additional requirements for private and commercial AIS transponder and networking needs (e.g. handheld devices or AIS for subsistence hunting or fishing vessels for ship-to-ship communication).	Mid-Term
Weather and Sea Ice Forecasting	Assess the expanded use of Unmanned Aerial Vehicles to assist in navigation, voyage planning and real time weather prediction, where appropriate.	Long-Term
Communication Systems	Explore the requirements for Enhanced Marine Safety Information to facilitate a safer, more aware vessel crew.	Long-Term

MTS Response Services

MTS Response Services are those services necessary to respond to marine transportation-related emergencies. These include the following services:

- Search and Rescue (SAR) to find and provide aid to people who are in distress or imminent danger;
- Environmental response management, including oil spill prevention, preparedness and response, and the response technologies and MTS capabilities (vessels, personnel, materials, and equipment) necessary to effectively plan for, prepare for, prevent, respond to, and clean up oil and other hazardous wastes spilled at sea; and
- Ice-breaking capability to free vessels beset in ice or in danger; ice-breakers also support SAR efforts, spill response, emergency marine delivery of life-sustaining resources to Alaskan communities, and research.

Emergency Response

The USCG is the primary Federal agency responsible for SAR in U.S. maritime regions. Emergency response in the Arctic is made even more difficult by the remoteness and vast distances of the region, impacts of intense and extended cold, and lack of shore infrastructure, and reliable communication networks. From the northernmost point of land at Point Barrow, Alaska, the nearest USCG air facility is at Kodiak, which is 820 nautical miles away (a 6-hour flight), and the closest refueling site for vessels is Dutch Harbor, 1,000 nautical miles away.

SOLAS, among other provisions, obligates all vessel masters to offer assistance to those in distress. In addition, on May 12, 2011, all the Arctic states signed an Arctic Search and Rescue Agreement, coordinating international SAR coverage and response in the Arctic. It establishes the area of SAR responsibility of each state party in addition to coordinating response assistance.

Over the past four summers, the USCG has set up forward operating locations in the U.S. Arctic to support Operation ARCTIC SHIELD. Through Operation ARCTIC SHIELD, the USCG is evaluating facilities and conducting research to inform future decisions for shore-side infrastructure in the region. These assets are supplemented with regional emergency response by the State of Alaska as well as private companies operating in the area. With the suspension of exploration activities, there will be a general drawdown in both the number of vessels in the region and support capacity as oil exploration campaigns dismantle response resources. This will reduce emergency response capability in the region and increase the reliance on Federal and State assets. This shift is particularly important as the cruise industry and commercial shipping prepare to sail through the Northwest Passage in the summer of 2016, and as the number of

pleasure and adventure craft transiting the Northwest Passage continues to increase. Although the increase in total traffic is modest when compared with other regions, survival and response conditions in the Arctic are unlike more temperate regions. The Arctic poses unique risks and requirements for response, and with these, increased requirements for an adequate state of readiness to respond to an incident.

A state of readiness is only possible when access for emergency personnel is made available. Given the limitations of available assets at forward operating locations, such as Barrow and Deadhorse, it is important to ensure additional access by aircraft, which requires infrastructure such as runways, hangers, and refueling. Continued collaboration with State and local authorities to ensure access by air and water to necessary areas is key and should be considered a near-term requirement for Arctic infrastructure to maintain response readiness. Additional consideration should include an evaluation of the facilities currently available on the North Slope, such as those in Barrow and Wainwright that were either purpose-built by Shell or leased during exploration operations. These facilities provide lodging and kitchen facilities, and are equipped with generators and waste management systems that could be used for seasonal staging areas by USCG or other programs engaged in readiness exercises or research.

Oil Spill Response

To date, significant factors have limited commercial development in the Arctic: extreme cold, extensive ice, intense storms, and limited industrial infrastructure. These conditions also make response to and control of an oil spill or blowout more challenging than in other areas. Challenges include ice interference with mechanical, chemical, and burning response methods and potentially greater hazardous effects due to a slower emulsification rate and longer toxic component persistence.

Responding to oil spills in ice-covered waters requires a combination of tactics rarely tested in real Arctic marine and ice environments. There is currently an ongoing effort to increase preparedness and oil pollution response capabilities domestically and internationally. Established through the National Oil and Hazardous Substance Pollution Contingency Plan (40 CFR Part 300), the National Response System operates through a network of Federal agencies, through which USCG, NOAA, Fish and Wildlife and EPA oversee and enforce oil spill response. Additionally, the Federal/State Preparedness Plan for Response to Oil and Hazardous Substances Discharges and Releases (the Unified Plan), was developed jointly among the State of Alaska, USCG, and EPA. These frameworks integrate with the Alaska Incident Management System Guide for Oil and Hazardous Substance Response, which provides standardized oil spill response

management guidelines to responders in Alaska.[33] The Alaska Management System coordinates with the national response frameworks (e.g., National Response System), but is specific to the State's interests.[34] The U.S. response framework intersects with other Arctic countries' authorities through the Agreement on Cooperation on Marine Oil Pollution Preparedness and Response in the Arctic.[35] This agreement's operational guidelines were developed and are maintained by the Arctic Council's Emergency Prevention, Preparedness, and Response Working Group (EPPR). EPPR facilitates exercises to test the agreement and guidelines.[36]

Continued coordination through international and interagency fora such as the EPPR, the newly established Arctic Coast Guard Forum, and others will provide significant opportunities for engagement across the Federal Government and the international Arctic response community. Future network initiatives should augment the work of the Alaska Regional Response Team (ARRT) under the Federal On-Scene Coordinator through the addition of a Pan-Arctic response equipment database, best practices recommendations built upon ongoing response exercises, and information sharing for continued development of guidelines for oil spill response in the Arctic region. Additionally, increased support for direct bi-lateral engagements (specifically with Russia and Canada) will foster existing relationships with Arctic nations through coordinated Joint Contingency Planning efforts. Improving these relationships will allow for enhancements and drills that will increase oil spill preparedness and response capabilities across the Arctic.

Response requirements should also consider the physical infrastructure needed to support oil spill clean-up and wildlife response/rehabilitation (e.g., housing, wildlife rehabilitation facilities, carcass/sample storage), as well as the manpower to undertake the operation. Consideration should also be given to whether there is sufficient upland infrastructure (e.g., landfills, incinerators, and storage tanks) with capacity to handle and dispose of spill material. Additionally, while there are guidelines to support expedited movement of people and equipment across borders, there are acknowledged challenges to transporting personnel and equipment from locations within the contiguous United States to the Arctic in the event of a catastrophic spill. Continuing support of the National Response System, and particularly ongoing spill response planning, is critical to developing the response tools and resources needed during an emergency.

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[33] Alaska Incident Management System Guide (AIMS) *For Oil and Hazardous Substance Response, Alaska Department of Environmental Conservation,* (November 2002). Available at: https://dec.alaska.gov/spar/ppr/docs/AIMS_Guide-Complete(Nov02).pdf as of December 2015.

[34] Operations, Logistics, and Coordination in an Arctic Oil Spill (2014). Transportation Research Board and National Research Council, Responding to Oil Spills in the U.S. Arctic Marine Environment. Washington, DC. The National Academies Press, doi: 10.17226/18625.

[35] Agreement on Cooperation on Marine Oil Pollution Preparedness and Response in the Arctic (2013). Available at: http://www.state.gov/r/pa/prs/ps/2013/05/209406.htm as of January 2016.

[36] Agreement on Cooperation on Marine Oil Pollution Preparedness and Response in the Arctic, Arctic Council (Revision 1: January 28, 2014). Available at: http://arctic-council.org/eppr/wp-content/uploads/2014/03/NCR-5979727-v1-OPERATIONAL_GUIDELINES_ENGLISH_FINAL_WITH_UPDATE_PROCEDURES_NO_PHONE_NR.pdf as of January 2016.

Lastly, continued scientific support for oil spill response and research is critical in developing the needed response and restoration techniques to address any future Arctic oil spill. The Interagency Coordinating Committee on Oil Pollution Research, which USCG chairs, published its *Oil Pollution Research and Technology Plan: FY2015-2021* in September 2015. This plan established 150 oil pollution research priorities in 25 standing research areas. Twenty-three priorities were specific to polar or extreme environments, in addition to many other priorities applicable to multiple environments, including the Arctic.

Continuing to work with agencies and stakeholders to develop a communication structure for decision making and information sharing purposes during emergencies is critical, as is the development of a system for caching the equipment needed to implement Geographic Response Strategies and respond to oiled wildlife. By working with stakeholders to determine and fill infrastructure needs for emergency response, including wildlife response and rehabilitation, particularly through the ARRT, it is possible to strengthen relationships with U.S. Arctic neighbors to better understand how nations will collaborate during emergencies.

Given the technical and logistical challenges of responding to pollution events in the Arctic and the serious, long-term effects of possible spills, a significant focus should be placed on pollution prevention. Regulations and best practices regarding the proper use and carriage of oil and other pollutants through the Arctic should be initiated and supported by the U.S. as part of international conventions and agreements.

Recommendations

MTS Response Services	Recommendations	Implementation Timeline
Emergency Response	Continue collaboration with State and local authorities to ensure readiness of Arctic maritime and aviation infrastructure for emergency response and SAR.	Near-Term
Oil Spill Readiness	Continue coordination through international fora to provide significant opportunities for engagement across the Federal Government and the international Arctic response community.	Near-Term
Oil Spill Readiness	Support Pan-Arctic response equipment database development, best practices recommendations, and information sharing for continued development of guidelines for oil spill response in the Arctic.	Near-Term
Emergency Response	Develop a plan to transport critical response equipment from the contiguous United States into the Arctic area in the event of a catastrophic event.	Near-Term
MTS Response	Evaluate facilities currently available on the North Slope for use as seasonal staging areas by those engaged in readiness exercises or research.	Near-Term
MTS Response	Pursue increase support for direct bi-lateral engagements to foster existing response relationships with other Arctic nations.	Mid-Term
Oil Spill Readiness	Continue scientific support for oil spill response and research directives in the *Oil Pollution Act of 1990* (OPA90).	Mid-Term
Oil Spill Readiness	Develop on-shore facilities for oil spill response (e.g. hazardous/oily waste disposal, wildlife response, responder housing).	Long-Term

Vessel Operations

Vessels are the mobile platforms necessary to move goods and people throughout the MTS. In the past, there has been limited vessel activity in the U.S Arctic. With the lengthening of the open-water season due to climate change and loss of sea ice, vessel activity has increased dramatically, as has the diversity of vessels operating in the region. A variety of vessel types operate in, or transit through, the U.S. Arctic annually, including the following:

- Commercial and oceangoing vessels
- Coastal and inland vessels
- Barge vessels
- Tug boats
- Towing vessels
- Bulk carrier ships
- Container ships
- Military vessels
- Fishing boats
- Marine mammal hunting craft
- Scientific research vessels
- Recreational boats, and
- Offshore structures

U.S. Icebreaking

The current Federal fleet of Polar icebreakers consists of one medium icebreaker (USCGC *Healy*) and one heavy icebreaker (USCGC *Polar Star*). The *Polar Star* is the only active heavy icebreaker and is primarily used in the Antarctic. The *Healy* is used primarily to support science missions in the Arctic, but may also be used to support other Coast Guard statutory missions such as search and rescue or provide persistent command and control capability, as required.

It is important to note that capabilities of Coast Guard icebreakers often far exceed minimum international standards for icebreaking vessels, such as International Association for Classing Societies. These standards identify minimum power and structural survivability requirements of a single purpose vessel operating in ice infested waters. Unlike commercial vessels that are built to perform single missions with minimal crews, Coast Guard assets are multi-purpose vessels that incorporate aviation support, command and control, and additional power and endurance requirements necessary to perform all missions. The Coast Guard has assessed all available commercial icebreakers and has determined no currently operating vessel meets these critical mission and performance requirements for either a heavy or medium icebreaker. As a result, acquisition of new assets is the only viable option for obtaining additional icebreaking capacity.

The Coast Guard currently has an acquisition program that will replace the capabilities of the *Polar Star* when complete. Due to lengthy design and production and anticipated decommissioning of the *Polar Star*, the Coast Guard will not provide additional capacity within

the 10-year horizon. While Coast Guard icebreaking support has been used to facilitate commerce in emergency situations, such as the 2014 fuel resupply in Nome, the Coast Guard does not intend to use these vessels to facilitate routine commercial maritime traffic or to support commercial drilling operations.

Waterway Usage Coordination

As more vessels transit U.S. Arctic waterways, planning, communication, and situational awareness will become more important to protect waterway users, the environment, and the people that live in the region. For example, subsistence-harvest activities use small vessels to access hunting grounds throughout the U.S. Arctic in and between coastal areas and islands. Though larger commercial vessels have the equipment and obligation to inform regional authorities of their plans, these smaller vessels are not bound by the same requirements. As such, maritime use and safety conflicts are serious issues for the region. The USCG Bering Strait Port Access Route Study outlines initial steps for waterways management recommendations to facilitate possible channels of communication for small- and large-vessel operators. Efforts should continue to formalize communication channels among waterways users so that all parties using the regional resources are aware of activities that may create conflicts for voyage routes or whaling and fishing activities. These efforts should utilize regional bodies like the Arctic Waterways Safety Committee to facilitate dialogue among communities and vessel operators to communicate voyage planning and waterways-use management, and to reduce conflicts that may arise from a crowded waterway during particularly sensitive times, such as marine mammal migrations and the whaling season.

This need for transparency among waterways users extends outside commercial and resource use vessels and includes activities from research vessels as well. Each summer, a number of research voyages transit the Arctic either pursuing science in U.S. waters or on routes through the region to other areas of interest. These research vessels provide a unique challenge because they, unlike commercial vessels, can spend extended periods of time within a limited area. This can create conflicts if research waters are also locations of traditional harvest or fishing for subsistence purposes. The extended presence of large research vessels creates a safety consideration for small vessels and may have consequences for marine mammal and bird populations competing for use of the same areas. The CMTS recommends the continuation of efforts to improve planning and transparency of research missions in order to include and inform Arctic communities, fostering cooperative planning that would minimize disruptions to subsistence activities while promoting scientific research in the region.

Human Element

As a result of the implementation of the Polar Code, the IMO developed training amendments to the STCW Convention, applicable to masters and deck officers serving on board vessels working in polar regions. These amendments will be adopted in May 2016 with an expected entry into force date of January 1, 2018. This common set of rules will also ensure that any increase in Arctic shipping would take place more efficiently and using the best environmental standards. Historically, at the international level, no specialized mandatory qualifications, training, or certifications existed for crews of vessels that operated in polar waters, including the Arctic. The challenge now for the United States and its international partners is implementing the Polar Code and harmonizing U.S. legislation and regulatory efforts that meet U.S. priorities for the Arctic and consider the needs of Arctic residents and other Arctic States. As with other international regulations, the Coast Guard derives its regulatory authority through implementing acts such as the *Act to Prevent Pollution from Ships* (APPS, 33 U.S.C. §§1905-1915) which implements MARPOL through domestic Coast Guard regulations. Given the expected long-term increase in shipping in the U.S. Arctic, the challenge for the Coast Guard will be considering and adapting to a potential need for increased resources for environmental response, search and rescue, and maritime domain awareness.

With respect to maritime domain awareness and Arctic governance in general, the challenges for the Arctic are two-fold; first being able to monitor vessels operating in the area despite limited capacity and second, to respond to any safety or environmental emergencies that may arise. In addition, the Coast Guard will have to monitor the many vessels transiting the Bering Strait that will not dock at a U.S. port, complicating enforcement in remote waters that include much of the U.S. Exclusive Economic Zone out to 200 nautical miles. The newly established Arctic Coast Guard Forum will address many of these response challenges. On October 30, 2015, the heads of Coast Guard-like agencies from all eight of the Arctic nations signed a joint statement establishing the Arctic Coast Guard Forum as an official mechanism for discussion and coordination of emergency response operations. The Forum's purpose is to leverage collective resources to foster safe, secure, and environmentally responsible maritime activities in the Arctic region. This construct will implement and reinforce previous agreements through the Arctic Council, such as the Search and Rescue Agreement, and may also facilitate the enforcement of new Arctic policies and regulations like the Polar Code.

As the Polar Code entry-into-force date of January 1, 2017, approaches, the United States should continue to work with international partners to evaluate the efficacy of the Polar Code, and develop the necessary interim policies and regulations to implement mandatory provisions of the Polar Code and the International Convention on Standards of Training, Certification and Watchkeeping for Seafarers (STCW). Additional work may also be needed to examine existing

requirements related to training and safety standards for the U.S. fishing fleet, as commercial fishing vessels are required to comply with some, but not all, of the Polar code provisions.

Recommendations

Vessel Operations	Recommendations	Implementation timeline
Ice Breaking	Expand U.S. icebreaking capacity to adequately meet mission demands in the high latitudes.	Near-Term
Vessel Operations	Update domestic law to implement the mandatory provisions of the Polar Code and the STCW Convention.	Near-Term
Human Element	Examine existing training and safety standards applicable to the U.S. fishing fleet with respect to the new Polar Code requirements.	Near-Term
Waterway Usage Coordination	Facilitate dialogue among communities and vessel operators to communicate voyage planning, and waterways use management.	Near-Term
Waterway Usage Coordination	Continue to improve planning and transparency of research missions to include and inform Arctic communities to minimize conflicts while promoting scientific research in the region.	Mid-Term
Waterway Usage Coordination	Continue to formalize communication channels among waterways users so that all parties utilizing the regional resources are aware of activities that may create conflicts for voyage routes or harvest activities.	Long-Term

SUMMARY

The U.S. Arctic is a dynamic and rapidly evolving maritime region. The recommendations put forward in this report extend beyond the traditional definition of transportation infrastructure (the basic equipment, structures, roads and bridges that are needed for a country, region, or organization to function properly) to include a framework for the necessary elements of a comprehensive U.S. Arctic marine transportation system. This framework necessarily involves elements of the traditional definition, but also includes communication, planning, management, environmental policies, regulatory implementation, and community engagement—all of which are required for safe, secure, and environmentally sound maritime transportation.

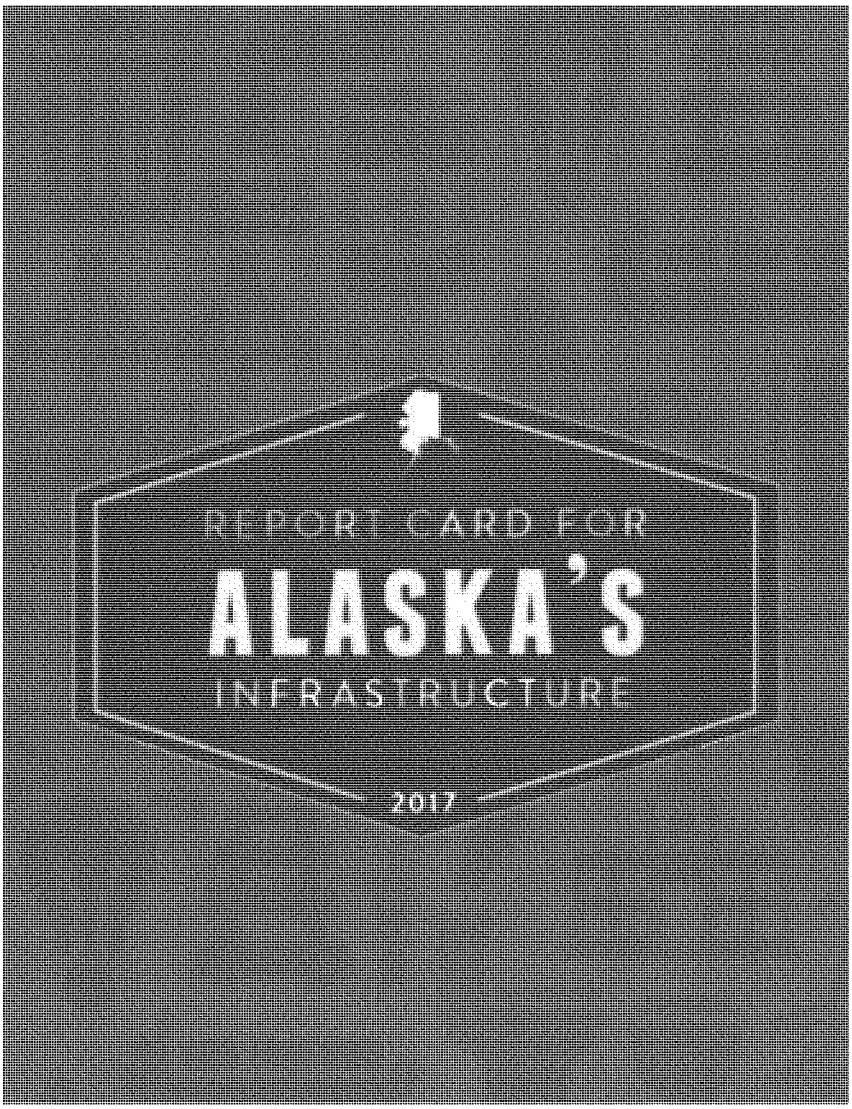
As the recommendations in the previous sections note, there are specific near-term actions that can be taken to address the current gaps in U.S. Arctic infrastructure, such as the following:

Near-Term Recommendations	
Navigable Waterways	Designate Port Clarence as an Arctic Maritime Place of Refuge.
	Review Port Clarence facilities to assess whether adequate support facilities are available at Port Clarence or in the region for a ship in need of assistance.
	Support Arctic Waterways Safety Committee efforts to bring stakeholders together.
	Leverage existing data-sharing frameworks, such as Data.gov, the Alaska Regional Response Team, and Alaska Ocean Observing System, to facilitate waterways planning and response to environmental emergencies.
	Leverage international partnerships supporting waterways coordination.
	Work with stakeholders to coordinate research efforts to de-conflict research within commercial and subsistence use areas.
	Designate M-5 Alaska Marine Highway Connector to connect the Arctic Ocean and the western section of the Northwest Passage.
Physical Infrastructure	Prioritize the need for Arctic port reception facilities to support international regulatory needs and future growth.
	Expand Arctic coastal and river water-level observations to support flood and storm-surge warnings.
	Review U.S. Arctic maritime commercial activities to identifying major infrastructure gaps that should be addressed to promote safe and sustainable Arctic communities.
	Co-locate new Continuously Operating Reference Stations and National Water Level Observation Network stations to significantly improve the Arctic geospatial framework with precise positioning and water levels.
Information Infrastructure	Improve weather, water, and climate predictions to an equivalent level of service as is provided to the rest of the nation.
	Implement short-range, sea-ice forecasting capability.

	Place hydrography and charting of the U.S. maritime Arctic among the highest priority requirements for agency execution.
	Advance Arctic communication networks to ensure vessel safety.
	Finalize the Port Access Route Study for the Bering Strait and continue efforts to provide routes for vessel traffic in the U.S. Arctic.
	Expand partnerships to provide new satellite Automatic Identification System (AIS) capabilities for offshore activity information.
MTS Response Services	Continue collaboration with State and local authorities to ensure readiness of Arctic maritime and aviation infrastructure for emergency response and Search and Rescue (SAR).
	Continue coordination through international fora to provide significant opportunities for engagement across the Federal Government and the international Arctic response community.
	Support Pan-Arctic response equipment database development, best practices recommendations, and information sharing for continued development of guidelines for oil spill response in the Arctic.
	Develop a plan to transport critical response equipment from the contiguous U.S. into the Arctic area in the event of a catastrophic event.
	Evaluate facilities currently available on the North Slope for use as seasonal staging areas by those engaged in readiness exercises or research.
Vessel Operations	Expand U.S. icebreaking capacity to adequately meet mission demands in the high latitudes.
	Update domestic law to implement the mandatory provisions of the Polar Code and the Convention on Standards of Training, Certification and Watchkeeping for Seafarers.
	Examine existing training and safety standards applicable to the U.S. fishing fleet with respect to the new Polar Code requirements.

These 25 recommendations cover the five core MTS components for Navigable Waterways, Physical Infrastructure, Information Infrastructure, MTS Response Services, and Vessel Operations. Implementing them would provide a path for Federal activities needed to preserve the mobility and safe navigation of U.S. military and civilian vessels throughout the Arctic region.

As sea ice retreats, the United States must recognize the importance of providing infrastructure to support domestic and international industry growth in shipping, mining, oil and gas exploration, fishing, and tourism. The current limitations in nautical charts, aids to navigation, telecommunications and emergency-response and rescue capabilities make operations challenging in the U.S. Arctic. The priorities and recommendations presented in this document create an actionable framework to improve the U.S. Arctic MTS and facilitate responsible activity and growth in the region for a safe and secure U.S. Arctic over the next decade.


REPORT CARD FOR
ALASKA'S
INFRASTRUCTURE
2017

INFRASTRUCTURE FOR ALL ALASKANS

Alaskans think about infrastructure a little bit differently than the rest of the United States. Alaska's infrastructure is truly unique, covering a vast area of over 663,000 square miles and supporting a population of just over 730,000. For transportation systems, there is no one mode of transport in Alaska, and sometimes the route is different depending on the time of year. Some homes do not have access to indoor plumbing, and while sometimes that's by choice, too often it's not. Many of Alaska's remote communities are still in need of water and wastewater systems that are safe, efficient, and sustainable, while even our most populated areas are still learning how best to handle every day solid waste in a subarctic environment.

Alaska's infrastructure investment is crucial to our way of life and the success of the economy. With declining oil prices and uncertain federal funding unable to keep up with the demand for projects or the operations and maintenance needs of current systems, the American Society of Civil Engineers (ASCE) Alaska Section wants to ensure Alaska's leaders have the best information available about the current conditions of Alaska's infrastructure. As Alaska legislators address budget challenges, the ASCE Alaska Section's Report Card – developed for Alaska, by Alaskans – demonstrates the importance of infrastructure investment.

There are solutions to Alaska's infrastructure poor grades! Together with the information provided in the Report Card for Alaska's Infrastructure, it is ASCE Alaska Section's goal that Alaska's Civil Engineers work together with state leaders to plan, design, build, operate and maintain a safe, efficient and sustainable infrastructure for all Alaskans.

RAISING THE GRADES

4 KEY SOLUTIONS

1. Have a Plan and Fund for the Future: All infrastructure owners and operators create and fund capital replacement plans for both immediate and long-term needs.

2. Maintenance is Key for Alaska: Maintenance is the everyday work that has to be done to keep things moving, and Alaska's infrastructure needs it. Sometimes it's all about the basics, and maintenance is the basic first step to good infrastructure. Maintenance need to be a consideration in design, as maintenance cost often is the largest ownership cost.

3. Keep Up Infrastructure Improvement Efforts: Elected officials must lead the efforts to improve Alaska's infrastructure for today and in the future. Alaska has some challenging times ahead, but kicking the can down the road will only cost Alaskans more in the future.

4. Innovate As We Replace: Alaska should support and encourage innovative solutions to infrastructure funding. The key to keeping up with rising needs is to keep replacing failing infrastructure with longer lasting, more resilient and smarter solutions.

Background on ASCE's Infrastructure Report Card Program

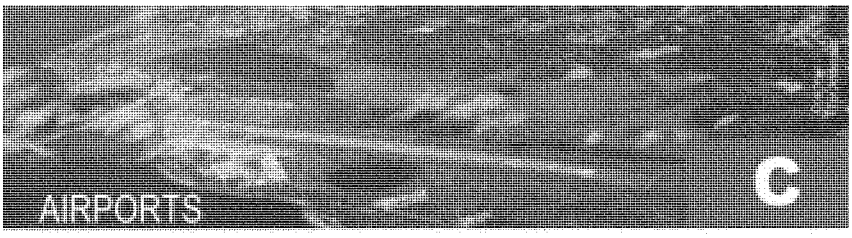
In 1998, the American Society of Civil Engineer's published the first Report Card for America's Infrastructure (Report Card). Using a simple A to F school report card format, the Report Card provides a comprehensive assessment of current infrastructure conditions and needs, both assigning grades and making recommendations for how to raise the grades. An Advisory Council of ASCE members assigns the grades according to the following eight criteria: capacity, condition, funding, future need, operation and maintenance, public safety, resilience, and innovation.

ABOUT ASCE - ALASKA

Civil engineers are entrusted by society to create a sustainable world and enhance the global quality of life. We are committed to maintaining and improving Alaska's infrastructure. Founded in 1951, the Alaska Section of the American Society of Civil Engineers (ASCE) represents about 850 civil engineers in Alaska. We understand that infrastructure is vital to our economy, health, and natural environment. With our commitment to serve and protect the public in mind, civil engineers throughout the state graded each infrastructure category according to the following eight criteria: capacity, condition, funding, future need, operation and maintenance, public safety, resilience, and innovation.

Report Card for Alaska's Infrastructure History

Members of the Alaska Section of ASCE have tried to prepare a report card for Alaska's infrastructure for over five years. Unfortunately, we never achieved full momentum, and it stalled several times. We finally had a group of dedicated engineers who were driven to complete the report card in 2016. Alaska's report card is complete, and we will have a formal launch on February 7th, in Juneau. At that time, the grades for nine categories of infrastructure will be released.



What You Should Know about Alaska's Airports

Large portions of Alaska are only accessible by air or water. As many as 8 out of 10 of Alaska's communities are not connected to the road system. These communities depend on aviation for access to fresh foods, mail, and healthcare. Alaska Department of Transportation and Public Facilities (Alaska DOT&PF) owns and operates 242 of the 400 public use airports in Alaska and has identified rural airports as "Alaska's Lifeline. "In addition to the public use airports, another 300 landing facilities are registered with the Federal Aviation Administration (FAA) in Alaska and thousands of private landing facilities and lakes are not registered. Alaska has six times as many pilots and 16 times as many aircraft per capita, compared to the rest of the country as a whole. The people of Alaska are eight times more likely to use aviation as transportation than people in the rest of the country. Aviation in Alaska is a huge economic engine, contributing approximately $3.5B annually to the state's economy.

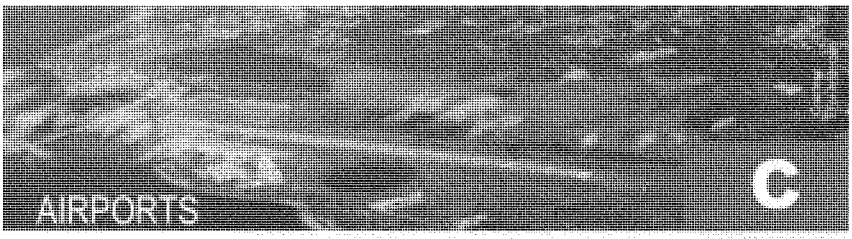
Capacity

Capacity and delays associated with capacity are not an issue at Alaska airports. Airfield capacity had been identified as a potential concern in the 20-year planning horizon of the 2014 ANC Airport Master Plan Update; however, activity growth since completion of that master plan has not met the forecast. The Alaska International Airport System (AIAS) – ANC and FAI, is an important cargo midpoint re-fueling stop between producers in Asia and consumers in the contiguous 48 states. Anchorage is second to Memphis in the U.S., and among the top five airports globally for cargo throughput, and serves approximately 5.4 million passengers annually. One effort to reduce future capacity issues at ANC is to incentivize some cargo traffic (those that are stopping only to refuel and change crews) to go to FAI where there is more capacity available. As traffic increases, this effort would allow destination cargo flights to arrive to Alaska while alleviating some of the pressure on ANC.

Daily fuel flowage at ANC alone is 1.7 M gallons. In 2012, Anchorage Fueling and Service Company added 4 new fuel tanks, to increase fuel storage capacity by 16 M gallons at ANC. This project helped increase the resiliency in case of a fuel delivery disruption. Due to a combination of reduced fuel sales and increased storage capacity, ANC went from about a 7-8-day reserve of fuel in 2006 to about a 20-day supply in 2016.

Condition

The Alaska DOT&PF has a robust pavement management system, inspecting airfield pavements, at both DOT&PF and municipally owned airports, every three years. The average pavement condition index (PCI) is used to measure pavement condition. All pavement surfaces are rated on a scale of 1-100, with 100 being newly constructed pavement. The current comprehensive pavement condition report for the state, published in 2013,



report an average PCI for international and regional airports of 73, and 64 for community and local airports. Runway rehabilitation such as a pavement overlay is usually needed once PCI drop below 70, and reconstruction may be needed when PCI drops to 55-60.

In 2008, the Alaska Aviation System Plan estimated a total of $98.9 Million in deferred maintenance. The Majority of the deferred maintenance, 70%, refers to airfield surfaces, with buildings being the second largest category of deferred maintenance at $15.2M. Cargo handling facilities range from state of the art at large airports to an ATV pulling up to the cargo carrier at local airports. The common denominator is that the job gets done.

Operations and Maintenance

Only the AIAS is self-funded with regards to operations and maintenance. For all other public airports in Alaska, the airport owner has to augment some of the Operation and Maintenance costs.

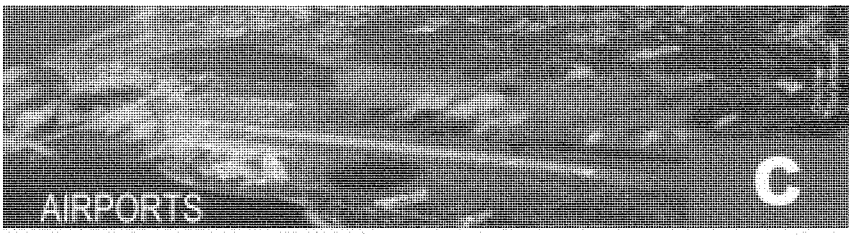
Alaska DOT&PF, the largest airport owner in the state, with 242 airports, spends $34M annually on maintenance and operations at its 240 rural airports. Separated from this budget are ANC and FAI, which are self-funded. Maintenance and capital improvement needs are tracked by Alaska DOT&PF in their "needs-list", a document that is updated annually to track both needs and in a near future, also improvements completed. The needs list, based on input from the local airport management, is used to guide annual budgeting of the state's resources. This needs list is making its way into the digital aviation system plan over the next several years through thorough field inspections called CIMP's (Capital Improvement and Maintenance Program). These inspections take an objective view of the needs on an airport and create a standardized system for measuring needs.

Safety

Take-off and landing are the segments of a flight with the most safety risk. When compared to many other states in the U.S., Alaska is over represented in aviation crash and fatality statistics.

In 2010, Alaska rolled out a new rate based safety metric: Fatal and Serious Injuries (FSI)/10,000 flight hours. This effort was undertaken to meet the FAA Administrators Flight plan. The goal was set to reduce FSI accidents in Alaska by 10% over a 10-year period. Base line was the average of FY06-08 (1.88 FSI/100,000 flight hours), this equals a goal of no more than 1.69 FSI/100,000 flight hours compared to the national goal of no more than 1.00/100,000 flight hours. Are we meeting the goals? In Fiscal year 2016, which ended September 2016, Alaska Aviation counted 15 fatalities, one less than the stated not-to-exceed goal for the year. Much work remains as FY 2017 started with three fatalities in Togiak.

Accidents are more common in Alaska because the availability of certified weather forecasts along flight route makes flight planning more challenging in Alaska, as the system plan shows the density of certified weather



coverage is lower in Alaska in general than in the contiguous 48 states. Currently there are only about 130 weather stations in Alaska, to reach the same on-route density that is provided in the lower 48, we would need to construct 200 more weather stations. Safe airways are defined by well surveyed routes, access to certified weather along the route, and reliable navigational beacons along the routes.

Another factor contributing to the high accident rate is that land alternatives to support emergency evacuations are in many cases lacking, leading to higher necessary risk taking. As an example, the rural community of King Cove is home to 700 people who lack road access to an all-weather airport, occasionally leading to pilots attempting evacuations to save lives where in other states, they would have stayed on the ground. Since 1980, nineteen people have lost their lives attempting emergency evacuations from the community.

Funding & Future Need

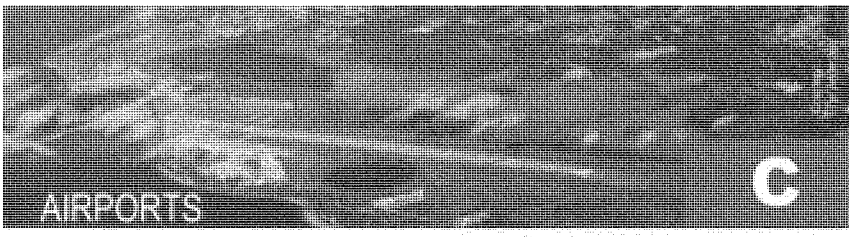
Aviation in Alaska is a huge economic engine, contributing approximately $3.5B annually to the state's economy. With regard to capital spending, approximately $200 M is invested through the FAA Airport Improvement Program annually, with local matching funds equaling $13M - $15M are also invested annually. DOT&PF spends $34M annually on maintenance and operations for rural airports. Alaska's second largest airport owner, North Slope Borough, with 6 airports, spends approximately $1.4M in maintenance of their airports, and anticipate spending approximately $78M in capital investments during their Capital budget period 2016-2020.

Five airports collect Passenger Facility Charges to augment their capital budget. ANC being the only one collecting at the $3 per passenger level. The remaining four airports have maxed out their collection ability at $4.50 per passenger.

Another major funding source for Alaska Aviation is the Essential Air Service program (EAS). EAS provides subsidies to airlines for providing scheduled air service to communities. There are 61 communities in Alaska using EAS subsidies for passenger services. There are 237 eligible communities in Alaska, but for a combination of reasons, such as local match obligations or too small passenger volumes many communities are not taking advantage of EAS.

This may seem like a well-funded airport system by comparison, but construction costs in rural Alaska far exceed those of construction in urban Alaska and even more so than those of most locations in the rest of the country.

Shipping construction equipment and materials to communities often comes at an enormous expense – both shipping and isolating equipment from use on other projects. Many Alaska communities receive barges once or twice per year and have no road access; therefore, requiring extensive project planning in order to construct in a season. Many airports are also constructed on top of permafrost; a situation that greatly increases construction cost and overall maintenance. Permafrost also goes hand in hand with a shorter construction season where aggregates may not be thawed until halfway through the summer. Shifting ground and extreme weather



conditions contribute to continual maintenance on lighting, pavement, and navigational aids on an airport. A review of the Alaska DOT&PF needs list reveals deferred maintenance at many airports, a problem that grows as it is pushed to the future. In 2009, Alaska DOT&PF estimated a deferred maintenance need close to $100M for the rural airport system. A new inventory of capital needs for DOT&PF owned airports is underway.

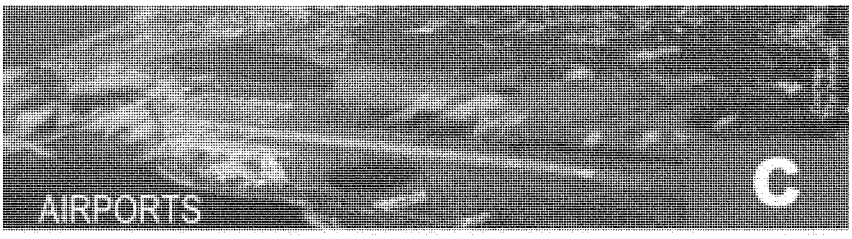
Innovation

The remote locations of Alaska airports often necessitate that engineers find innovative solutions to solve problems like scarcity of materials, extreme geography, and transportation costs. Finding sustainable design solutions may often be the only way a project can even be funded, often the final design is a combination of reduced material needs through reuse of in-situ materials and innovative solutions to augment the materials available on site. University of Alaska is studying how different stabilizers, resins and fibers can be used to "augment poor quality local materials" at lower costs than barging aggregates to the construction site. Barging, can add several hundred dollars of cost per cubic yard to a project. Engineering firms are also doing their best to repurpose local materials, a cubic yard of material saved is one that does not have to be brought in. Alaska DOT&PF has a program "Everyday Lean Innovations and Ideas" where maintenance staff is encouraged to find cost saving solutions to everyday problems. One winner designed a compact snow and ice crusher, called the Yeti, that allows staff to fracture ice and create pockets to allow deicing chemical under the ice for faster melt down.

Resilience

Alaska DOT&PF has taken several measures to increase emergency preparedness at remote locations. The state owns trailers with a portable replacement lighting system and generator that can easily be loaded on an airplane and deployed to remote locations, these trailers are stored at airports that maximizes rapid deployment. The trailer contains replacement runway lighting system with and independent power source. Remote airports have emergency generators to power airfield lighting. Alaska DOT&PF has installed emergency shelters at 21 rural communities, with 5 more communities being added to the program in 2016. These shelters are available for employees to use during bad weather or for overnight trips.

Alaska, with its vast distances and sparse population, offers a wide variety of engineering challenges to overcome in the design of infrastructure improvements. Many of Alaska's communities were established based on traditional hunting, fishing, trapping or trading areas, or in some cases the presence of particular natural resources in abundance. Site conditions are often challenging with permafrost, poor soils, lack of suitable material nearby or excessive erosion. Airport placement is often a challenge in remote communities. For example, river or ocean sandbars or coastlines have been used as initial landing sites at or nearby the community, leading to flooding and even changes in current. This is often the only suitable location for an



airport and many locations now have improvements with lighting systems and upgraded structural sections for runways and taxiways.

Another aspect of design that is becoming more and more necessary is to consider the effects of climate trends on design criteria. How do we maintain the structural integrity of the ground when the permafrost starts to melt? How do we prevent erosion of the sandy beach that is normally protected from the winter storms by ice?

Let's Raise the Grade

- **Make funding deferred maintenance a priority**
- **Increase research funding to find cost effective alternative solutions to scarce aggregates**
- **Construct more "on-route" certified weather stations**
- **Continue the fly safe information program**

Find Out More

- **State of Alaska Aviation System Plan** – www.alaskaaasp.com

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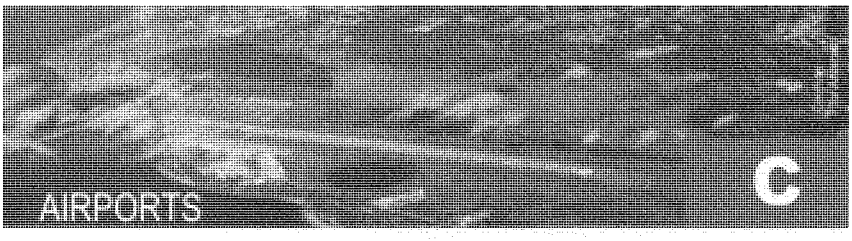

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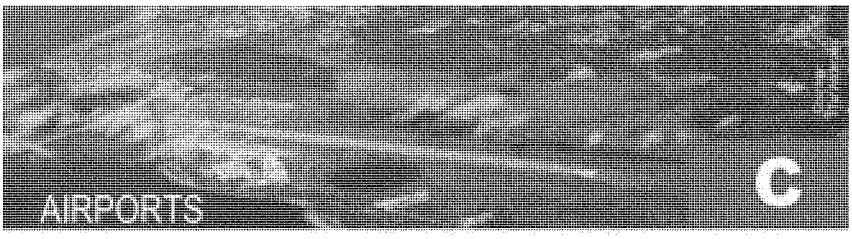

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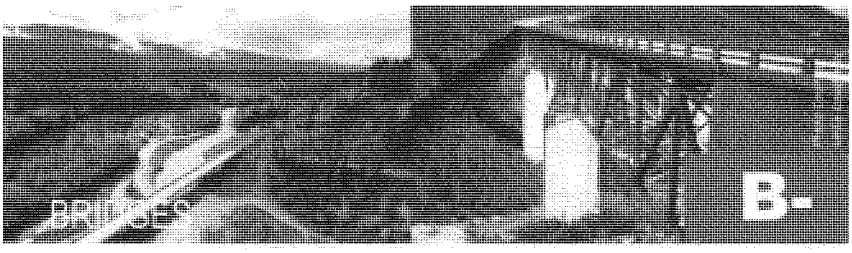


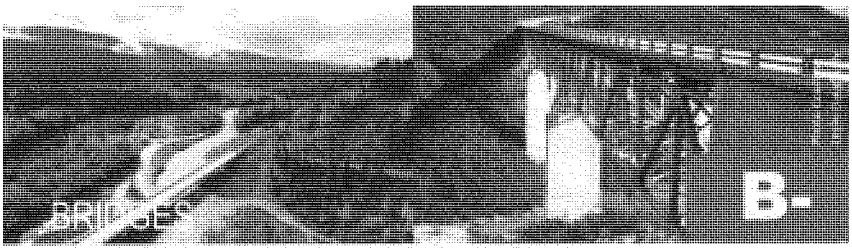
What You Should Know about Alaska's Bridges

As of 2015 Alaska had 1,453 highway bridges open to the public; however, due to Alaska's vast geographic area and unique remote villages, only about half of those bridges are part of a conventional road system comparable to the rest of the United States. Alaska's "other" bridges are in communities with access limited to only boat or plane; are located in resource extraction areas with short lifespans and limited public use; or are only open for a few months of the year, such as those in Denali National Park. Most of the 481 bridges in Alaska owned and maintained by the federal government fall under these unique categories of limited use. Nearly all of the federal bridges – 455 of the 481 total – are only one lane wide and almost 75% have an average daily traffic (ADT) of 10 or fewer vehicles. As a result, this report only considers the remaining 972 bridges owned by state and local agencies, because they are permanent structures comparable to bridges in the contiguous United States.

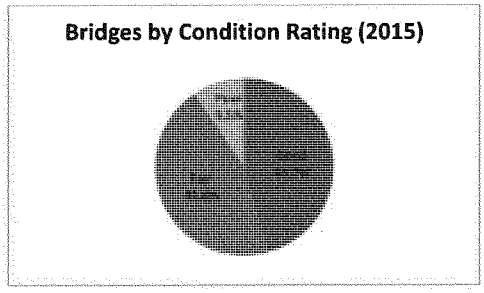
Many bridges in Alaska are in cities not connected to the road system. These bridges off the road system don't see the same heavy traffic (both volumes and loads) as the bridges on the road system. The bridges on the road system are part of what's referred to as the National Highway System (NHS), which includes the Interstate Highway System as well as other roads important to the nation's economy, defense, and mobility. The Alaska Marine Highway System (AMHS) is also considered part of the NHS by the Federal Highway Administration (FHWA), so transfer bridges at ferry docks are included in Alaska's bridge inventory.

Condition and Capacity

With an average bridge age of 35 years, Alaska's bridges are younger than the national average of 44 years. The target design life for new bridges is 75 years, whereas older bridges were only expected to last 50 years. Some of Alaska's older bridges are reaching the end of their service life, and replacement of these bridges will ensure the public is not negatively impacted if problems arise. One of the major problems in other states that affects the life of a bridge is corrosion due to de-icing chemicals applied to the roadways. Alaska does not see these extensive corrosion problems, because de-icing chemicals don't work in in Alaska's extreme cold.

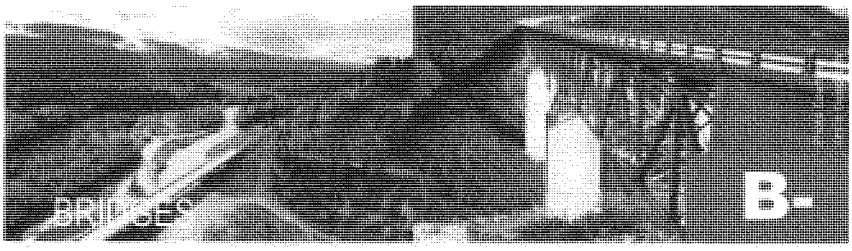


The Alaska Department of Transportation & Public Facilities (DOT&PF) is responsible for inspecting to federal standards every state and locally-owned bridge open to the public at a minimum of every 24 months. As of the 2015 published inspection data, just under half (45.7%) of bridges received a good condition rating, another large portion (44.8%) are in fair condition, and the remaining 9.5% are in poor condition. This is a slight improvement from the 11% of bridges rated poor in 2013. However, this data does not include the more than 75 bridges built or rehabilitated in 2015 and 2016.



Rating	Condition	Typical Work Required
Good	No significant defects • Condition does not adversely affect performance	Preservation activities
Fair	Minor deterioration	Minor rehabilitation such as patching concrete and painting
Poor	Advanced deterioration • Conditions impact structural capacity	Structural repair, replacement, or reconstruction of bridge

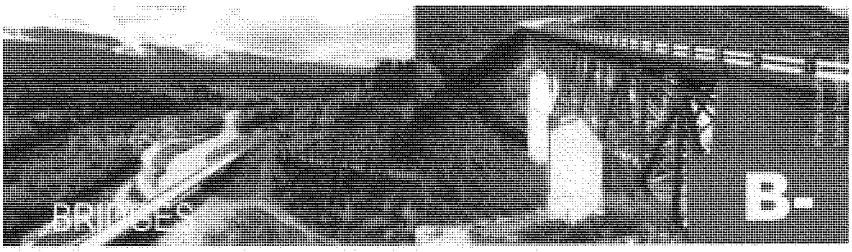
Another indication of bridge capacity is if a bridge is load posted, meaning that it cannot carry legal loads and heavy vehicles are restricted. About 10% of Alaska's bridges have a load posting, but none of



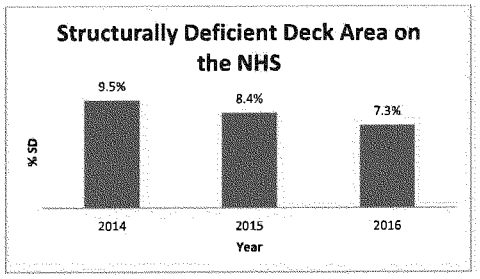
these posted structures are on the NHS, which greatly reduces the impact restricted bridges have on commerce.

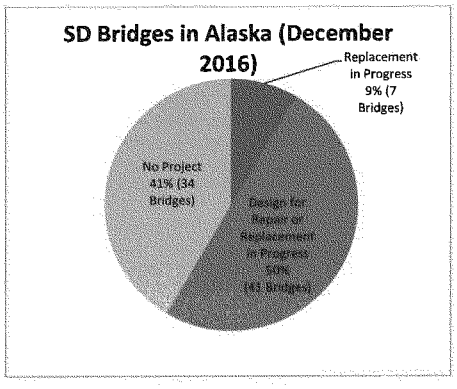
Structurally deficient bridges are being replaced, like at the Tok River on the Tok Cutoff. The old bridge in the background was demolished after the new one was opened. These timely replacements are key to keeping bridge infrastructure from falling into disrepair.

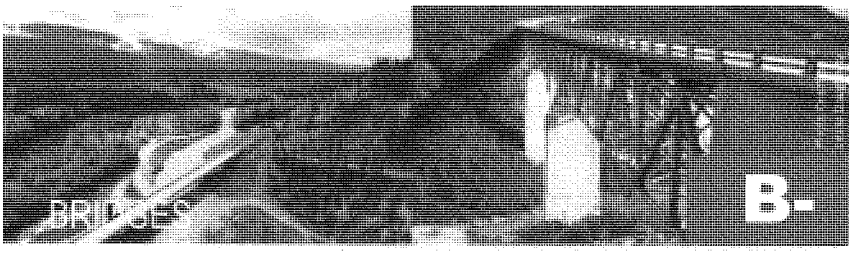
The long-term trend has been an improvement in the reduction of structurally deficient (SD) and functionally obsolete (FO) bridges, but the rate could be accelerated. The SD designation does not mean that a bridge is unsafe, but these bridges require repair and more frequent inspection and maintenance. FO bridges generally are narrower or have less vertical or horizontal clearance than would be required for a modern bridge. The data including federal bridges show that 144 bridges in Alaska – 9.7% – are structurally deficient, and of the bridges graded here, 82 (8.4%) are SD. The 2016 data shows that SD deck area – the actual roadway over a bridge considered structurally deficient – on the NHS has decreased from 9.5% in 2014 to 7.3% in 2016. The three longest SD bridges on the NHS account for about one-third of that SD deck area. An advantage is that fixing just a few of the longer bridges would drop the percent significantly. Seven of the 82 SD bridges in Alaska are already in the process of being replaced. Of the remaining 75 bridges, 41 have projects already in the planning or design phase for



repair or replacement. Further analysis would be needed to determine if the remaining bridges have adequate capacity for their location or should be repaired or replaced.







Funding and Future Needs

The majority of Alaska's funding for bridge maintenance and improvement projects comes from federal funds. Federal funding has allowed for adequate bridge replacement over time, but federal funding cannot be used for all bridge maintenance activities. The newest federal funding legislation, Fixing America's Surface Transportation (FAST) Act, was signed at the end of 2015. Under the FAST Act Alaska will receive an increasing amount of overall transportation funding – from $509 million in 2016 to $555 million in 2020. While this should be sufficient to continue replacing bridges, further investment in preventative maintenance may help defer these replacements and reduce the lifetime cost of structures.

Operation and Maintenance

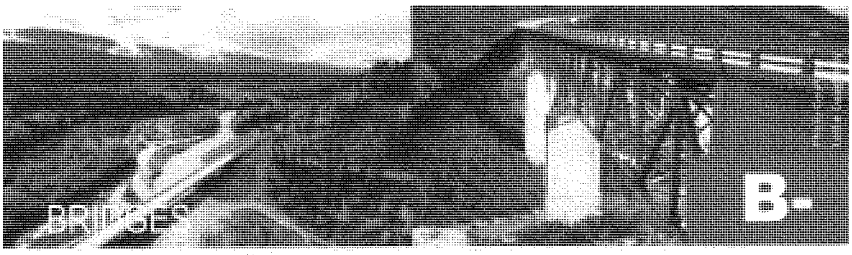
Of the three DOT&PF maintenance regions in the state, Northern, Central, and Southcoast, only the Northern and Central Regions have bridge maintenance crews. Current bridge maintenance funding information is only available from Northern Region, which maintains 376 bridges. In 2016 about $300,000 was allocated for bridge maintenance, or only about $800 per bridge per year.

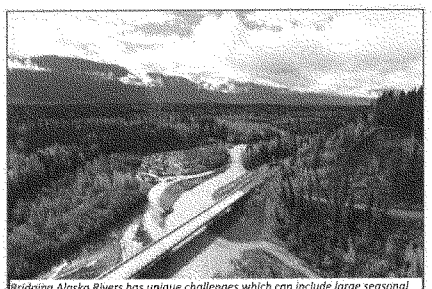
DOT&PF works with its transportation partners to improve the utilization of their system. For example, the Alaska DOT&PF has performed instrumentation and load testing of in-service bridges to better predict how bridges react to truck loads. The results of the testing program allowed commercial trucking companies to haul larger loads along the state's primary commerce corridors. However, anecdotal information indicates that commercial trucking companies would like to see more load testing of bridges and bridge capacities that exceed legal loads. Further investigation would be needed to determine the transportation industry's needs and impacts to the state economy of increased bridge capacity.

Resilience

Resilient bridges, as defined by M. Myint Lwin, retired Director of the FHWA Office of Bridge Technology, "have the capability to withstand unusual or extreme forces without collapse or loss of lives. They are able to recover from distress or major damage with minimal disruption to traffic and essential services."

As such, resilience is critical for Alaska, which is the most seismic state in the country in terms of both frequency of events and historic earthquake magnitude. Avoiding earthquake damage that closes a





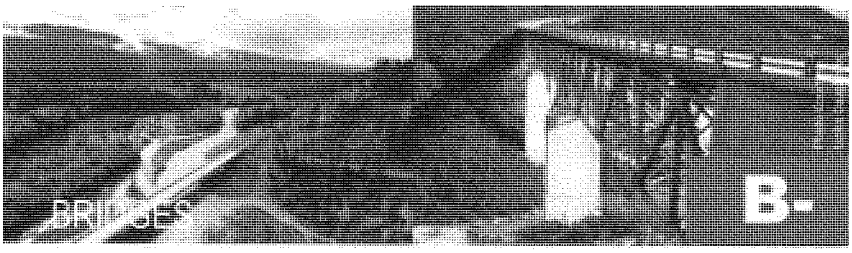
Bridging Alaska Rivers has unique challenges which can include large seasonal fluctuations in flow of glacial run-off water that frequently jump channels. Other cold weather challenges are aufeis (ice accumulation), ice jams, and glacial outburst floods.

bridge is imperative, because most Alaskan roads do not have available detours and part of the state could be cutoff after a large earthquake. This occurred after the record-breaking 1964 Alaska Earthquake when dozens of bridges were destroyed and rebuilding efforts took years. As a result, DOT&PF has been at the forefront of incorporating seismic design details and methodologies, including their own seismic bridge research to develop these strategies. Older bridges in the state were not built to modern seismic standards, but the most vulnerable of these bridges have already undergone seismic retrofits to enhance how the bridge will perform during a seismic event. However, the less vulnerable bridges still need to be replaced or retrofitted. Additionally, bridges built to perform well during an earthquake are more expensive than conventional bridges in non-seismic areas.

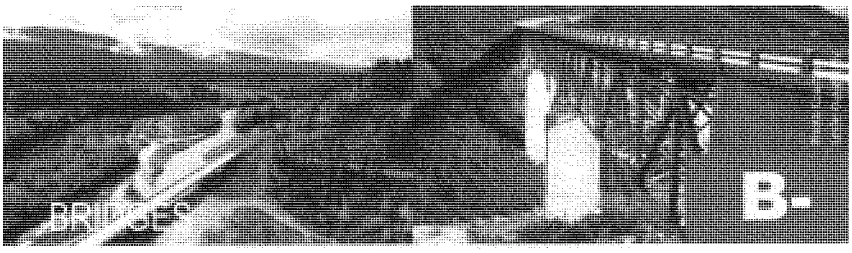
The ability to withstand flooding and scour are also commonly associated with resilience. Alaska's bridges have a good track record in floods, and DOT&PF has a scour monitoring and retrofit program to address vulnerabilities.

Research and Innovation

As mentioned, Alaska has a history of research due to seismic conditions, but the effects of Alaska's extreme cold weather also play a part in how bridges perform and has required research for guidance not addressed by the national bridge code. Alaska DOT&PF currently spends about $2 million a year for bridge research and presently has six ongoing research programs in cooperation with various universities nationwide. DOT&PF has completed FHWA experimental features projects over the years to evaluate new bridge components such as seismic isolation bearings, polyester concrete, and types of waterproofing membranes. Alaska's long winters also mean shorter construction seasons, so DOT&PF



has developed various systems to encourage an engineering and construction process known as ABC (Accelerated Bridge Construction).



Recommendations

Alaska currently has a healthy bridge inventory, but proper maintenance and timely investment are required to ensure Alaska's bridge infrastructure does not rapidly decline. Recommendations include:

- Provide adequate long-term funding sources and increase rehabilitation or replacement of structurally deficient bridges. Include adequate funding for locally-owned bridges.
- Continue to retrofit or replace seismically vulnerable bridges.
- Invest in adequate routine maintenance to ensure that Alaska's bridges meet or exceed their intended design life. Fund bridge maintenance in the DOT&PF Southcoast Region.
- Investigate if bridges on important haul routes should be strengthened or replaced to accommodate commercial trucking needs.

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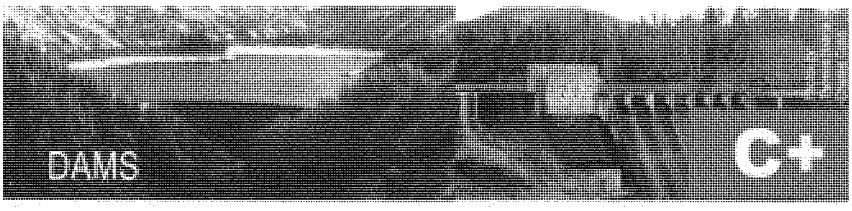
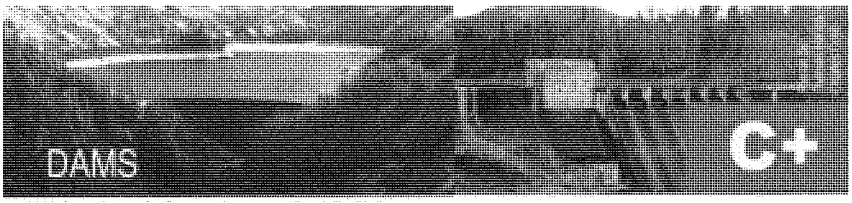


What You Should Know about Alaska's Dams

During the early 1980's, a Phase 1 inventory was completed of all Alaska dams by the U.S Army Corps of Engineers (USACE) and Alaska Department of Natural Resources (ADNR), which included dams ranging in size from "two logs across a creek" to the large hydroelectric dams in southeast Alaska. The National Inventory of Dams (NID) maintained by the USACE lists 28 dams in Alaska with a high hazard potential including state and federally regulated dams. There are currently 178 dams in the Alaska Dam Inventory, with 76 dams under state jurisdiction[i]. The NID lists 25 dams under federal jurisdiction, including 20 hydroelectric related dams regulated by the Federal Energy Regulatory Commission (FERC). The balance of the inventory is represented by non-jurisdictional dams, and the majority of these dams are relatively small or low hazard potential. The large concrete dams in Alaska include the Green Lake Dam and the Blue Lake Dam near Sitka, the Salmon Creek Dam in Juneau and the Swan Lake Dam and the Lake Connell Dam near Ketchikan, with all but the latter serving hydroelectric generators. Large embankment dams serve hydroelectric generators at Terror Lake on Kodiak Island, Bradley Lake near Homer, Solomon Gulch in Valdez, and Coopers Lake in Cooper's Landing, and store mine tailings at the Fort Knox and Red Dog Mines. Embankment dams provide flood protection for Fairbanks at the Moose Creek Diversion and for Seward at the Lowell Creek Diversion. Small dams provide potable water supplies across Alaska, from Anchorage to Barrow, from Kotzebue to Kodiak to Ketchikan, and from Atka to Metlakatla.

With the passage of the Alaska Water Use Act of 1966 (AS 46.15) Alaska demonstrated leadership in dam safety. The Alaska Dam Safety Program was organized by ADNR in the mid-1980's and improved and formalized by the passage of the Alaska Dam Safety Act of 1987 (AS 46.17). Regulations were passed in 1989 and revised in 2004 (11 AAC 93). The *Guidelines for Cooperation with the Alaska Dam Safety Program*, last revised in 2005, provides a detailed overview of the state regulatory program for dams. The current Alaska Dam Safety Program is managed as a cooperative effort between ADNR and stakeholders in design, construction, and operation of dams in Alaska. Based on statute, the dam safety program has established regulations for applications for new dam construction, repair, modification, operation, removal or abandonment of Dams. ADNR issues "Certificates of Approval" for these activities. The regulations also require periodic safety inspections for all jurisdictional dams, and emergency action plans for high and significant hazard potential dams. The State of Alaska employs two full time engineers to ensure the safety of the state's jurisdictional dams. Federally owned and operated dams, and dams regulated by the FERC are specifically exempt from state jurisdiction by state law.

During August and September of 2012 several areas of Alaska saw extreme, extended rainfalls that produced record breaking flood levels. The rain events were later reported by the National Weather Service as "500 year storms" in some areas. No dams failed during these floods.



Capacity

Alaska has a small number of dams compared to most other states. The suspension of the Susitna hydroelectric project may signal a limited capacity for large scale hydroelectric development in Alaska. A significant interest remains for increased small hydroelectric capacity, such as the Crater Lake project proposed by the Cordova Electric Cooperative, especially given the dependence on diesel powered electric generators in many communities. Anchorage is the largest population center in Alaska and relies on the Eklutna Dam and the Ship Creek Dam for the primary source of drinking water. Other relatively large communities that utilize dams for water supply include Sitka, Wrangell, Craig, Hydaburg, Metlakatla, Barrow and other villages. These water supply dams are especially important for communities with fish processing such as Kodiak, Petersburg, and Dutch Harbor. Many Alaska villages are in need of water supply system improvements. For example, the City of Atka has a modern water treatment system, but its source is a small, decrepit non-jurisdictional dam. This indicates a demand for additional capacity that could be served by new, small, water supply dams in rural Alaska.

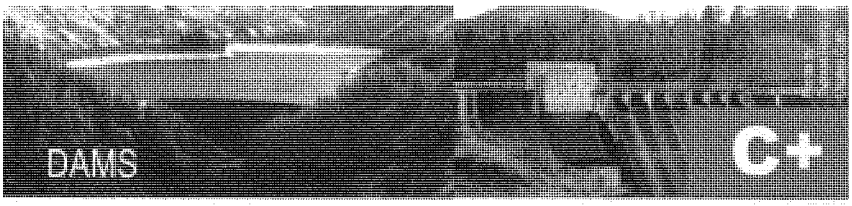
Condition

Condition assessment ratings are assigned to dams using criteria developed by the USACE. Currently, 18 of the 28 high hazard potential dams listed in the state and national inventories have an overall condition assessment rating of satisfactory or fair. This means these dams have no safety deficiencies identified for loads under normal operating conditions. Dams with satisfactory ratings are expected to demonstrate acceptable performance under all loading conditions including extreme floods and earthquakes in accordance with current applicable regulatory criteria or tolerable risk guidelines. Dams with lower ratings may have recognized deficiencies, or simply need additional evaluations to better understand their expected performance under extreme loads.

Over the last several years, a number of state regulated dams were rehabilitated through a collaborative effort by dam owners and state funding after deficiencies were identified during inspections. Major remediation projects include the Lower Fire Lake Dam in Eagle River, the Lake Lucile Dam in Palmer, and the Mahoona Dam in Ouzinkie. Private dam owners who conducted major repairs include the Lake O' the Hills Dam in Anchorage, and the Itasigrook Dam and Isatkuak Dams in Barrow. State regulated high hazard potential dams known to be deficient and in need of risk mitigation include the Lowell Creek Diversion Dam in Seward, and the Upper and Lower Wrangell Dams in Wrangell. An update is in progress to the Dam Hazard Annex of the State Hazard Mitigation Plan which will provide a more detailed review of the condition of dams in Alaska.

Operations and Maintenance

ADNR issues *Certificates of Approval to Operate a Dam* for dams that are in service and in compliance with the regulations. All dams must have a current Operations and Maintenance (O&M) manual before the ADNR will issue a certificate. The O&M manual must include instructions for operating the dam, maintenance requirements, schedules for routine maintenance and inspections, and other important information. Compliance with the requirements of the O&M manual is always included as a condition to a *Certificate of Approval to Operate a Dam*.



These certificates are renewed based on the same cycle as a periodic safety inspection. In 2016, approximately 78% of state regulated dams have an O&M manual. All FERC regulated dams in Alaska and two dams operated by the USACE have an O&M manual, which represents 88% of the federally regulated dams listed on the NID.

Public Safety

The Alaska dam safety regulations require a periodic safety inspection every three years for high and significant hazard potential dams. Low hazard potential dams must be inspected every five years. These inspections must be conducted by a qualified professional engineer and approved by ADNR. If the inspection engineer recommends work on the dam for maintenance or to improve safety, ADNR will reference those requirements as a special condition of the *Certificate of Approval to Operate a Dam*. Compliance with periodic safety inspection requirements has generally increased over the past 15 years. For state regulated dams, the hazard potential classification must be reviewed with periodic safety inspections to ensure that downstream development has not changed the risk profile of existing dams.

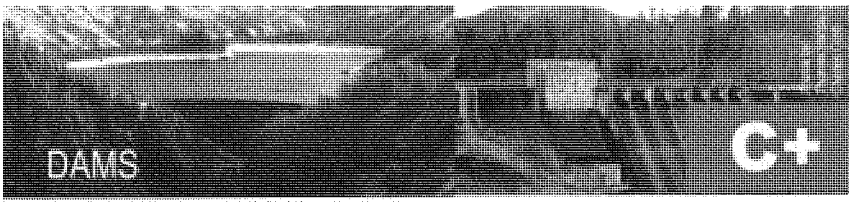
High and significant hazard potential dams regulated by the federal and state governments are required to have emergency action plans (EAP). There are a total of 17 state regulated high hazard potential dams in Alaska and 14 have an emergency action plan in place, while all 11 federally regulated, high hazard potential dams in Alaska have an EAP. Currently, 89% of the high hazard potential dams have emergency action plans while 59% of the significant hazard potential dams have emergency action plans. Furthermore, many of the communities where dams are located have multi-hazard, community emergency response plans that may include the dam, but these plans are not recognized under the current state dam safety regulations.

At least 9 dams have been removed in the last two decades, and planning is in progress to remove the Lower Eklutna Dam near Anchorage.

Funding & Future Need

The Alaska Dam Safety Program is primarily funded by the state General Fund. Fees collected for dam reconstruction and new construction applications are used for project specific technical reviews. Federal funding for state dam safety programs is contingent on state funding and is considered as a supplement. The funding total provides for the two positions employed. The Federal support comes with performance reporting requirements including updates to the NID. The ADNR has provided updates for the state jurisdictional dams to the NID since it was established, but does not receive any reports on federal jurisdictional dams in the Alaska. Application fees are spent on professional engineering consultants under contract to ADNR to support complex technical reviews, as needed. Future spending is authorized through capital improvement program budget methods.

While there are dams with serious deficiencies that are in need of funding for repairs, dam owners with public interests and the Alaska state legislature have collaborated greatly over the last several years to address a number of deficient dams. A dam currently in serious need of funding for a major rehabilitation is the high hazard potential, Lowell Creek Diversion Dam in Seward. The dam and a 2068-foot long tunnel through Bear Mountain were



constructed by the U. S. Army before World War II to protect the community from flooding; both the dam and the tunnel are undersized based on current hydrologic design standards. The dam is owned by the City of Seward, but Congress has historically mandated maintenance responsibility for the tunnel to the USACE. Section 5032 of the Water Resources Development Act of 2007 orders the USACE to develop an alternative flood mitigation project or transfer maintenance responsibility to the City of Seward in 2022 whether the dam and tunnel are rehabilitated or not. The City of Wrangell also has two high hazard potential water supply dams that need rehabilitation due to seismic risks. There is no formal program in Alaska for funding rehabilitation of deficient dams.

Innovation

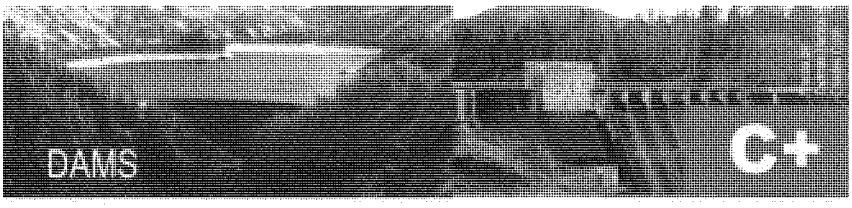
The Alaska Dam Safety Program is nationally recognized for innovation. The *Guidelines for Cooperation with the Alaska Dam Safety Program* provide a transparent overview of the entire regulatory program and includes guidance on important information expected from dam owners such as design standards, operations and maintenance manuals, emergency action plans, and incident reporting. The application process described in regulations is being profiled in a white paper on state and federal design review processes for dams under development by the Design Review Committee of the Association of State Dam Safety Officials. The Hazard Potential Classification and Jurisdictional Review form used by ADNR provides a unique format to regularly review the hazard potential classification of dams, or equitably determine if a proposed dam is under state regulatory jurisdiction. The Alaska Dam Safety Program is also closely involved in regulating mine tailings dams in Alaska and is leading a national discussion on the unique aspects of regulating tailings dams. The Alaska Dam Safety Program has a website at http://dnr.alaska.gov/mlw/water/dams/ with links to important information, including statutes and regulations.

In addition, a number of dams in Alaska, including new construction and rehabilitation projects, as well as water and tailings dams at mines, utilize geosynthetic membranes, geotextiles, geopipes, and other relatively novel materials in innovative applications.

Resilience

Many Alaska dams are low hazard potential dams located far from otherwise developed areas or close to the sea, and not all communities rely solely on impoundments for drinking water. Most high and significant hazard dams have emergency action plans to mitigate the concentrated risks. Of the few without an appropriate emergency action plan, many are covered by community emergency response plans showing a community resilience even if a dam operator may not meet regulatory requirements for current emergency action plans. The *Emergency Action Plan for the Alaska Dam Safety Program* provides a generic response plan for all dams in the state.

No dams failed during severe flooding events in 2012, although a levee failure was suspected near Talkeetna. The relatively few dams and low population at risk from dams in Alaska indicates that the overall risk from dams to Alaska is relatively low and the resilience is high. However, apart from the concentrated risks associated with the



specific dams, the more acute situations with the Lowell Creek Diversion Dam in Seward and the Upper and Lower Wrangell Dams, represent significantly higher risk and potential impacts from a dam failure to those communities.

Let's Raise the Grade

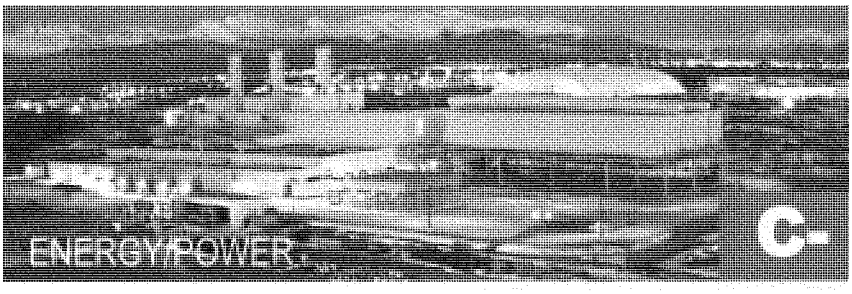
- **Make repairs to Lowell Creek Diversion Dam and the Upper and Lower Wrangell Dams**
- **Create a revolving emergency fund for dam and levee repairs, where municipalities can borrow funds to start major repairs to prevent local disasters.**
- **Continue funding the Alaska Dam Safety Program in ADNR**
- **Develop a Levee Safety Program based on the success of the Alaska Dam Safety Program**
- **Emergency action plans for all High Hazard Dams by 2020**

Find Out More

- **Alaska Dam Safety Program -** http://dnr.alaska.gov/mlw/water/dams/

References

- **Guidelines for Cooperation with the Alaska Dam Safety Program (2005) -** http://dnr.alaska.gov/mlw/water/dams/AK_Dam_Safety_Guidelines062005.pdf
- **Update on the Alaska Dam Safety Program and the draft Water Resources Development Act of 2012. Report dated December 14, 2012. Charles F. Cobb P.E., State Dam Safety Engineer, Department of Natural Resources, Division of Mining, Land & Water, Water Resources Section.**
- **Personal interview with Dam Safety Engineers Charles F. Cobb and Ben Wagner. September 20, 2016.**
- **Why Lowell Creek Diversion Tunnel is such a priority. Heidi Zemach. Seward City News. November 18, 2015.** http://sewardcitynews.com/2015/11/why-lowell-creek-diversion-tunnel-is-such-a-priority/
- **Water Infrastructure Development Bill Passes Senate. Press release from Sen. Murkowski's office, September 15, 2016. Provided in personal email communication from Ryan West, legislative correspondent, received September 15, 2016.**
- **Sullivan Secures Victories for Alaska's Water Infrastructure. Press release from Sen. Sullivans Office, September 15, 2016. Provided in personal email communication from Margret Sharpe, Wasilla office for Senator Sullivan, received September 15, 2016.**
- **Flooded Lowell Creek bridge – Seward, AK – 9/19/02, YouTube published September 20, 2016,** https://www.youtube.com/watch?v=e0KbzZ9CT0Y
- **2013 Lowell Creek Bridge Flooded Clip1, 2, &3. YouTube published December 2013,** https://www.youtube.com/watch?v=DR9T_2jUVV4 https://www.youtube.com/watch?v=4nWAfP3yx7U https://www.youtube.com/watch?v=ti5ZUnUStkM
- **2016 National Inventory of Dams data provided by the USACE.**



What You Should Know about Alaska's Energy Infrastructure

Alaska enjoys integrated and abundant power generation and transmission systems in the Railbelt corridor (from Fairbanks to the Kenai Peninsula) and in portions of Southeast Alaska. These systems produce about 90% of Alaska's total generation (about 5.9 megawatt-hours (MWh) out of a statewide total of 6.55 MWh in 2011). Most of these power plants are in good condition, and several major plants are new. Transmission is, however, constrained and dispatch of the most economic power is not currently guaranteed. Much of the data about Alaska's Energy Infrastructure is not publicly available, therefore for this report we contacted several of the utilities to gain greater insight into their infrastructure.

For the rest of Alaska, in what could be called the rural or off-road system, the challenges are greater. Most rural utilities are "microgrid" systems not connected to other communities. Although there are successful rural cooperatives, basic operation and maintenance remains difficult in many small communities around the state. Basic administration such as billing is often challenged, as are workforce training and retention.

Capacity

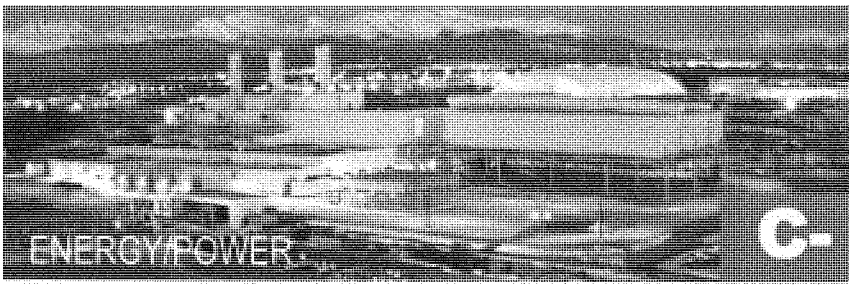
Railbelt

Based on large investments made in power generation in the last decade, the supply-side ("upstream") generation capacity is assessed as adequate for current and foreseeable demand. Railbelt utilities now have a surplus of modern, high quality generation equipment.

But the transmission component has not kept pace. State studies indicate over $900 million in transmission upgrades are warranted in order to fully achieve full system redundancy (i.e., ability to back up from multiple generator sources) and dispatch of the most economic power in the system.

Southeast

Southeast Alaska's generation capacity is mostly provided by hydropower. Juneau and other communities also have diesel generator backups, which periodically must be used because of avalanches or other events. There appears to be an abundance of affordable hydropower in many communities, and the ASCE



team did not review any literature suggesting that generation capacity in Southeast Alaska was compromised generally.

On the transmission side, transmission capacity appears generally adequate, although some lines have been demonstrated vulnerable to interruption due to avalanches and other factors. Though specific to the communities served (mainly Ketchikan, Petersburg and Wrangell), the Swan Lake – Tyee Lake intertie, completed in about 2009, have provided increased reliability and redundancy to the service area.

Finally, it is important to bear in mind that the Southeast region is a large area that includes rural communities, which have isolated systems that are dependent on diesel, similar to rural areas elsewhere in Alaska. For these communities, the condition is probably more similar to rural mainland Alaska than to more developed areas in Southeast Alaska.

Rural

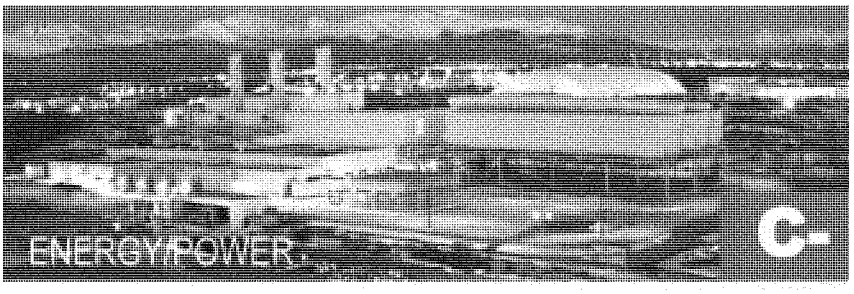
The Alaska Energy Authority survey of rural powerhouses in 2012 indicated the capacity of the systems was adequately and appropriately sized in the majority of villages (83.2%). About 4.3 percent were classified as undersized, and the remainder oversized.

Generators in this region run almost entirely on liquid fuel. ASCE did not locate reports challenging the capacity of bulk fuel storage tank farms, so these are assumed to have adequate capacity.

Condition

Railbelt:

A major Southcentral Alaskan utility (Municipal Light and Power) has noted that some major generation equipment is aging, requiring additional maintains support. It is also fuel inefficient.
However, ML&P and other utilities have been aggressively replacing older equipment with new units, allowing the older units to be retired or placed in standby. The total investment is reportedly between $1.2 and $1.5 billion in the past five years.



ASCE did not locate information generally derogatory to the physical condition of transmission lines in the Railbelt, although we are aware of some pole lines that have been subject to settlement and jacking issues. However, two major utilities contacted by ASCE self graded their infrastructure conditions at a score of 3 and 4, respectively, out of 5 points.

Southeast:

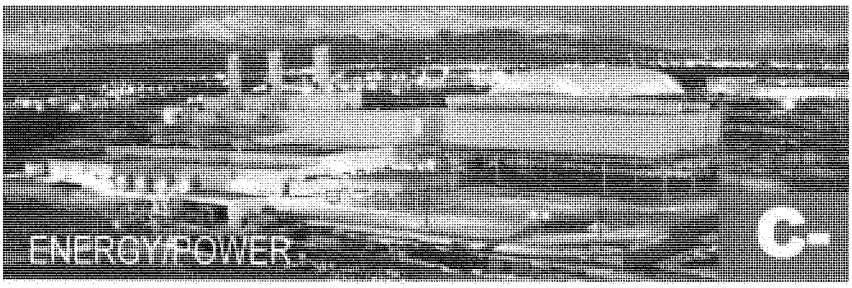
A major Southeast utility scored itself at 4 of 5 in the "condition" category. No further condition information was found by ASCE in open literature, relative to the condition of generation or transmission facilities in the region, so this assessment is accepted as characteristic of the region.

Rural

The Alaska Energy Authority (AEA) inventoried about 250 community power plants in Alaska with capacity ranging from 45 kW to 374,000 kW. AEA specifically inventoried 523 individual generating units in Alaska, of which only about 29% were assessed to be in "good" condition by the AEA in 2012. 60% were rated fair and about 11% were considered in "poor" condition. These conditions appear to be related to maintenance challenges, compounded by difficulties in recruiting, developing and retaining qualified maintenance personnel in remote locations.

With regard to bulk fuel facilities, the Denali Commission has documented the challenged condition of bulk fuel tank farms in rural Alaska, describing 56 communities remaining with "unmet needs." At the current rate of funding, it could take several decades to repair or refurbish deficient tankage facilities.

In general, conditions of energy facilities are an example of the divergent conditions between rural and urban Alaska . ASCE Report Card criteria require that the energy sector within the State should be evaluated as a whole. It is difficult at least, and perhaps not possible, to reconcile the conditions of rural utilities (outside of AVEC) with the much more advanced situation of the on-road utilities.



Operation and Maintenance

Railbelt

Two responding Railbelt utilities self-assigned a 4 of 5 score in this category. ASCE does not have independent information to augment that score and accepts the 4 of 5 as representative for the Railbelt as a whole.

Southeast

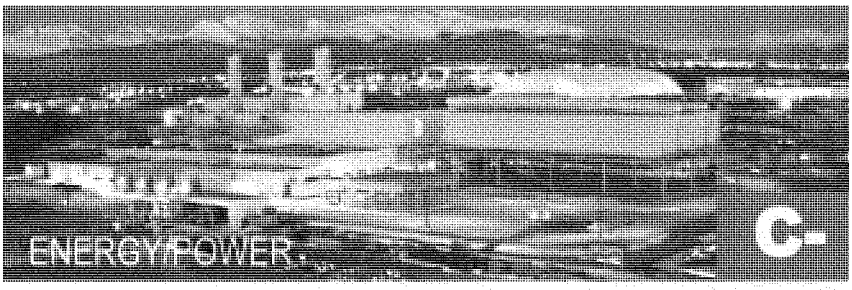
The Southeast utility that responded to ASCE assigned a 4 of 5 score to itself. ASCE does not have independent information to augment that scoring and accepts 4 of 5 as representative for Southeast as a whole.

Rural

The responding rural energy cooperative assigned a 3 of 5 score.in this category. Challenges to operation and maintenance of rural facilities outside the cooperative systems are well documented in studies documented in the background report available upon request.

Public Safety

For this category, ASCE is largely reliant on utility responses based on its survey. It is noted that the public safety measure suggested by ASCE were loss of power events exceeding 48 hours. Never would be a 5, yearly a 3, monthly a 1. This was suggested as a measure of public safety because, were such an outage to occur in mid-winter, it could have life safety consequences, particularly in rural Alaska (in addition to the risks of damage to the energy infrastructure). Railbelt utilities scored themselves 3 or 4 of 5; the responding Southeast utility scored itself at 3 of 5; and the responding rural cooperative scored itself at 4.5 of 5 (a score that may not be representative of rural utility reliability outside the co-op system).



Funding

Any discussion of funding for energy in Alaska should be prefaced by an overview of fundamental economic conditions. The most urbanized portion of Alaska (i.e., the Railbelt area) enjoys access to relatively cheap natural gas for power generation, and Southeast utilities benefit from inexpensive hydropower. The rest of the state is heavily reliant on liquid fuel, which is expensive to transport. This form of fuel places a high burden on consumers and adversely affects economic viability of communities. The State of Alaska has a program known as Power Cost Equalization (PCE) that mostly offsets these costs, but does not completely resolve the problem.

Railbelt

Responding utilities self-rated as well funded. However, with respect to Railbelt transmission improvements, there do not appear to be any currently available means for funding $900 million in identified projects.

One significant and long-identified project - an intertie to connect Copper Valley Electric Association to the Railbelt grid – has not been accomplished as a result of funding limitations. It should also be noted there is also an opportunity to connect the Alaska Highway (Tok area Alaska Power and Telephone system) to the Interior (Golden Valley Electric Association) grid. The extent of their distribution systems stretch to within 50 miles of one another, potentially saving Tok area consumers approximately half of their electric bills.

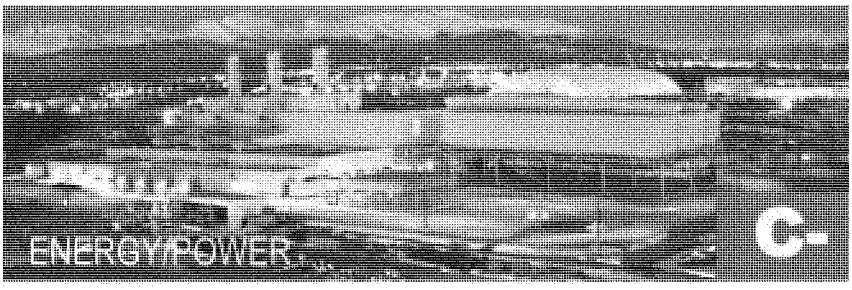
Southeast

The responding Southeast utility rated its funding capacity at 5 of out 5. ASCE relies on this as representative of other utilities in the region.

Rural

The responding rural cooperative assessed its funding capacity at 4 of 5, perhaps reflecting its effectiveness as a cooperative in efficiently delivering services based on a centralized administrative, billing, operation and maintenance entity.

For other operators, funding challenges are implied by findings relative to bulk fuel tank farms, and by the challenges in maintaining generator equipment to a good condition.



Future needs

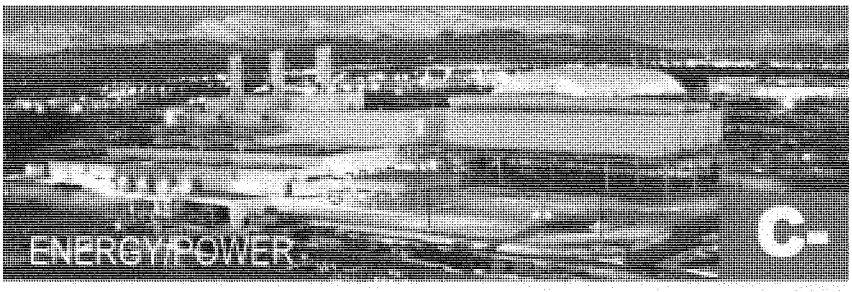
Responding utilities in all regions indicated their infrastructure capacities are projected as satisfactory for continued operation in the future. However, based on observations (also noted in the "condition" category), the continued operability of rural generators is challenged, and therefore may not meet future needs.

Resilience

The resilience of Alaska's energy infrastructure has not been comprehensively studied. However, in all regions, the resiliency has been tested by severe weather conditions, seismic events and other emergencies. Overall, the systems have performed well, in part owing to redundancy of generation equipment.

Innovation

For the responses attained from utilities, ASCE had suggested the following: "Energy from Renewable Sources (% of Total), Use of Energy-Saving Technology (i.e. Smart Meters): Are you involved in a clean energy project or program?" For this category, responding utilities rated themselves between 4 and 5. In addition, ASCE notes the work currently being pursued by Renewable Energy Alaska Project (REAP) and the Alaska Native Tribal Health Consortium (ANTHC) focused on developing viable and sustainable alternatives to high cost liquid fuel.



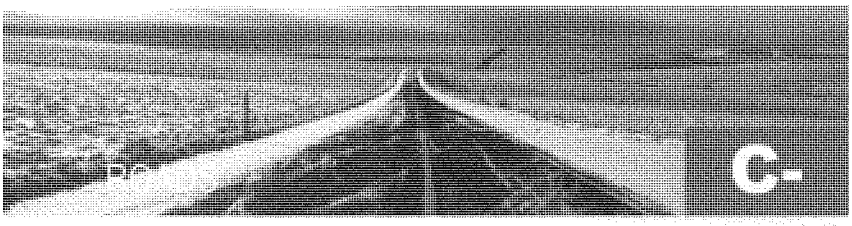
Let's Raise the Grade

The following actions are recommended:

- Extend and improve energy cooperatives and business processes/incentives, to enhance and streamline operation and maintenance, particularly in rural areas. This will require creation of policies that will promote formation of energy consortiums and cooperatives.
- Along with these improvements, invest in workforce development to build the capacity of local workers to operate and maintain rural facilities. This will likely lead to more efficient and effective utilization of capital expenditures for lifecycle upgrades and replacements.
- Upgrade Railbelt transmission line capacity to improve redundancy, reliability, and economy, following recommendations in the Alaska Energy Authority study.
- Consider extension of Railbelt infrastructure to accessible areas on the major road system, notably to Copper Valley Electric Association (Glennallen/Valdez area) and Alaska Power and Telegraph (Eastern Interior/Tok area).

Find Out More *[Resources]*

- **UAA Institute of Social and Economic Research: Alaska Energy Statistics 1960-2011** (http://iser.uaa.alaska.edu/Publications/2013_12-AlaskaEnergyStatistics2011Report_Final_2014-04-30.pdf)
- Alaska Energy Authority Pre/Post – Watana Transmission Study Draft Report (http://www.akenergyauthority.org/Content/Publications/AKRailbeltTransmissionPlan.pdf)
- **US Department of Energy/Lawrence Livermore National Laboratories:** Sustainable Energy Solutions for Rural Alaska (https://emp.lbl.gov/sites/all/files/lbnl-1005097.pdf)



What You Should Know about Alaska's Roads

State Highways and Roadways

Alaska's roadways, although very limited in total miles compared to most states, are vital to the economic growth and development of the state. The Alaska Department of Transportation and Public Facilities maintains 5,609 centerline miles of highways, 3,737 of which are paved. The highway system provides connectivity for freight and travel from the lower 48 states through Canada into Alaska, and from Alaska's economic hub, Anchorage, to communities across the state. Alaska, having some of the richest and most productive oil fields in the country, requires transport of equipment and infrastructure to the oil fields on the North Slope of Alaska. The 414 mile Dalton Highway (Alaska Route 11) is the only highway that connects Alaska's North Slope oil fields to the rest of the state, and shutdown of this highway for maintenance or due to catastrophic events has major effects on Alaska's economy, and affects the production and price of oil. Other major highways include the Alaska Highway, Seward Highway, Glenn Highway, Parks Highway, and Richardson Highway, which are corridors that provide connectivity throughout the central and northern part of the state.

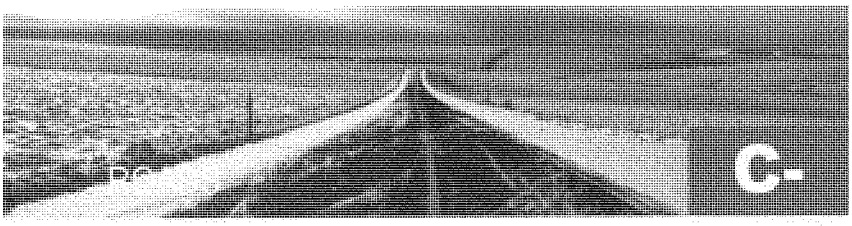
Municipal and Borough Roadways

Municipal and Borough Roadways are typically a mixture of paved and unpaved roads in Alaska's hub towns and cities. Many of these areas are a mixture of state and municipal or borough owned roads, and are maintained by state and local governments. These towns and cities are the main population centers spread across the state where goods are typically shipped to in order to reach villages by road and air. Many of these areas contain populations over 1,000 people.

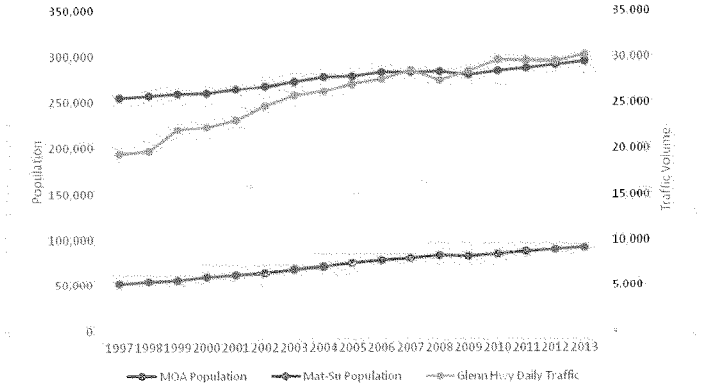
Village and Rural Roadways

Village and Rural Roadways consist mainly of unpaved roads, walkways, trails, and boardwalks in areas outside of Alaska's hub towns. These areas contain populations of less than 500 people and the local roadway facilities are typically maintained by local village governments and regional native corporations. The roads, walkways, trails, and boardwalks in these areas are of importance to locals because they serve as routes to local hub towns, medical facilities, schools, and routes to subsistence hunting and fishing locations. Villages located north of the Arctic Circle and Western Alaska are built on permafrost which experience thawing and melting in the summer months. These conditions make it unsustainable and cost prohibitive to build conventional roadways due to rapid deterioration. Many of these villages are connected by a series of boardwalks that are accessible by pedestrians, four-wheelers (all-terrain vehicles), and snow machines (snow mobiles).

Capacity

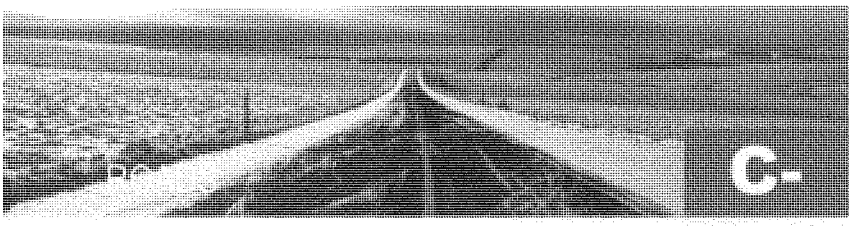


Alaska has the lowest population density in the country, 1.3 people per square mile, and because of this there is low traffic congestion outside of its population centers. However, Anchorage contains nearly 40% of the state's population, causing the Municipality of Anchorage (MOA) and the nearby Matanuska-Susitna Borough (MSB) to experience the heaviest traffic in the state. These areas have the highest population densities across the state. The MOA and MSB have experienced steady population growth over the last decade, which have contributed to capacity issues in the area. The figure below shows increasing traffic volume (vehicles per day) along the Glenn Highway which connects the borough and the municipality, in conjunction with population growth in Anchorage from 1997 to 2013. Several intersections in Anchorage experience Level of Service E and F, which are the highest congestion designations, during peak AM and PM traffic.



Source: US Census American Community Survey 5-year Estimates, Status of the System Report 2010, Volumes from DOT & PF Annual Traffic Volume Reports

The Anchorage Metropolitan Area Transportation Solutions (AMATS) have identified several projects which will make improvements to the Road System, Public Transportation, Pedestrian and Bicycle Systems, and Freight



Distribution and Regional Connection Elements. Many of the projects highlighted in the AMATS plan are currently underway, however, in order to keep up with a rate of 1-3% increase in population growth per year, the AK DOT&PF, Municipality of Anchorage, and Matanuska Susitna Borough will continue to require investing in the projects highlighted by the study.

Condition

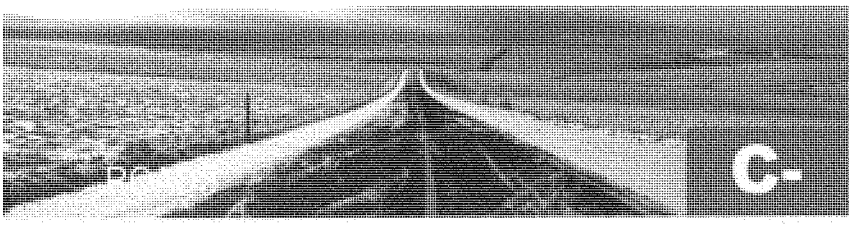
In 2013 the Alaska Department of Transportation & Public Facilities released Alaska's Pavement report. The report is an evaluation of approximately 4,100 lane-miles of Alaska's highways in order to come up with a comprehensive score of the condition of the state's pavement. The evaluation includes several data points that are entered into the Performance and Economic Rating System (PERS) software. These data points include:

- General sectional information, such as numerical identification, number of lanes, road classification, pavement type, functional class, etc.
- Traffic data (vehicles per day) and equivalent axle loadings.
- Structural data showing materials and thicknesses forming the support system of the roadway.
- Surface data with rutting and with IRI (International Roughness Index) indicators used to calculate remaining life.
- Modeling information allowing the engineer to account for varying conditions by modifying the formulas.
- Past construction and maintenance data.

PSR Ratings Guide

>4.0		Very Good
<4.0	> 3.5	Good
<3.5	> 3.1	Fair
3.4		2017 Statewide Goal
<3.0	> 2.6	Marginal
<2.6		Poor

Using these data points the PERS software calculates a Pavement Serviceability Rating (PSR) for each roadway segment evaluated and a comprehensive PSR for all roadways evaluated. The rating system assigns a score between 0 (very poor) and 5 (excellent). The evaluation resulted in a cumulative PSR of 3.1, which is Fair, however just above a Marginal rating. This result was mainly affected by irregularities in the pavement including cracks, potholes, and frost heaves.



The department is currently developing the 2016 Alaska Pavement Report, at the time of this publication the report was not yet available.

Operations and Maintenance

Maintaining roadways in Alaska is very challenging due to many factors that are not commonly experienced in many other states. Extreme weather conditions, with temperature that range from -60° in winter to 100°F in summer, areas where snow can average over 200" per year that are prone to avalanches, and temperate rainforest locations that average over 150" of rain per year, create conditions that are ripe for pavement ware. From October through April it is legal for drivers to use tires with studs for traction in snowy and icy conditions. The use of studs causes rutting, which are a longitudinal grooves along the wheel path, over a period of time, which significantly decreases the life of the pavement and the ride quality. Many roadways in middle and northern Alaska are built on permafrost, which is a thin layer of soil over several feet of ice. With the average temperatures across Alaska on the increase, this is causing the melting of permafrost, which causes roadbeds in these areas to fail. The melting and freezing of permafrost and subsurface water cause and effect called "Frost-Heaving" which is characteristic of large vertical deviations, bumps and dips, which can be very dangerous for drivers and cause very poor ride quality. Many of Alaska's highways are in remote locations that are hundreds of miles from the nearest cities which make them difficult to access by maintenance and construction crews. These factors combined make each road mile in Alaska significantly more expensive to construct and maintain in comparison to a road mile in most other states. With significant budget cuts planned at the state level it will become increasingly difficult to maintain rural roads.

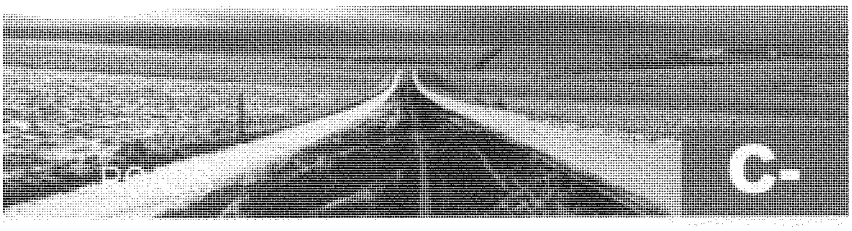
Public Safety

The AK DOT&PF has adopted the Alaska Strategic Highway Safety Plan (SHSP) which involves a multi-disciplinary approach to improving public safety on state roadways: Engineering, Education, Enforcement, and Emergency Medical Services. The goal of the plan titled *move Toward Zero Deaths*, is to significantly reduce roadway fatalities by half by 2030 and eventually eliminate roadway fatalities.

In an analysis performed in 2013 of the SHSP it has been noted that Alaska has achieved improvements in public safety on highways, but there still remains room for improvement. The three-year average of fatalities on highways were consistently on the decline until 2013. Since 2013 there has been a 40% increase in fatalities. The three-year average of serious injuries has risen which does not meet the 3.1% reduction per year desired in the plan.

In order to achieve reductions in fatalities and improve on reductions in serious injuries the department is focusing on three areas of emphasis with strategic initiatives to ensure targets are met.

Driver Behavior



1. Strengthen enforcement programs related to driving violations.
2. Improve the prosecution and adjudication of all driver violations.
3. Educate drivers to be responsible.

Roadways

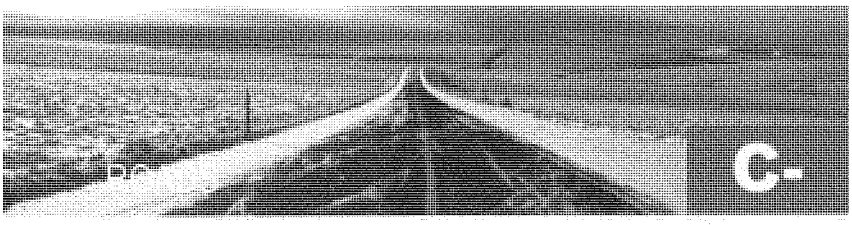
1. Implement education/awareness programs to enhance roadway safety.
2. Implement engineering programs to enhance roadway safety.
3. Implement improvements to EMS to enhance roadway safety.
4. Utilize data and electronic information programs to enhance roadway safety.
5. Implement HSIP-qualified strategies.

Special Users

1. Implement education/awareness practices to enhance bicycle, pedestrian, motorcyclist, and OHV safety.
2. Implement engineering programs to enhance bicycle, pedestrian, motorcyclist, and OHV safety.
3. Implement evaluation programs to enhance bicycle, pedestrian, motorcyclist, and OHV safety.

Funding

According the Statewide Long-Range Transportation plan, the DOT&PF does not currently have sufficient funding in order to preserve the existing transportation and for future development. Without an increase in state revenue, funding in not expected to increase in the near term due to sustained low oil prices. The State of Alaska experienced a $3 billion budget deficit in 2016, which has been referred to as Alaska's worst economic recession since the 1980's. The budget deficit has triggered law makers to make significant cuts to state programs, including reducing budgets maintenance and operations for the DOT&PF. In June 2016 Governor Walker vetoed $250 million in highway construction spending, which put a pause on 8 highway projects around the state. In December, 2015 the Fixing America's Transportation Infrastructure (F.A.S.T.) Act was signed into law, which allocated $2.6 billion to Alaska for highway preservation and improvement projects. The F.A.S.T. act is expected add nearly $555.3 million per year in highway spending through 2020 which will offset a portion of the significant cuts that are being planned at the state level.



Innovation

In 2009 the AK DOT&PF released its *iways* architecture, which is an innovative plan to improve efficiency, safety, and reliability of the state's transportation system by implementing Intelligent Transportation System (ITS) technologies. The department has been implementing projects throughout the state which include advanced communication, information processing, and computer hardware and software. These projects include 511 Traveler Information, Automated Vehicle Identification (AVI), Roadway Weather Information System (RWIS), and Traffic Signal Electronics Modernization. The current draft of the Statewide Long Range Transportation Plan includes policies that will continue support of the iways architecture in order to continue to use and implement new technologies that will improve efficiency and effectiveness.

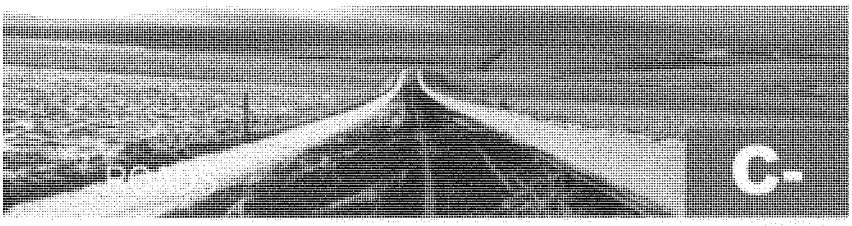
Resilience

A limited study was conducted by FHWA in 2016 regarding Alaska's resilience to climate change, which highlighted case studies of three events that resulted in infrastructure damage which was linked to a changing climate. The study concluded that in many areas, due to sparse population, cost cannot be considered into the traditional benefit-cost analyses and broader factors of concern need to be taken into account to reflect appropriate response measures.

The current draft of the AK DOT&PF's Long Range Transportation Plan (LRTP) includes a risk-based analysis of trends affecting transportation system performance, which highlight climate change, earthquakes, natural disasters, and extreme weather events as having a high likelihood of affecting transportation infrastructure and increasing cost in the future. The plan includes policies that take these events into consideration in the project development phase in order to improve system resiliency.

Let's Raise the Grade

- Replace substandard roadways with pavement sections and materials that are more resilient to the extreme conditions.
- Construct new roadways with service life of the road as a priority, utilizing non-frost susceptible soils and strong pavements that can withstand the ware from the use of studded tires, frost heave, and melting tundra.
- **Focus a portion of funding toward projects that will ease congestion issues in the areas of the state that experience poor Level of Service.**
- **Continue to support efforts to improve public safety by minimizing roadway fatalities and injuries.**
- **Continue funding and implementation of innovative transportation infrastructure.**



Find Out More

- http://dot.alaska.gov/stwddes/desmaterials/assets/pdf/pavement_report_2013.pdf
- http://dot.alaska.gov/iways/documents/iways-SummRpt.pdf
- http://dot.alaska.gov/stwdplng/areaplans/2030/assets/SWLRTPPfinal022908.pdf
- http://dot.alaska.gov/stwdplng/areaplans/lrtpp2014/docs/20160907_LRTP_policyplan_draft.pdf
- http://dot.alaska.gov/stwdplng/shsp/assets/2013_SHSP_Revision_Final.pdf
- https://www.fhwa.dot.gov/fastact/estfy20162020apports.pdf
- https://www.fhwa.dot.gov/environment/climate_change/adaptation/resilience_pilots/2013-2015_pilots/alaska/fhwahep16088.pdf
- https://www.muni.org/Departments/OCPD/Planning/AMATS/Documents/CMP/2016/CMPFINAL_3316.pdf

What You Should Know about the Alaska Marine Highway System

The Alaska Marine Highway System (AMHS) is the state's publicly owned ferry system. As is typical throughout Alaska, highway access is unavailable to most Southcoast communities, many of which are on islands or in remote areas where roads are not feasible. These coastal communities therefore rely heavily on the AMHS for travel and to transport goods. This critical infrastructure system currently consists of 11 vessels connecting 33 Alaskan and two non-Alaskan communities through scheduled ferry service. From the southern terminus in Bellingham, WA the AMHS stretches more than 3,500 miles to Unalaska/Dutch Harbor[ii]. Overall, the AMHS generates about 1,700 direct and indirect employment jobs. The AMHS is a cohesive system of vessels and dedicated staff that provide essential connectivity in our state It also includes all the terminal facilities that allow passengers, their vehicles and cargo to load and offload. The AMHS was designated as a National Scenic Byway by United States Department of Transportation in 2002, and earned the distinction as an All-American Road in 2005.[iii]

Capacity

AMHS passenger traffic has averaged 320,000 passengers over the last ten years. Over the same period vehicle traffic has averaged 106,400 vehicles per year. AMHS also plays an important role in freight transport, where goods such as perishable food, seafood, vehicles, trailers and all-terrain vehicles are shipped in tractor trailer vans, allowing customers to take delivery of their new car etc. in their home community.

The table below shows the individual capacities of each vessel in the AMHS fleet.

Table 1. AMHS Vessels

	Year Built	Passenger Capacity	Vehicle Capacity (20-feet)	# of Staterooms
Matanuska	1963	499	88	106
Malaspina	1963	499	88	72
Taku	1963	370	69	40
Tustemena	1964	174	36	24
Columbia	1974	600	134	103
Leconte	1974	247	34	-
Aurora	1977	300	34	-
Kennicott	1998	499	80	109
Lituya	2004	149	18	-
Fairweather	2004	250	36	-
Chenega	2005	250	36	-

Source: AMHS.

The Alaska Department of Transportation and Public Facilities (ADOT&PF) prepares an Annual Traffic Volume Report each year. This report provides a wealth of information about the historical usage for each segment in the AMHS. One of the sections in this report is called "Link Volume Summary." This section compares the overall capacity to the usage and allow AMHS to best deploy their vessels based on demand, but also gives a good insight into the level of utilization[iv]. A review of the reports for 2010 – 2015 show that as a system on average, the usage is between 24 – 31% of capacity for passengers and 57 – 62% of capacity for vehicles.

There are three categories of vessels in AMHS: Mainline Ferries, Day Ferries, and Shuttle or Fast Ferries[v]. The Mainline Ferries all have the amenities needed for passengers who may be onboard overnight or for multiple days. Cabins are available for rent and cafes and restaurants offer food for purchase. Not surprisingly, stateroom utilization is much higher on longer journeys. The Chignik – Kodiak link shows a cabin utilization of 92% during 2015[vi]. Judging by the last ten years' traffic levels, it appears that AMHS does have the capacity for current and likely future demands.

Condition,

The Department of Transportation and Public Facilities own 11 vessels. Two of them, TAKU and CHENEGA, are in non-operational status due to budget reductions. One of them, TAKU, is in the process of being sold while CHENEGA is in long term unmanned layup. With five of the nine operating vessels being 40 years old or older, and three of those vessels being over 50 years oldvii, the AMHS is operating with an older fleet that is nearing its life expectancy. In the latest approved Long Range Transportation Plan (LRTP) from 2008 it was noted:

> The fleet survey report assumes the vessel life expectancy at 64 years and that the vessels need to be repowered at mid-life, about 32 years. As the vessels get older, ADOT&PF estimates that the maintenance costs will increase significantly. ADOT&PF staff also believes that the 64 year life expectancy is optimistic and is heavily dependent of operating conditionsviii.

The LRTP is being updated and in its draft form it also points to the aging fleet as one of the challenges AMHS is facingix. An aging fleet requires significant investment for maintenance. To combat costs associated with maintaining old vessels, new vessels (e.g., the Alaska Class Ferries) are being designed and built. The new vessels will have smaller crews and may have better fuel efficiency. Two vessels are scheduled for delivery in 2018, both will have capacity for 300 passengers and 53 vehicles. These vessels are intended for day-traffic, on shorter routes where the ferry returns to the point of origination the same day. The vessels TAKU and CHENEGA, listed above, was removed from service in 2015 due to lack of funding for overhaul necessary to keep the vessel in good operational condition.

ADOT&PF documents the condition of the ferry terminals and marine facilities used by the Alaska Marine Highway System in all of its ports of call. The ownership and configuration of shore side facilities at each of these communities vary from community to community. Owners include the State of Alaska, Bellingham Port Authority, the Prince Rupert Port Authority, various city owned wharves, and privately owned fish processing docks. Common for all 42 separate berthing facilities in these 37 communities is that above water components are inspected biennially, and under water inspections are performed on a five-year cycle. The inspection results are included in the annually updated Shore Facilities Condition Survey Reportx. In addition to using the shore facilities condition survey report as a facilities condition inventory, it is also used to identify capital project needs for each shore facility and their system wide respective priorities.

Operation and Maintenance

AMHS provides year-round and seasonally scheduled ferry service. The schedule varies from year to year, depending on available funding and operation budgets. Based on available funding ADOT&PF prepares an operations schedule to best meet the essential needs for community service. With portions of the fleet being close to the end of their anticipated service life, maintenance costs are likely to increase significantly over the next several

years. The draft Long Range Transportation Plan[xi] identifies operating and maintenance as one of the challenges that the AMHS is currently facing. Both labor and fuel costs have grown over recent years. In 2014 and 2015, fuel accounted for 20% and 18% respectively of overall operating costs. The three largest cost groups for operations and maintenance (O&M) are Marine vessel operations (which includes payroll) at close to 70%, Fuel at about 17-18%, and Shore Operations at about 5% of overall O&M expenditures. In 2008, ADOT&PF anticipated an average annual need of $120M for O&M[xii]. In review of the financial reports of fiscal years 2009-2015[xiii] we can see that the actual numbers have ranged between $122M in FY10 and $152M in 2013. This range represent the amount provided by state legislators in appropriations. Rather than being the representation of the actual O&M need, expenditures are the result of operations planning to utilize the budgeted funds to the greatest utility for the community. The financial reports alone are therefore not a good measurement of the actual trends of Operations and Maintenance costs. Maybe a better indicator of the challenges AMHS is facing for O&M is the fact that MV TAKU and CHENEGA were taken out of service due to lacking funding for scheduled overhaul of the vessel. If we study fare-box recovery rates, we can see that the cost recovery has gone from about 50% in 2004 to just over 30% in 2015. This illustrates maybe the greatest challenge for AMHS: How to contain operating costs while maximizing revenue generation.

Funding

In a sense the AMHS is an extension of the National Highway System, providing travel routes to reach remote communities in Alaska. The funding mechanisms are very different; while the National Highway System initially was self-funded through user fees, and is operated as a service we all need as the backbone of our nation's economy, the AMHS is run as an enterprise fund, relying on the Alaska Legislature to appropriate general funds to make up for the short fall in revenue vs. expenditure to operate the system.

AMHS spent $84.0 million in Alaska in 2014 counting operations ($45.7 million) and capital ($38.2 million) expenditures, and an additional $100.7 million in payroll expenditures[xiv]. If we place those expenditures alongside the operating revenues, which in 2015 were $53.9 million[xv], we can see that the state needs to appropriate more than $100 million annually. However, current fiscal challenges may result in significant budget cuts, which will result in challenges for operations and maintenance. Budget cuts for FY 2015 resulted in the removal of MV TAKU and CHENEGA from service, as capital funding for necessary overhaul was eliminated from the budget[xvi].

Historically fare-box recovery rates were around 50% until 2005, when the fleet was increased from 9 to 11 vessels. The fare-box recovery shows a slowly declining trend over the last ten years[xvii] The State has commissioned fare studies in that were completed in 2008 and 2015. The 2008 rate study had to reach outside USA to identify comparable ferry systems. The study found that AMHS has a lower fare-box recovery rate than other similar

systems. But studies also show that some of the routes have a much better recovery rate than others. The recommendation from the 2008 study was that fares should first be normalized based on common utility, such as nautical miles travelled[xviii]. The Tariff study prepared in 2015 found that tariffs have not changed since the latest increase in 2007, meanwhile the cost to operate has increased by 33%. Alternative freight and cargo rates have meanwhile increased by as much as 236 percent per nautical mile[xix].

Future needs

The current funding situation presents several challenges for the AMHS. In their community engagement presentation, the following opportunities were presented on how to better prepare for a leaner future:

- Promote AMHS as an important part of Alaska's transportation system – serves much more than SE and SW Alaska
- Maintain core services to all 33 Alaskan ports, Prince Rupert, and Bellingham
- Budget Constraints – minimize impact to Alaskans
- New reservations system to improve customer service
- Continue finding efficiencies and reducing costs to maintain service
- Retire excess vessels ... Reduce fleet and/or reduce routes
- New vessels: Two Alaska Class, Tustumena replacement
- Dock modifications
- Revisit Southeast Alaska Transportation Plan
- Economic Impact Study update

In addition to the two new vessels entering service in 2018, the four oldest vessels in the fleet need to be replaced over the next twelve years. The 2008 transportation plan identified this need to be a total of $600M[xx], in addition to this capital investment in new vessels ADOT&PF also anticipates an average annual cost of $23M for vessel refurbishment and recertification. In the Shore facilities report from 2015 the need for capital improvements to Ferry Terminals and Docks was totaled to be $92.4M[xxi].

Approved capital investments for the next 5 years can be found in the Alaska Statewide Transportation Improvement Program[xxii]. The list of projects includes Ferry Terminal Modifications in Gustavus, Haines, Auke Bay, Skagway, and Tenakee, shore facility and vessel condition surveys, ferry refurbishments, construction of new ferries, and upgrades to the sewage systems at several terminals. These capital improvement needs total close to $500M.

Public Safety

In the 2012 system analysis several goals were set for the AMHS, including to increase the Transportation System Safety through implementation of improvements in marine navigation systems, and to support safety inspections of marine vessels. These goals are measurable as accident rates per 100,000 people per transportation mode, the frequency of incidents that interrupt inter-community travel, and frequency of opportunities for isolated community residents to travel to health care providers[xxiii].

Resilience

Resilience can be measured in the ability to respond to the failure of one or more components such as a vessel needing to be taken out of service unexpectedly. Only two years ago, the combination of various vessels in the AMHS allow for dispatching changes to cover the absence of any vessel at any time. With fewer operational vessels (9 vs. 11), this is no longer always the case causing gaps in service when vessels need to be taken out of revenue service for maintenance or due to mechanical breakdowns. Typically, vessel overhauls are scheduled during the off season, where one vessel is taken out of service at a time, while still providing service to the coastal communities.

Innovation

AMHS adheres to environmental standards set by the International Maritime Organization, U.S. Environmental Protection Agency, and State of Alaska Department of Environmental Conservation. In addition, AMHS is a member of the Green WATERS Program, a voluntary program aimed toward reducing waste and operating in a cleaner, greener, and more sustainable environment. The AMHS Ship to Shore Environmental Guide was designed to provide employees with the tools to respond to environmental concerns quickly and efficiently. AMHS also uses best practices and cost-effective technologies that not only protect the environment but maintain a high quality of life for Alaska residents, such as:

- Fueling with ultra-low sulfur diesel
- Using environmentally acceptable lubricants
- New program to streamline hazardous waste
- Using technology to reduce paper waste
- Recycling plastic and paper products

Key Marine Highway Facts

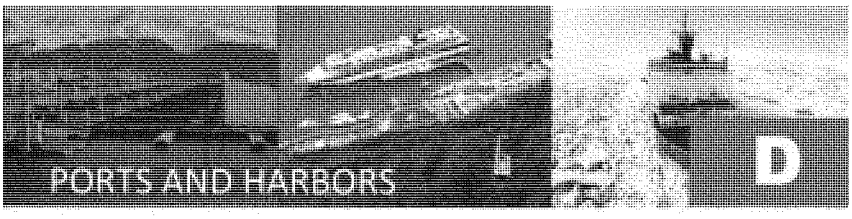
- The total economic impact of AMHS results in **1,700 jobs** and an estimated **$273 million** in direct and indirect spending.
- **In 2015, AMHS served 288,133 passengers and 100,547 vehicles per year, 2/3rds of which are Alaska Residents.**
- Alaska has **6,640 miles** of coastline, and the AMHS serves 33 communities using 11 vessels.
- Every dollar of General Fund money budgeted to AMHS generates **$2.30** economic activity in Alaska.
- Fewer ferries and more downtime will result in increased cost of goods which will **significantly increase the cost of living** in coastal communities.

Let's Raise the Grade

- **Plan and budget for adequate annual maintenance to minimize the amount of vessel downtime.**
- **Continue to seek operational efficiency improvements in order to decrease the cost of vessel and shore side operations.**
- **Provide a one-time increase in the funding in the Marine Highway System Fund to allow the system to have time and resources to accommodate annual changes in funding support.**
- **Develop a long-range strategic plan for the operations of the Marine Highway System to direct business decisions regarding scheduling and vessel usage.**
- **Develop a long-range vessel repair and replacement plan to make sure that the vessels are operating at peak efficiency.**
- **Implement strategies to increase ridership including consideration of commercial carriers and visitor use.**

Find Out More

- The Economic Impacts of the Alaska Marine Highway System (http://www.dot.state.ak.us/amhs/doc/reports/econ_15.pdf)
- 2015 Annual Traffic Volume Report. Alaska Marine Highway System
- Alaska Marine Highway System Analysis
- Shore Facilities Condition Survey (http://dot.alaska.gov/project_info/AMHS_Shore_Fac_Report.shtml)



What you need to know about Alaska's Ports and Harbors

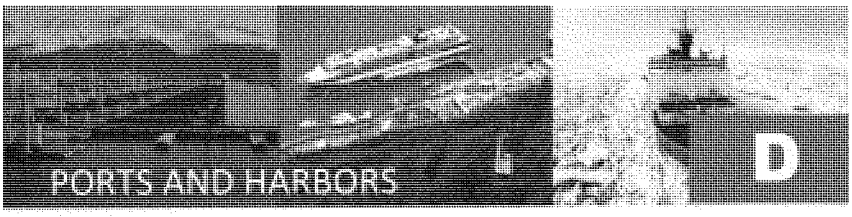
Ports & harbors across Alaska provide services that support critical economic activities. These facilities play a vital role in the communities they serve by providing local employment opportunities, promoting economic diversification and meeting cultural and subsistence lifestyles. In 2015, $28B and 40.8 million tons of goods were moved via marine transport out of state; and, $4.8B and 3.4 million tons of goods into the state via marine transport. Ports & harbors ensure a thriving commercial fishing industry exist with over $1.7B of fish product landed in Alaska in 2014, including six of the top ten fishing ports by volume in the US. Tourism plays a significant role in several communities with over 1 million passengers arriving via cruise ships in 2016. Other harbors rely on summer independent travelers who use facilities for recreational or charter fishing and mooring floats necessary to attract yacht cruisers.

Capacity

Alaska possesses 33,000 miles of coastline, more than the combined shoreline of the continental U.S., yet there are only 125 ports & harbors within the state. Alaska is dependent upon resource extraction, including fisheries, but lacks infrastructure to support vessels operating in Alaska. As a result, there is $5B lost revenue opportunity to the Seattle port & harbors infrastructure. Recent infrastructure improvement to cruise ship docks in Southeast Alaska has enhanced the capacity to moor neo-panamax size cruise ships at ports supporting tourism. The largest ports by volume include Valdez (Trans-Alaskan Pipeline terminus), Nikiski (oil refinery), Anchorage (consumer products) and Kivalina (Red Dog Mine) which currently maintain their respective facility capacity to meet export demands. The Port of Anchorage has the capacity to receive necessary goods and products required for the largest population centers.

Condition

The condition of the ports and harbors across the state vary greatly. Ports and harbors that can leverage funding through State matching grants or have access to cruise ship "head taxes" have the potential to maintain, upgrade or replace. Often, however, funding can be limited and repairs limited to "band-aid" fixes. For example: The Port of Anchorage dock facility has exceeded its useful life and severe piling corrosion threatens to impact port operations serving 74% of the Alaskan population, including military facilities of national significance. It requires an estimated $400 million to accomplish replacement and modernization of the facility. To date only a quarter of the funding needed has been secured. Engineering studies show that Port of Anchorage docks are severely corroded and its wharf piles have been classified as being in poor condition since 2000. Anchorage currently budgets more than $5 million annually to maintain operational capacity of existing wharf piles and other aging Port



infrastructure, but this work does little to enhance the facility's earthquake survivability. This situation imperils Alaska's economy because the State does not have cargo import capacity or infrastructure that could adequately substitute for the Port of Anchorage if it is significantly damaged by an earthquake or other disaster.

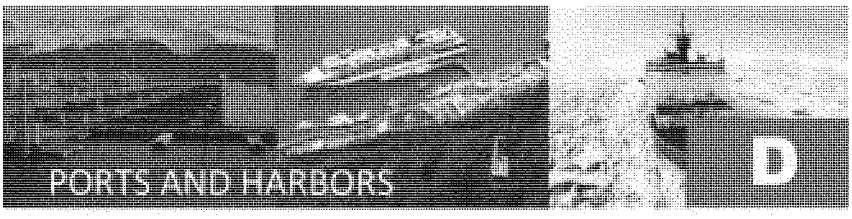
Operations & Maintenance

The majority of harbors, constructed circa statehood in 1959 and were maintained by the state until 2000, when Alaska Department of Transportation began program of divesture to local municipalities. This has resulted in operations and maintenance inconsistency throughout the municipal harbors and the 24 state managed harbors. This is primarily due to municipalities possessing varying levels of resources (both financial & human capital) to maintain their respective infrastructure. Several port and harbor facilities (Anchorage, Homer, and Nome) are dredged annually to ensure navigability and access to key communities and are typically funded at the federal level. However, after several decades, there remain numerous harbors requiring maintenance dredging to which funding has yet to be prioritized.

Funding

There exists in excess of $100M in recapitalization needs for the Alaska small boat harbors alone. The vast majority of harbors are maintained by the local municipalities with limited funding available from the state level. Additionally, waning state grant opportunities have challenged ports and harbors to conduct major preventative maintenance and to reconstruct facilities which are past their useful life. Many of the small boat harbors support subsistence lifestyles and thus are unable to collect sufficient fees to maintain or rebuild aging infrastructure. Small boat harbors, which cater to a cash economy, must generate sufficient revenue during the short Alaskan boating seasons, typically May through August. In 2006, the Alaska DOT established a 50%-50% matching grant program allowing for reconstruction of small boat harbors; however, the program has only fully funded all applicants twice. The ability for harbors to generate sufficient fund balances and the state's ability to continue to fund the program severely jeopardizes harbor reinvestment opportunities. A survey conducted of all Alaska harbormasters resulted in funding being the most significant challenge in providing services to maintain and recapitalize aging infrastructure.

Ports accommodating cruise ships have access to additional funding through the Commercial Passenger Vessel Excise Tax (CPV). The CPV is collected by the state which redistributes a portion of the tax collected to the cities and boroughs in which cruise ships make port calls.



Future Needs

Alaska lacks deep water Arctic ports. An emerging Arctic Ocean poses both opportunity and risk for trans-shipment, destinational shipment and future resource extraction requirements along coastal Alaska. Enhancing port infrastructure – including deep-draft port facilities currently unavailable north of Unalaska/Dutch Harbor – would meet the State's goal of encouraging economic development in remote areas. It would provide local and regional economic development opportunities (resource extraction, tourism, and research); decrease Arctic region operating costs; provide protected dockage to support offshore oil and gas endeavors, fishing fleet, and resource extraction vessels; and provide vessel repair and maintenance support as well as facilities for emergency response and assistance vessels. It would improve international relationships and increase U.S. exports, optimize the aforementioned benefits while preserving natural resources; raise awareness of U.S. as an Arctic nation; and provide upland support to vessels operating in the region (fuel, water, electricity, food, medical, and storage, laydown/staging for resource extraction).

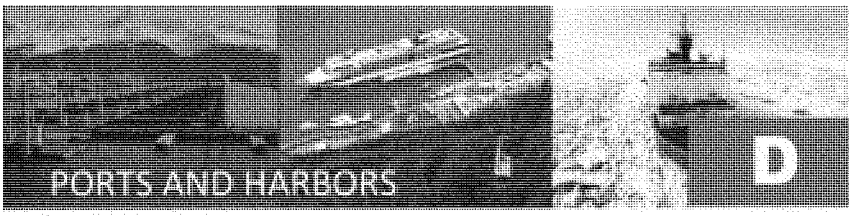
Public Safety

Alaskan ports and harbors are experiencing challenges with abandoned and derelict vessels many, which are from WWII-era and wooden. Alaska ports & harbors face risk associated with removal and disposal from irresponsible owners. The distances between harbors and reliance on water transportation for access for emergency and freight services necessitates safe, secure and accessible ports and harbors. In 2012, the Port of Nome was unable to secure barge deliveries of heating and transportation fuels before the sea-ice made the harbor inaccessible resulting in an historic operation requiring a U.S. Coast Guard icebreaker and Russian ice-strengthen tanker to deliver fuel in mid-winter.

Resilience

The Port of Anchorage sees 85 percent of the consumer goods for Alaska. The Port of Anchorage is in an active seismic zone and has experienced the highest recorded earthquake in North America; seismic activity could result in a supply interruption thereby paralyzing much of Alaska, including strategic military facilities. In addition, a significant number of other Alaskan ports & harbors are not connected to the terrestrial road system. This increases dependency upon marine transportation hubs but also exposes the communities to risks associated with coastal erosion, weather impacts or natural disasters which disrupt logistical supply chains.

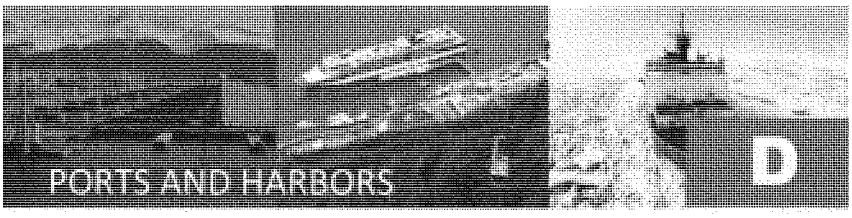
Innovation



The goal is to build facilities that last longer, are more environmentally friendly and meet user needs well into the future. Alaska has some of the greatest tidal ranges in the world, most of the new cruise ship berths recently constructed utilize floating "pontoon system" to embark and disembark passengers which enhance the safety and efficiency of large passenger vessels. Several ports which have cruise ships embarking have successfully leveraged the use of state Commercial Passenger Vessel Excise Tax for building infrastructure which improves safety and efficiency for the cruise ships and its passengers.

Recommendations

1. With limited opportunities to fund port and harbor recapitalization projects at the federal level, it is imperative that the State of Alaska prioritize legislative grant appropriations and matching harbor grant opportunities to the maximum extent allowable. Without safe and efficient access to ports and the ocean, the main regional economic driver in many of our communities is gone.
2. The Port of Anchorage is in desperate need of capital infusion to rebuild aging infrastructure and construct resilient facilities which provides 85% of all consumer goods to three-quarters of the state's population. Funding $300M through State legislative appropriations or bonds are necessary to realize the port needs in Alaska's largest city.
3. Several federal waterways are maintained the US Army Corps of Engineers through dredging and breakwaters projects within Alaska. Annual dredging at ports such as Dillingham and Ninilchik are necessary to maintain economic vitality for their rural regions. Other Army Corps projects include dredging on a 10-year cycle for the Cook Inlet Navigation Channel, Bethel, Ketchikan and Seward. The recent 2017 passage of the Waterways Infrastructure Improvement for the Nation (WIIN) Act will positively impact Alaska harbors directly by permanently requiring 10% of the annual Harbor Maintenance Trust Fund be directed to emerging ports, which move less than one million tons of commercial cargo across the docks. The WIIN Act will also provide funding to the Small, Remote, Subsistence Harbors program which will greatly benefit Alaska's waterways; however, this program requires and merits federal appropriation on an annual basis. This program was made permanent in the last WRDA bill giving Alaskan ports and harbors access to a consistent stream of funding in keeping navigation channels open and our jetties repaired.
4. That the State of Alaska and the federal government work in concert to develop the necessary infrastructure and governance to meet the economic opportunity which a Deep Draft Arctic Port provides to this Nation.



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What You Should Know about Alaska's Solid Waste

Alaska, the largest state in the Union covers 663,300 square miles, has 33,000 miles of coastline but only around 13,000 miles of road. This vast expanse makes dealing with solid waste challenging. The road system connects around 100 of the over 375 communities in Alaska which means collecting waste from Alaska's outermost communities has to be done either by air, sea, or left in the community. Alaska's extreme weather, permafrost, small population, and high costs combine to make dealing with solid waste a unique and challenging problem. The Alaska Department of Environmental Conservation (ADEC) has three classifications for landfills:

- Class I (Large) >20 ton per day 9 Facilities serving ~594,000 people
- Class II (Medium) 5-20 ton per day 14 Facilities serving ~60,000 people
- Class III (Small Remote) <5 ton per day 184 Facilities serving ~84,000 people

Class II & III Landfills

Alaska remains the only state operating Class III landfills. Class III landfills are not connected by road to a larger landfill or are more than 50 miles by road from a larger landfill and serve less than 1,500 people. Alaska was granted primacy over federal regulations given the unique challenges faced. An estimated 95% of rural Alaska communities use open waste disposal sites. Depending on the geological conditions present in each community, these landfills range from shallow trenches to pads on permafrost. Many of these dumps and landfills lie close to groundwater and within the boundaries of the communities. Over the years the waste stream has dramatically changed in rural Alaska from primarily organic waste to plastics, electronics and hazardous materials. These items require additional landfill space and have increased pollution potential if not disposed of correctly.

While Class II and III landfills play an important role in Alaska's solid waste infrastructure, for the purposes of this infrastructure report ranking they were excluded from the scoring. This is due to the complexity of the issues involved with them, the differences between communities, the differences between regulations, and the lack of regulation and monitoring at these sites. This report is solely ranked by surveys done on the Class I landfills, which serve 80% of Alaska's population. There are numerous studies and reports that discuss the challenges faced with Class II and III landfills; several of these are listed in the resources at the end of this section. This report is intended to serve as a basis for solid waste infrastructure rating in Alaska for Class I landfills. Class II and III landfills should be included in the statewide score in the future. The inclusion of these landfills will likely lower the infrastructure grade significantly due to the myriad of challenges faced in rural Alaska.

Class I Landfills

Class I landfills are the largest and most regulated landfills found in Alaska. They receive more than 20 tons of waste per day for disposal.

Class I landfills are required to prevent leachate from leaving the landfill by means of a composite liner system. Leachate is water that percolates through the waste and leaches out the constituents. Additionally, the landfill must be designed to have no more than 12 inches of leachate on the liner at any one time. This requires leachate to be actively managed and disposed of. Several landfills in Alaska treat leachate in a wastewater treatment plant, others re-inject leachate back into their landfill. The Central Peninsula Landfill disposes of leachate by an innovative leachate evaporation system.

Class I landfills waste disposal leads to decomposition and other reactions in the waste that generates a significant amount of landfill gas. Landfill gas is usually composed of mostly methane which is a hazardous greenhouse gas. To minimize leachate generation and control landfill gasses after the landfill has reached its final capacity, Class I landfills are required to be capped by a liner system that is as impermeable as the bottom liner system. Class I landfills are also required to monitor, record, and manage environmental impacts to groundwater and air quality during operation and a minimum of 30 years after the landfill has been closed.

Waste Backhaul

Waste backhaul refers to the practice of shipping waste out of the community. Backhaul in Alaska is usually referring to shipping out hazardous waste or recyclable material, however several communities in southeast Alaska also ship out municipal solid waste. Shipping waste in southeast Alaska is accomplished by loading the waste into containers which are shipped to a lined landfill in eastern Washington. Backhauling waste in southeast Alaska is principally implemented because of the high rainfall the region receives would make leachate management difficult and costly. Other backhaul practices in Alaska includes Class I landfills shipping out hazardous waste because they are not permitted to dispose of some types of waste.

Capacity

Class I landfills in Alaska typically have a capacity of 1-50 years for existing lined areas. The Anchorage Regional Landfill was built in 1988 and has capacity through 2050. Most Class I landfills within Alaska have been built within the last 20-30 years, and most sites have additional room and plans to expand when needed. Surveys received from landfill operators show that the typical Class I landfill has a total life of 20-60 years including all additional space for future expansions. Lined landfills try to minimize the amount of lined area ready to receive waste for two reasons. The first is cost, as it would be prohibitively expensive to develop the entire landfill site at one time. To spread the cost throughout the life of the landfill, landfills are typically developed in stages or "cells". The other reason landfills minimize the lined area is leachate. Because the bottom of the Class I landfills have impermeable liners, leachate collects and must be properly treated and disposed of for a cost. To minimize the amount of leachate produced, landfills only develop additional lined cells as needed.

Recycling efforts in Alaska divert a small amount of waste from landfills. However, much of the recyclable material is shipped out of state to be processed.

Condition

Evaluation of the condition of Class I landfills in Alaska was based on survey questionnaires and ADEC yearly scores. Class II and III landfills were not evaluated in this score. Transfer stations were not evaluated for scoring. No critical issues were seen with Class I landfills in the state of Alaska. A minor issue seen with landfills in the state of Alaska includes proper planning documents to ensure funding is adequate for future growth and keeping up on the condition of current infrastructure. A unique issue seen in Alaska due to lack of infrastructure present is the Anchorage Regional Landfill hauls leachate by means of trucking to ensure proper disposal to the Anchorage Water and Waste Water Utility sewer system. To improve the condition of the leachate disposal system the Anchorage Regional Landfill is currently evaluating options such as direct piping installation to remove issues that arise from hauling leachate. This would help limit the landfill's carbon footprint.

Operations and Maintenance

Operation and maintenance needs vary significantly within the state of Alaska. Funding sources for operation and maintenance varied in its source making the landfills that meet their operation and funding needs non-consistent. Sources of funding varied from property taxes, to commercial users, to rate based individual users paying monthly bills for solid waste service. Larger communities seem to be able to handle their operation and maintenance needs on a more consistent basis due to the funding available and backup pieces' of equipment being available for maintenance emergencies.

One unique issue seen in Alaska solid waste operations is self-haul (when the public delivers their own waste to the landfill) versus collection services. This balance varies greatly depending on the location of the landfill within the state. For example, the Anchorage Regional Landfill has only 15 percent of the collection being self-haul while in Unalaska the self-haul rate was 80 percent.

Another unique operations item in Alaska is snow removal and keeping frozen material from being used as daily cover in winter conditions. Large snow removal equipment along with equipment sized to dig through frozen soil conditions are necessary for the landfill to operate correctly.

Funding

Class I landfills in Alaska are receiving adequate funding on average. Rate increases are often incorporated into long term planning to account for current and future funding needs. However, due to state and federal funding shortfalls, improvements and expansions to facilities can result in sharp increases in residential rates which can be impractical for residents.

Although not included in scoring, many Class II and III landfills in rural Alaska lack adequate funding for operations and maintenance as well as capacity. The cost of construction intensifies the existing funding issues in rural Alaska.

Public Safety

Evaluation of the Health and Safety of Class I landfills in Alaska was based on survey questionnaires. Health and safety issues with Alaska Class I landfills include bird control and landfill gas surface emissions. Due to Alaska's large bird population, balancing the need for bird control while also protecting bird species such as bald eagles is a daily challenge for many landfills across the state.

Landfill gas emissions are also a challenge at some landfills in Alaska. Some surface gas emissions are due to the soil available for daily cover having a low percentage of fine grained particle present in the soil. Steps to correct surface gas emissions in landfills in the state of Alaska include gas well installation and utilizing daily cover material with high fines (when available) to help limit surface gas emissions.

Innovation

Many Class I landfills are incorporating sustainable practices into their business models. Anchorage has established a gas-to-energy project that transfers methane off-gas from the landfill to energy that feeds into the electrical grid. Unalaska is using a green laser system to deter birds from the landfill, which is an innovative solution that is effective at removing birds, as well as incorporating a leachate tank that holds up to five days of landfill leachate before discharging to the wastewater treatment plant. This ensures that leachate is properly treated before being discharged into the ocean, and comes after violations of the Clean Water Act resulted in large fines for the city.

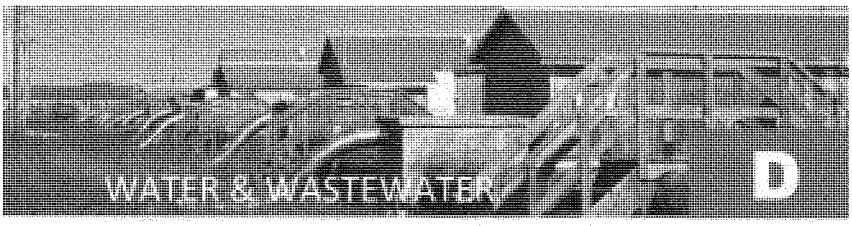
Let's Raise the Grade

- **Make state and federal funding for improvements a priority**
- **Increase investment for long-term planning and capacity**
- **Ensure the sustained sufficiency and reliability of statewide landfill facilities**
- **Continue and grow innovative landfill practices such as energy-to-gas projects and recycling efforts**
- **Incorporate Class II and III landfills into future scoring efforts**
- **Work with rural Alaska to ensure all landfills are permitted and operating safely**

Find Out More

- State of Alaska Solid Waste program - http://dec.alaska.gov/eh/sw/
- http://www.alaskavillagevoices.org/garbage-what-happens-to-it-in-rural-alaska/

- http://www.zendergroup.org/backhaul.html



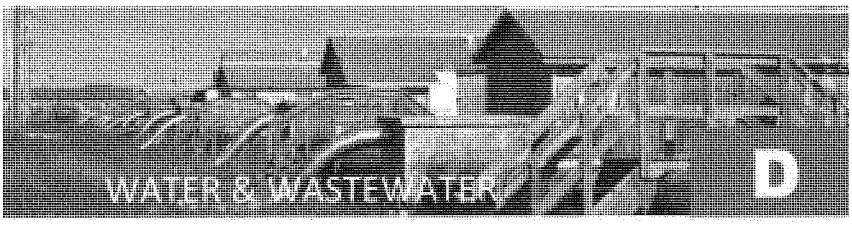
What You Should Know about Alaska's Water and Wastewater

Alaska is the geographically largest state in the union covering 663,000 square miles. With an approximate population of 740,000, that translates to a population density of 1.1 people per square mile, by far the lowest density of any state. Over 75% of Alaskan communities are inaccessible by roads creating a unique environment for water and wastewater services. Because of this, communities operate their own separate water and wastewater utilities, without regional watershed management authorities. Each individual system is responsible for controlling water from the source, through distribution to end users, sewer collection, treatment, and discharge. Because of the end-to-end nature of these systems, this report evaluates water and wastewater systems together. Alaska's water and wastewater systems can be generally divided into two categories; municipal and rural. Municipal systems are typically located in the larger population centers of Southcentral, Interior, and Southeast Alaska such as Anchorage, Fairbanks, Juneau, Ketchikan, etc. These systems are quite similar to municipal water and wastewater system found throughout the rest of the United States, consisting of water treatment, pressurized distribution, wastewater collection via gravity/lift stations, and conventional centralized treatment systems. These systems are operated by a municipal utility and are funded primarily through user fees and/or local taxes, with some receiving state grants for capital upgrades. Although approximately 75% of the Alaska population lives in these larger population areas, an estimated 25% of households within these communities are on private drinking water wells and septic systems. As private well and septic systems fail, they are sometimes unable to be replaced due to proximity issues to neighboring property well and septic systems creating health problems or expensive solutions

There are 280 communities on rural systems most of which are Alaskan Native villages and are only accessible by water or air. Rural systems may include piped systems (both above ground and underground), gravity and vacuum sewer collection systems, individual septic tanks and wells, haul systems (separate house water and sewer tanks), and washeterias (single-point community showers and laundry). Thirty-one of these communities have no available water or wastewater system. Residents in these communities' haul water from rivers, lakes, and ice, surviving on as little as five gallons of water per day per person. Rural systems are often run by tribal governments and are funded mainly through federal grants and programs administered by the state's Village Safe Water (VSW) program or Alaska Native Tribal Health Consortium (ANTHC).

Capacity

Alaska's municipal water and wastewater systems track at or below national averages for percentage of houses served within a community. In rural Alaska, 75 communities in Alaska are considered underserved, meaning 55% or less of homes are served by a piped water and wastewater system, or covered haul system. Thirty-one communities have no access to safe, treated drinking water or safe disposal of wastewater. As a result, Alaska is ranked last among the states and Puerto Rico for percentage of homes with complete water and wastewater services, with 23% of Native Alaskan households and 19% of households below the poverty line lacking complete



household plumbing. Though most communities have an abundance of available water resources, there is a lack of infrastructure to access those resources.

Condition

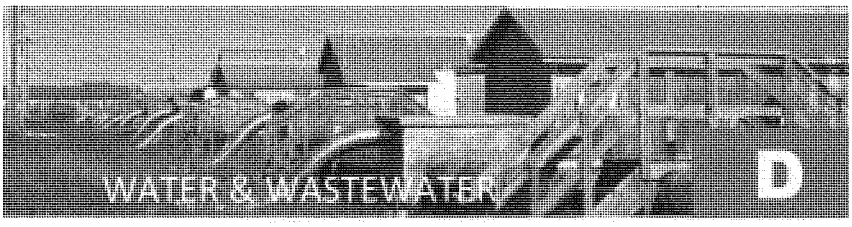
The average water/wastewater system in Alaska is 20 to 30 years old. While most of the larger municipal systems have stayed on top of maintenance, and continue to expand and improve service, there is still room for improvement. The surge of federal funding in the 1970s and 1980s that created most of the systems in rural Alaska did not provide any funding for ongoing maintenance. Across the state many systems have exceeded their design life and are operating on the original community infrastructure.

Additionally, Alaska's extreme weather and environment has taken a toll on infrastructure. Many of the materials and designs implemented during the 70s and 80s had never been used or tested in these conditions. For example, in the 80s much of the water piping was PVC pipe, which becomes very brittle when exposed to freezing temperatures causing breaks and pipe collapse. Further, melting permafrost and frost heaving has damaged manholes and disrupted sewer grades, increasing blockages and freezing. Corrosive soils coupled with the use of cast iron and ductile iron pipe from the 1950s through the 2000s has resulted in many failures of water mains.

Operations and Maintenance

Alaska has some of the highest water/wastewater system operation and maintenance (O&M) costs in the United States. It has the second highest average electric rates and the fourth highest average fuel rates. Rural communities have their own fuel storage and power generation facilities without access to larger grids. Because of this, electric rates in rural communities are often 4 times the national average with some community rates over $1/kW-hr. Fuel prices are equally high with prices ranging from $5 to $10 per gallon. Compounding this is the general isolation of rural communities which increases the price of goods significantly. A lack of local jobs and tax base means rural communities lack the ability to self-fund O&M on their water and sewer systems through fees or taxes. As a result, O&M costs are often subsidized by state or federal sources resulting in significant budget short falls and deferred maintenance.

Alaska also has a lack of certified water and wastewater treatment operators. This issue is compounded in rural communities for a variety of reasons. To combat this, Alaska has developed the Rural Maintenance Worker program in which maintenance workers partner with multiple communities, regularly traveling to communities within their region to do routine maintenance, check operations, and provide training.



Funding

VSW estimates that of 220 villages, they need approximately $565 million in funding for improvements and expansions. The 2016 State budget only funded 9% of total urban grant requests leaving an $81.3 million annual funding deficit. This was a 25% funding drop from 2015. Alaska has a total estimated need of $1.5 billion for water and wastewater systems. Without a focused effort and increased funding, Alaska's water and wastewater systems' dependability will continue to deteriorate resulting in fewer Alaskans having access to clean, sanitary water and wastewater services.

Future Need

There are 106 communities in Alaska that are either underserved or have no water or wastewater systems. In addition, Alaska is projected to have a 20% population increase by 2045. Municipal systems face the challenge of keeping up with an approximately 80% increase over 30 years in Alaska's population centers. If a state natural gas pipe line, or other large development project happens, the population in Alaska could increase at a faster rate. Without focused planning, Alaska will not be able to keep up with the demand placed on water sources, distribution systems, or provide adequate wastewater treatment to meet stringent requirements.

Public Safety

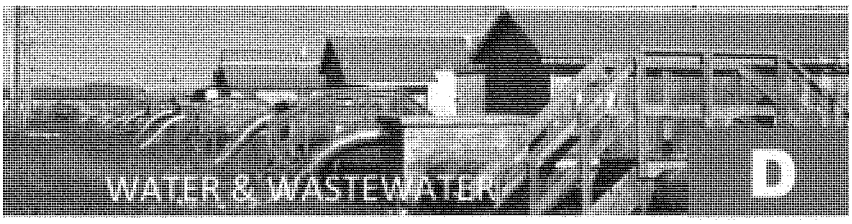
Alaska ranks last in percentage of people with access to water and wastewater services. It is 30 years behind the national average. This effects the health of Alaskan residents with Alaska having some of the highest rates of pneumococcal, respiratory tract, and gastrointestinal infections in the United States.

Resilience

Climate change and melting permafrost are decreasing systems' resiliency. The U.S. Army Corps of Engineers lists 83 communities at risk of significant erosion damage. Most communities are along rivers or coasts with no road access requiring fuel to be shipped by barges. Changing river channels, ice, and flooding restrict fuel deliveries resulting in communities running out of fuel and shutting down water and wastewater systems. In recent years, above ground distribution systems have floated away during flooding events or severe winter weather has frozen water systems solid. The lack of access often means weeks if not months of shutdown.

Innovation

The extreme conditions and remote locations within Alaska necessitate looking for innovations. Alaska's remote communities have incorporated modular and package treatment systems to reduce construction, operation, and maintenance costs. Due to limited access to trained operators, several school districts and native heath corporations has used advanced remote monitoring and control systems. The Lower Kuskokwim School District



operates some of the most remote and challenging systems. For the last 10 years, they have successfully pioneered remote monitoring and control systems in the state. There have been several design programs, like the state's Alaska Water Sewer Challenge, that seek to develop innovations.

Let's Raise the Grade

In order to improve Alaska's Water and Wastewater Infrastructure Grade more Alaskans need to have access to clean, safe, and reliable water systems. Municipal systems need to expand to meet the increased growth rate for the next 30 years. Rural systems need to expand to more communities to serve more Alaskans. Systems need to be designed and constructed to withstand extreme weather and Climate Change. Systems need to increase efficiencies to reduce operational costs due to high fuel costs.

These can be addressed by a combination of the following:

- Make State and Federal funding for improvements a priority
- Better coordinate between State, Federal, and Alaska Native programs
- Perform system evaluations to identify and assess risks and incorporate into planning efforts
- Develop and implement innovated technology and operations
- Focus on durable and sustainable system designs to reduce lifecycle and O&M costs
- Bridge the gap in O&M funding to allow communities to maintain existing infrastructure.

Find Out More

- Rural Alaska Sanitation, "Unserved Community List", 2015.
- Village Safe Water Program, State of Alaska.
- Alaska Water and Sewer Challenge.
- Alaska Municipal Water and Wastewater Capital Projects Lists.
- Anchorage Water and Wastewater Utility.
- Fairbanks Golden Heart Utility.
- City and Borough of Juneau Utility.
- USDA Rural Development, Alaska.
- Alaska Native Villages and Rural Communities Water Grant Program, EPA.
- Barrow Utilities.

Closing comments from the Report Card Committee

The Report Card for Alaska's Infrastructure 2017, is a collaborative effort undertaken by the Alaska Section of the American Society of Civil Engineers (ASCE). This effort was made possible through the hard work of several of our members and also non-members.

Our Infrastructure is all too often taken for granted in our daily lives and we often fail to consider what it takes to ensure the infrastructure is constructed and maintained to meet the needs of our society and future generations.

During 2016 we have reviewed publicly available information on nine of our state's infrastructure systems, often had questions for the infrastructure owner's or our peers. All the time wanting to give an objective overview or our infrastructure we have relied heavily on public knowledge and the professional expertise of our peers and our own knowledge of the infrastructure we work with every day. This report card is the result of that effort.

We hope that this report card will give valuable insight in, and a better understanding of Alaska's Infrastructure.

Our vast and beautiful state offer many unique challenges to those providing the infrastructure necessary for our everyday lives. Our state would not be the great place to live, work and play without our infrastructure. Thank you to all that make that possible.

Through the whole process we have had valuable help, guidance and support from ASCE staff members including Brittney Kohler, Becky Moylan, and Carolyn Sofman; and the ASCE Committee on America's Infrastructure.

We also want to recognize the authors and many that offered their help in the writing of the report card. We sincerely apologize if we have failed to include anyone that helped in this effort. Any such omissions are completely unintentional. The following were the authors of the respective report card sections

Airports. Lead author Tor Anderzen, P.E., M., ASCE, Senior Aviation Engineer at HDL Engineering Consultants. Tor had much help from Rebecca Rauf, C.M. Aviation System Planner and Alexa Greene Western Area Planner at Alaska Department of Transportation and Public Facilities. Ori Miller EIT and engineering student at University of Alaska Fairbanks also provided much needed help with interviews of airport managers, and data gathering.

Bridges. Lead Author Leslie Daugherty, PE, SE, Senior Bridge Engineer at Alaska Department of Transportation and Public Facilities. She has much help from many of her peers within the Bridge Engineering division Alaska Department of Transportation and Public Facilities

Dams. Lead Authors Charles F. Cobb, P.E., State Dam Safety Engineer, Alaska Department of Natural Resources and Tor Anderzen, P.E., M., ASCE, Senior Aviation Engineer at HDL Engineering Consultants. With the help and assistance of Ben Wagner, State Dam Safety Engineer, Alaska Department of Natural Resources.

Energy. Lead Authors: Donald "Greg" Kinney, P.E., Project Engineer at **Alyeska** Pipeline Service Company and Ori Miller, EIT and engineering student at University of Alaska Fairbanks.

Highways. Lead Author: David Gamez, P.E., M.ASCE, Civil Engineer at CH2M. David had much help from Carolyn Moorehouse and Leslie Daugherty at Alaska Department of Transportation and Public Facilities.

Alaska's Marine Highway System. Lead Author Tor Anderzen, P.E., M., ASCE, Senior Aviation Engineer at HDL Engineering Consultants. Tor had much help from Deputy Commissioner Captain Michael Neussl, System Planner, Christa Hagan, and Engineering Manager for Marine Facilities David Lowell, P.E., All of Alaska DOT&PF Alaska Marine Highway System. Much needed assistance was also provided by Rep. Sam Kito III, P.E. of Juneau and David Gamez, P.E., M.ASCE, Civil Engineer at CH2M.

Ports and Harbors. Lead Authors Carl Uchityl, P.E. Port Director, City and Borough of Juneau and Elizabeth Greer P.E. Senior Engineer, AECOM. Carl also had the assistance of many fellow port directors and harbor masters.

Solid Waste. Lead Authors: David Squier, P.E. Civil Engineer at Bristol Companies, Russel Porter, P.E. Civil Engineer at Stephi Engineers, and Christi Meyn, Civil Engineer at CRW Engineering Group, LLC.

Water and Wastewater. Lead Authors: Dan Nichols, P.E. Rural Engineering Director, WH Pacific, Stephen Nuss, P.E. Director Engineering Division at Alaska Water and Wastewater Utility, and Chris Bowman, P.E. Senior project engineer at HDL Engineering Consultants.

Many other members of ASCE were instrumental in the completion of this project, among them we especially want to recognize: Dale Nelson, P.E., F.ASCE, ASCE Region 8 Director; Jessica Smith AICP, Transportation Planner, Matanuska Susitna Borough; Jen Gillenwater, P.E. Project Engineer, Bristol Companies; Justin Kanouse, EIT, DOWL; and LaQuita Chiemenowski, P.E. Enterprise Engineering, Inc.

For the report card committee

Greg Kinney, P.E.

Tor Anderzen, P.E.

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[i] A dam under state jurisdiction is defined in AS 46.17 as an artificial barrier that:
1. Has or will have an impounding capacity at maximum water storage elevation of 50 acre-feet and is at least 10 feet in height measured from the lowest point of the toe to the crest of the dam; or
2. is at least 20 feet in height measured from the lowest point of the toe to the crest; or
3. Poses a threat to lives and property as determined by the department after an inspection. Artificial barriers with a Class I (high) and Class II (significant) hazard potential classification as defined in 11 AAC 93.157 are considered dams. This definition of a dam is inconsistent with the definition used by the USACE for the NID, which contributes to inconsistencies between the state and federal databases.

[ii] History of AMHS, Alaska Department of Transportation and Public Facilities. http://www.dot.state.ak.us/amhs/history.shtml

[iii] Ferry Field Guide, The 50th anniversary of the Alaska Marine Highway System. DOT&PF. http://www.dot.state.ak.us/amhs/doc/reports/school_stud_guide.pdf

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[v] Our Fleet, Alaska Marine Highway System, Alaska Department of Transportation & Public Facilities. http://www.dot.state.ak.us/amhs/fleet.shtml

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[vii] Annual Financial Report 2015, Alaska Marine Highway Fund. DOT&PF Dec 15, 2015. http://www.dot.state.ak.us/amhs/doc/reports/afr_15.pdf

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[x] 2015 Shore Facilities Condition Survey Report. Alaska Marine Highway System. Southeast Region Marine Engineering Section, Alaska Department of Transportation and Public Facilities. http://dot.alaska.gov/project_info/AMHS_Shore_Fac_Report.shtml

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[xii] *Let's get moving 2030*. Statewide Long-Range Transportation Policy Plan, Alaska Department of Transportation and Public Facilities. http://dot.alaska.gov/stwdplng/areaplans/2030/index.shtml

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[xiv] Economic Impacts of Alaska Marine Highway System McDowell Group, Inc. January 2016. http://www.dot.state.ak.us/amhs/doc/reports/econ_15.pdf

[xv] Annual Financial Report 2015, Alaska Marine Highway Fund. DOT&PF Dec 15, 2015. http://www.dot.state.ak.us/amhs/doc/reports/afr_15.pdf

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[xvii] AMHS Community Engagement Meetings, Alaska Department of Transportation & Public Facilities. Presentation, last revised December 4, 2015. http://www.dot.state.ak.us/amhs/doc/reports/presentation_011516.pdf

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[xix] Northern Economics Inc. Alaska Marine Highway System Tariff Analysis. Prepared for Alaska Department of Transportation and Public Facilities/Alaska Marine Highway System. January 2015.

[xx] *Let's get moving 2030*. Statewide Long-Range Transportation Policy Plan, Alaska Department of Transportation and Public Facilities. http://dot.alaska.gov/stwdplng/areaplans/2030/index.shtml

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The CHAIRMAN. They will be incorporated as part of the record. Thank you, Joy.

Kara Moriarty, welcome.

STATEMENT OF KARA MORIARTY, PRESIDENT AND CEO, ALASKA OIL AND GAS ASSOCIATION

Ms. MORIARTY. Good afternoon, Chair Murkowski and other members of the committee. My name is Kara Moriarty, and I am the President and CEO of the Alaska Oil and Gas Association. It is truly an honor to be here today, and I thank you for the opportunity to testify.

To truly evaluate the potential infrastructure needs and benefits relating to oil and gas in our state, it is important to put in context our state's resource potential, which you mentioned at the beginning of the hearing, as well as our nation's resource demands.

It is important to note the significance of the industry on the economy. Mr. Masterman mentioned that, and the reason we say that is one-third of all jobs in the state can be attributed back to the oil and gas industry. And revenues from the industry have dominated the state revenues. To put it bluntly, the oil and gas industry is the state's largest economic driver.

On this very day 150 years ago, the United States purchased Alaska from Russia. And I doubt that little did Americans know what other vast resources were yet to be discovered beyond what they knew was already there.

The first oil was discovered early in the 20th century, but the first commercial discovery happened 60 years ago in the Cook Inlet Basin. But what truly changed the landscape for Alaska was the giant discovery on the North Slope. At the time, the Prudhoe Bay field was the largest discovery in North America, with estimates of 9.6 billion barrels of oil and 26 trillion cubic feet of natural gas. It was during this time in the 1960s that Congress enacted a series of significant environmental legislation and the Trans-Alaska Pipeline System was constructed.

This summer will mark the 40th anniversary of production from the North Slope. And since that time, over 17 billion barrels of oil have been produced. Production peaked at just over two million barrels a day and, at the time, represented a quarter of our domestic production. But today production now averages around 500,000 barrels a day, which represents less than six percent of the nation's domestic supply.

But there is reason for great optimism for Alaska, that we can continue to assist this nation in meeting its energy demands for future generations. Just last year, production increased in Alaska for the first time from the previous year, and stable and increased production is not only important for the upstream side of the industry, but also for the downstream side. In-state refineries not only supply Alaska families and businesses with much important fuels, but they also provide—the refineries provide—a crucial role in supporting our military forces as well.

So billions and billions of oil and natural gas remain, and estimates show that one-third of the nation's reserves are in the Arctic. My written testimony goes into detail about the potential near-term and long-term projects.

But as we talk about infrastructure, the U.S. Department of Transportation released a report prioritizing the infrastructure needs in the Arctic. Conservative estimates predict that vessel traffic in the Arctic will more than double by 2023. Obviously, identifying infrastructure projects that have multiple benefits to multiple stakeholders is vital. The report focused on five core components: navigable waterways, physical infrastructure, information infrastructure, response services, and vessels. Progress in those areas will invariably support both offshore and onshore oil and gas development.

The report offered a litany of recommendations, some of which you just heard about today such as an Arctic port, coordination with stakeholders to coordinate research efforts and to continue to allow for subsistence activities, charting maritime waters, improving weather and climate predictions, and supporting development of response equipment.

The industry does not desire federal infrastructure projects that would serve to merely subsidize one particular energy project over the other. Rather, efforts should focus on coordinating with stakeholders to identify infrastructure corridors, which could mean shared roads and pipelines, to not only aid the industry, but also local communities, and other aspects of the public and private sector.

Frankly, the federal agencies could do more to help build an environment so that private industry will build the infrastructure by working together to assist in permitting and regulatory cooperation.

The North Slope needs basic infrastructure projects that will meet the most basic needs. And of course, those would lead to benefits to the industry, but what really leads to delay in infrastructure from our perspective is often the cost and the delays. We just ask for reasonable, rational, and timely permitting and a regulatory framework to allow the private industry to invest in the infrastructure to support the communities and ourselves.

So, again, we thank you for the opportunity to be here today, and I, again, appreciate and will take any questions that you may have.

[The prepared statement of Ms. Moriarty follows:]

Testimony of
Kara Moriarty

President and CEO
Alaska Oil and Gas Association

Before the U.S. Senate Committee on
ENERGY AND NATURAL RESOURCES

Thursday, March 30, 2017
2:30 PM
Room 366 in the Dirksen Senate Office Building

POTENTIAL FOR INFRASTRUCTURE IMPROVEMENTS IN ALASKA

To truly evaluate the potential infrastructure needs and benefits relating to the North Slope in Alaska, it is crucial to appreciate the short and long-term resource potential in the region. In that vein, it is also vital to consider the various projects that are in development currently as well as those projects that have the potential for production in the near term. Of course, any discussion regarding the resource recovery potential in Alaska must contemplate areas and regions that are currently unavailable for resource extraction, but that could become available for exploration and development in the future. Finally, analysis regarding the potential of oil and gas projects in Alaska must be coupled with an understanding of the nation's long term energy needs, particularly the ongoing demand for traditional energy sources in the decades to come. In other words, recommendations related to potential infrastructure improvements must be placed in the context of Alaska's resource potential and our nation's resource demands moving forward.

Significance of Industry on Economy

The oil and gas industry in Alaska is the state's largest economic driver. Economic studies by university and private economic firms have historically and consistently estimated that one-third of all jobs in Alaska are generated by the oil and gas industry. Since statehood, revenues from oil and gas through royalties, production tax, property tax, and corporate income tax have generated over $150 billion (non-inflation adjusted) and since production from the North Slope began 40 years ago, oil and gas revenues have accounted for approximately 85% of the state's unrestricted general fund.

History of North Slope Production

Early in the 20th Century, the U.S. Geological Survey (USGS) began its first surveys of Alaska's Arctic in an endeavor to discover petroleum reserves for the U.S. Navy. Although those surveys identified some potential for hydrocarbon reserves, the logistical realities related to the severe and remote Alaskan North Slope discouraged any momentum to engage in serious exploration, and serious efforts were abandoned in favor of U.S. regions that provided easier access.

In the 1960s, private companies began to display interest in the North Slope and began to conduct their own surveys. However, many of the logistical and meteorological issues remained, which resulted in imperfect data and, for the most part, these efforts proved fruitless and were ultimately abandoned.

In the Summer of 1968, exploration efforts paid off with a discovery in Prudhoe Bay that, at the time, was estimated to contain 9.6 billion barrels of oil and 26 trillion cubic feet of natural gas, which represented the most substantial and significant reserves ever discovered in North America. Despite the massive hydrocarbon reserves, the logistical realities remained a deterrence to development, raising legitimate questions concerning how to get the oil reserved to market. Discussions began regarding the potential routes for a pipeline, where, ironically, environmentalists preferred a route that went through the coastal plain of the Arctic National Wildlife Range (ANWR) and into Northern Canada, due to the fact that ANWR "had no redeeming qualities whatsoever". Complicating matters further, during the time in which producers were considering the most prudent path for an Alaskan pipeline, Congress enacted a series of significant environmental legislation, including the Clean Air Act, Clean Water Act, Coastal Zone Management Act, Endangered Species Act, Marine Mammal Protection Act and Outer Continental Shelf Lands Act. As a result, Prudhoe Bay and the soon to be constructed Trans Alaska Pipeline System (TAPS), became the most studied, observed, regulated, and litigated project in history.

Over a decade later, following the issuance of nearly 1500 federal and state permits, oil began to flow through TAPS from Prudhoe Bay to Valdez. In the nearly forty years since, over 17 billion barrels of oil have been transported from Alaska's North Slope. It should be noted that production has already vastly exceeded original estimates. During a significant period of time, Alaskan oil effectively represented approximately a quarter of America's domestic production, peaking at over 2,000,000 barrels a day. However, production has declined greatly since its peak in 1989. In 2016, production averaged 517,000 barrels per day, which represented less than six percent of this nation's domestic supply. But, there is reason for optimism that Alaska can continue to assist this nation in meeting its energy demands for future generations. Just last year, production in Alaska increased from the previous year and this historical decline can be reversed. Although the

North Slope of Alaska has already provided billions and billions of barrels of oils, there are billions and billions more that remain untapped.

Stable and/or increased production is not only important for the industry operating on the North Slope, it is also important for the downstream side of the industry; the refining sector. Alaska has three in-state refineries, supplying gasoline and diesel for Alaska drivers as well as jet fuel for Alaska's cargo hub in Anchorage, as well as the military. For refineries to continue to invest in Alaska, they need assurance that the supply of product to refine will be available, so any significant declines are a key factor in their investment decisions which impact the State and Alaskans. If refineries did not exist in Alaska, the cost of fuel would be much great.

The remainder of this discussion focuses on that potential and the role the federal government can play in helping industry reach that potential.

Current and Potential Oil and Gas Energy Projects

The following does not represent an exhaustive break-down of each and every oil and gas project on the North Slope, but hopefully will provide enough details to provide the proper context when considering both infrastructure needs and the role the North Slope has played in meeting our nation's energy demands. The majority of the descriptions that follow represent projects that are in their infancy, which is important to consider when evaluating infrastructure needs and the long-term potential of Alaska's North Slope. However, one should not discount the role that already existing development can play moving forward. The future of oil and gas production in Alaska will be a balance of maximining aging fields while simultaneously bringing new fields online.

The Liberty oilfield contains one of the largest potential sources of new light oil production on the North Slope, with an estimated 80-130 million barrels of recoverable oil. Development of this resource will help offset declining light oil production on the North Slope and contribute to increasing the life span and efficiency of TAPS. If the project is developed, total investment is about $1.5 billion creating 200 construction jobs with peak production estimated to be 70,000 barrels/day from a total of five production wells. Hilcorp has filed a Development and Production Plan (DPP) with the Bureau of Ocean Energy Management for the Liberty Project. The DPP plan represents the first of many steps in the permitting process, which entails multiple approvals at the local, state and federal levels. It is difficult to predict the timelines associated with getting permit approval, but even optimistic estimates would expect it would take multiple years before the process will run its course. Once each of the necessary permits have been obtained, Hilcorp will conduct a final analysis before determining whether to proceed with the project. The Liberty project calls for the construction of a self-contained island connected to land by a subsea pipeline. Located 15 miles east of Prudhoe Bay in Foggy Island Bay, Liberty Island will sit about

six miles offshore in 19 feet of water. The area is well protected from the moving polar icepack, shielded by a belt of offshore barrier islands and covered by stable "shore-fast" sea ice in winter. The proposed island is similar to other islands that have been safely developing Alaska's offshore resources responsibly for nearly 30 years: Endicott, Northstar, Oooguruk and Nikaitchuq. The 9.3-acre, manmade Liberty Island will take an estimated two years to construct. The island will have facilities for drilling, production, production support, utilities, camp and relief-well area. The outer perimeter of the island will be heavily reinforced using proven North Slope technology. While the island location is near shore, no permanent road or causeway will connect Liberty Island to the mainland. Personnel and equipment will be transported via helicopter or boat.

Hilcorp is also moving forward with the Moose Pad Development Project, which contemplates the construction of Moose Pad and an access road located on the west side of Milne Point Road. To support new oil production wells on Moose Pad, this $400 million investment will include approximately 275 construction jobs to install an oil production pipeline, a small tie-in pad, and new pad infrastructure. The Moose Pad Development Project relates to the Schrader Bluff reservoir on the North Slope, which is estimated to contain 10 to 20 billion barrels of oil reserves. The proposed new pad (Moose Pad) will provide Hilcorp access to approximately 7 square miles of undeveloped oil reserves within the MPU. Initial development plans for Moose Pad will include approximately 24 new wells to be drilled using directional drilling technology for the oil production wells. To increase the amount of crude oil that can be extracted from the Schrader Bluff reservoir, the new wells will include both oil production wells and enhanced oil recovery injection wells.

In recent news, partners Repsol and Armstrong Energy made the largest U.S. onshore conventional hydrocarbons discovery in three decades. The operators have been actively exploring in Alaska since 2008 and have recently experienced consecutive discoveries on the North Slope. The discoveries are located in a prospect called Horseshoe, near the North Slope village of Nuiqsut, on the edge of Alaska's National Petroleum Reserve, commonly referred to as Pikka. The resources currently identified in this region amount to some 1.2 billion barrels of recoverable light oil. Expectations are that first production should come online in 2021, and peak output is estimated at 120,000 bpd.

Caelus Energy is a privately held independent that currently operates the Oooguruk Unit where they produce close to 5 million barrels of oil annually. They hold close to 500,000 acres of operating and exploration leases across the North Slope. Last fall the company announced the results of their two well exploration program at Smith Bay.

Caelus and its partners estimate 6-10 billion barrels of oil in place, which makes Smith Bay one of the world's largest oil discoveries in recent years, and the largest on Alaska's North Slope in four decades. The Smith Bay development has the potential to provide 200,000

barrels/day of light oil to TAPS, which would increase current Alaska production by 40 percent (based on 2016 flow rates) and extend the pipeline's long-term viability by reducing the average viscosity of its oil. In addition to production, a project like Smith Bay will employ thousands of Alaskans, including North Slope residents during construction and operation and will pay billions in revenue through royalties and taxes. Make no mistake, while this project has many milestones ahead, on paper is a project of national significance. Caelus owns a 75 percent working interest ownership in 26 leases covering 117,000 acres in Smith Bay.

While the project lies in State of Alaska waters, the bay is surrounded by the National Petroleum Reserve-Alaska and is approximately 125 miles from existing oil and gas infrastructure. It is estimated that project of this size and scope could cost nearly $10 billion dollars, including all development and drilling costs. However, there are ways that the state and federal government can assist in lowering those costs and that is through strategic infrastructure development as well as expedited permitting. Two significant items that would be an asset to the residents of the North Slope as well as to the companies seeking to produce our natural resources is the funding of an access road and bridges connecting communities and developments through the NPR-A. Truly, anything the government can do to lessen the upfront development costs and permitting time will ensure this project can come online in a reasonable manner.

In addition to Smith Bay, the company is working to bring its Nuna oil development online – truly a "shovel ready" project. The company built a 22-acre drill pad and road and is looking to install facilities and flow lines over the next few years. Oil production is forecasting to peak at approximately 20,000 barrels per day, and the current projection for the project is first oil near the end of 2018.

And lastly the company will seek to drill additional exploration wells on their eastern North slope acreage. Caelus conducted hundreds of high-resolution seismic and has 2-3 exciting prospects. In total, estimates show all of these potential Caelus Energy projects would create 2100 jobs, $34 billion in revenue to the state of Alaska, and 2 billion barrels of oil.

Earlier this year, ConocoPhillips announced the 300 million-barrel Willow discovery from a pair of exploration wells drilled in the Greater Mooses Tooth unit in early 2016. ConocoPhillips Co. is looking at a 2023 timeline to bring its new Willow discovery into production, although, as is a reoccurring theme, permitting delays create a fair degree of uncertainty for that timeline. The Willow prospect is estimated to be capable of producing up to 100,000 barrels of oil per day, with a chance for greater potential discovery as acreage nearby yet to be explored. ConocoPhillips has indicated that it has yet to determine whether to develop the field as a satellite of the Alpine field or as a standalone field. The former would be less expensive, but would produce lower volumes over a longer period of time.

The company also acquired considerable acreage in the vicinity of the discovery in a December 2016 lease sale and commissioned a 3-D seismic survey earlier this year.

ExxonMobil has started production at its Point Thomson project, its first operated project on Alaska's North Slope. Point Thomson is located on state acreage along the Beaufort Sea, 60 miles east of Prudhoe Bay and 60 miles west of the village of Kaktovik. The facilities were designed to initially produce approximately 5,000 barrels per day of condensate and 100 million standard cubic feet per day of recycled gas. By design, the recycled gas is re-injected for potential future recovery. At peak production, the facility is designed to produce up to 10,000 barrels per day of natural gas condensate and 200 million cubic feet of recycled gas. The Point Thomson reservoir holds approximately eight trillion cubic feet of natural gas and associated condensate, which is considered a premium hydrocarbon similar to kerosene or diesel and represents a quarter of the known gas on the North Slope. ExxonMobil and the working-interest owners have invested approximately $4 billion in the development of Point Thomson production facilities through 2015. About 100 Alaskan companies have contributed to the success of the project, and thousands of people worked onsite and around the state during peak construction activity.

Again, the projects detailed above are not comprehensive, nor do they describe the many energy projects that continue to provide valuable production. Nevertheless, these projects should provide some insight and excitement regarding the potential of production moving forward. It also serves to underscore that these projects have been designed and implanted in a region that, in many ways, suffers from many of the same logistical strains that have existed for decades. It underscores the discussion below that articulates the unsettling lack of basic infrastructure in the Arctic region.

Arctic OCS and ANWR

It is impossible to discuss the resource potential, or achieving true energy independence without considering the incredible assets that remain untapped in the Arctic Outer Continental Shelf (OCS) and Arctic National Wildlife Refuge (ANWR). Surveys and analysis of the region estimate that 90 billion barrels of undiscovered, technically recoverable oil and 44 billion barrels of natural gas liquids reside in the Arctic. In total, this Arctic potential represents 22% of the Earth's undiscovered oil and natural gas. In Alaska's Arctic waters, the U.S. government conservatively estimates 26 billion barrels of oil in the Chukchi and Beaufort Seas alone. Recent economic assessments have estimated the job potential from these prospects would create almost 55,000 yearly jobs across the US over the next fifty years. Arctic OCS development could generate an annual average of 35,000 jobs in Alaska, total estimated payroll of over $70 billion, over $15 billion in potential cumulative revenues to the State of Alaska, and over $4 billion in estimated property tax payments to local governments, over the next half-century. However, the potential benefits of future OCS development in the Alaskan Arctic will extend well

beyond the state. As an initial matter, OCS leases generate direct revenues to the federal government. Furthermore, the corresponding and dramatic increases in economic activity born from exploration, development, and production of OCS oil and gas resources will also generate jobs, income, and additional tax revenues to the rest of the nation.

More specifically from Alaska and the North Slope Borough's perspective, there are three categories of direct revenues that would potentially accrue. First, the State of Alaska assesses and collects property taxes on any petroleum-related property located onshore as well as collecting a corporate income tax on a defined portion of income generated by any OCS activities. Alaska property tax is estimated be determining the share of total infrastructure associated with OCS production that is located on Alaska lands. It is important to note that the majority of the taxes collected is then allocated to local jurisdictions where the infrastructure is located, with the state of Alaska keeping the remainder. Second, Alaska collects corporate income tax by calculating the percentage of worldwide corporate profits attributable to activities in Alaska. Invariably, vigorous and successful OCS activity would result in an increase in worldwide profits for those companies operating in the Alaska OCS. Finally, Alaska would also receive a share of bonuses and lease revenues on federal tracts between three and six miles offshore. Of course, this discussion does not even contemplate the many other positive externalities that would be categorized as non-petroleum revenues, such as those revenues generated from non-petroleum business activity supportive of OCS development as well as household income resulting from OCS development. It is also important to consider the indirect revenues associated with Alaska OCS development, such as increasing the volume of oil in TAPS, which will, in turn, extend the life of TAPS.

In addition to considering the extensive benefits to Alaska, the federal government take associated with lease revenues in the Beaufort OCS is estimated to be nearly $50 billion over fifty years. That amount reflects bonus bids, rental payments, and royalty payments, the latter representing the majority of the lease payments and assuming a 12.5 percent royalty rate. The estimated federal government take from lease revenues in the Chukchi OCS would also be nearly $50 billion over the same time period. All in all, the federal government stands to obtain almost $100 billion in revenue from the exploration and development of the Arctic OCS. These figures do not account for the corresponding increase in federal revenue associated with corporate and personal income taxes, which would also be substantial.

Although the Arctic OCS has been a primary focus for the oil and gas industry over the past decade, it is impossible to understate the potential for significant discoveries of hydrocarbon reserves in ANWR. ANWR was originally established 1960 by President Eisenhower to designate 8.9 million acres as wilderness. ANWR was greatly expanded with the passage of the Alaska National Interest Lands Conservation Act (ANILCA) in

1980. When President Carter signed ANILCA, ANWR was expanded to over 19 million acres, but there was an area along the coastal plain specifically set aside to be considered for oil and gas development, 1.5 million acres known as the "1002 area". Because of the vast protections and wilderness designations, significant exploration in the region has been effectively prohibited, with surveys being limited to surface geological investigations, aeromagnetic surveys, and two winter seismic surveys that were conducted over thirty years ago. With one exception, no exploratory drilling has been accomplished in ANWR.

Nevertheless, there is every reason to believe that the Coastal Plain of ANWR contains massive economically recoverable oil resources. The first evidence suggesting these reserves relates to its location. Less than 70 miles to the west of ANWR's Coastal Plain, are the main North Slope facilities and oil fields, such as the Prudhoe Bay, Lisburne, Endicott, Milne Point, and Kuparuk. As previously stated, these fields have collectively produced over 17 billion of barrels of oil, and continue to be productive today. And the new Point Thomson field in production is around 5 miles from the boundary of ANWR. Similarly, to the east of ANWR's Coastal Plain, major discoveries have been made in Canada, near the Mackenzie River Delta and in the Beaufort Sea. However, there is more than the mere proximity to other oil and gas discoveries that supports a belief in ANWR's resource potential. Starting in 1980, the USGS began surveying ANWR's Coastal Plain, with initial estimates of up to 17 billion barrels of oil and 34 trillion cubic feet of natural gas. Almost a decade later, the U.S. Department of Interior, following several years of surface geological investigations, aeromagnetic surveys, and seismic surveys issued a report on the oil and gas potential of the Coastal Plain, in which it estimated that there are billions of barrels of oil to be discovered in the area. More specifically, the DOI estimated that "in-place resources" range from 4.8 billion to 29.4 billion barrels of oil, and identified twenty-six separate oil and gas prospects in the Coastal Plain that could each contain fields of 500 million barrels or more.

LNG Project

In addition to vast amounts of oil, Alaska is also home to massive amounts of natural gas. The recovery and reinjection of gas into the oil fields on the North Slope has led to billions of barrels of additional oil recovery, but the gas is basically stranded as there is currently no viable way to get the gas to market. Due to the large supply of natural gas in the Continental U.S., the state of Alaska and industry are working together on a potential LNG project to monetize the gas for Asian markets. This project is a $45 billion infrastructure project that could be geopolitically strategic to displace Russian gas going to Asia. Currently the State of Alaska is positioned to lead this commercial effort and they are currently assessing a tolling model, preserving regulatory process and identifying financing options for a successful path forward.

EIA forecasts

Although fossil fuel consumption is often discussed in binary terms, it is important to note that for the next several decades, energy consumption in the U.S. will remain heavily dependent on hydrocarbon resources to meet demand. The U.S. Energy Information Administration's (EIA) 2017 outlook outlines the likely energy demands of our nation through 2050. Although EIA presents various scenarios moving forward that account any number of variables, it is prudent to examine those figures that represent the median outlook. With that in mind, overall U.S. energy consumption is projected to remain relatively flat, rising approximately 5% from the 2016 level by 2040 and somewhat close to its previous peak. Of course, if our nation experiences greater economic growth than anticipated, the U.S.'s energy consumption will understandably rise accordingly. Based on EIA models, natural gas use is likely to increase more than any other fuel sources in terms of quantity of energy consumed, led by demand from the industrial and electric power sectors. In general, petroleum consumption projects to remain relatively flat as increases in energy efficiency offset growth in the transportation and industrial activity measures. More specifically, crude oil production projects to actually increases from current levels, then levels off around 2025 as tight oil development moves into less productive areas. Like natural gas, projected crude oil production varies considerably with assumptions about resources and technology. Ultimately, this context is offered to highlight that our nation will rely heavily on fossil fuel production and consumption for, at the very least, another generation. What remains to be seen is whether the U.S. can, over the coming years, truly achieve energy independence. Although the biggest hurdle to that endeavor remains the federal regulatory approach to oil and gas production, a beneficial infrastructure can play an important role.

Infrastructure Needs

In April 2016, the U.S. Department of Transportation released "A Ten-Year Prioritization of Infrastructure Needs in the U.S. Arctic." The report fell under the 2013 United States National Strategy for the Arctic Region and the 2014 Strategy Implementation Plan's objective to "Prepare for Increased Activity in the Maritime Domain." The report did not focus solely on the oil and gas industry, but represented a holistic analysis of the general infrastructure needs of the Alaskan Arctic, highlighting a dramatic increase in maritime traffic coupled with a marked lack of onshore infrastructure in Alaska. For example, conservative estimates predict that vessel traffic in Alaska's Arctic will more than double by 2023. A substantial portion of the report endeavored to identify key areas and potential projects that can be undertaken to improve safety and commerce in the American Arctic.

Accordingly, the report discusses a prudent path forward that can address the Arctic infrastructure gaps by identifying critical requirements. Specifically, the report identifies five core components: 1) navigable waterways, 2) physical infrastructure, 3) information

infrastructure, 4) response services, and 5) vessels. Although these "gaps" are often discussed in the context of marine traffic, progress in these areas would also invariably serve to support oil and gas development, both onshore and offshore. The report offers a litany of recommendations, many of which are more pressing than others. Some of the recommendations are as follows: designating an American Arctic port of refuge at Port Clarence; working with stakeholders to coordinate research efforts and de-conflict research within commercial and subsistence use areas; placing hydrography and charting of the U.S. maritime Arctic among the highest priority requirements for agency execution; improving weather, water, and climate predictions to an equivalent level of service comparable to what is provided to the rest of the nation; supporting development of a Pan-Arctic response equipment database; and sharing information for continued development of guidelines for oil spill response in the Arctic.

These efforts dovetail into the fundamental question of how federal infrastructure can be implanted in a manner that offers assistance to existing and future oil and gas energy projects. Industry does not desire federal infrastructure projects that would serve to merely subsidize a particular energy project. Rather, efforts should be focused on identifying infrastructure projects that have multiple benefits to multiple stakeholders. Working together with these stakeholders, infrastructure corridors could be identified and federal agencies could work together to not only provide funding for potential projects, but could assist projects through permitting and regulatory cooperation. Additionally, better information infrastructure would serve to aid industry, but also local communities, and other aspects of the public and private sector. Similarly, a strategically placed road or common carrier pipeline could benefit multiple oil and gas operators while also offering benefits to local communities and people. Put bluntly, the North Slope in Alaska is in need of basic infrastructure projects that can and will meet the most basic needs of Alaskan communities. Of course, this will lead to tangential benefits to industry, but candidly, it is the uncertainty, costs, and delays associated with the federal regulatory rubric that undermines the role that the North Slope can play in meeting our nation's energy needs.

The CHAIRMAN. Thank you, Kara.
Chris, welcome.

STATEMENT OF CHRIS ROSE, EXECUTIVE DIRECTOR, RENEWABLE ENERGY ALASKA PROJECT (REAP)

Mr. ROSE. Thank you, Madam Chairwoman and members of the committee. It is a great honor to be here. I appreciate the opportunity to speak.

I am the Executive Director of Renewable Energy Alaska Project, which is a statewide coalition of more than 80 organizations that have a mission of promoting renewable energy and energy efficiency in Alaska. And we typically do not focus in on specific projects. Instead, we promote policies and programs that will develop renewable energy projects and energy efficiency projects across the state.

In 2008, we were instrumental in getting a state law passed to create the renewable energy fund, which has set up a great vetting system to look at how projects should be developed and score them. That resulted in $257 million of state money going into renewable energy projects and leveraging about another $130 million in private and federal money.

Sixty-six projects have been built so far, mostly in rural areas, and we have talked about how expensive it is to operate in these communities where the cost of energy often takes 50 percent of a person's take-home pay. Those 66 projects so far are displacing 30 million gallons of diesel today, and we believe that we can continue to optimize those projects. We know that we can continue to build more projects, but as you know, the State of Alaska's budget crisis has got us to the point we do not have a lot of grant money right now.

So one of the things that we are looking at is we are at a crossroads and we need to find ways to bring in public-private investments. I spent the last three days in Juneau with Bert Hunter, who is the Chief Investment Officer of the Connecticut Green Bank. That is the second time he has come to Alaska graciously this year. We met with legislators, members of the Administration, the Mayor of Anchorage, and bankers yesterday.

Essentially what Connecticut has done has been really interesting for us to see. They had a renewable energy fund like we did for about 11 years, from 2000 to 2011, and during that time, they had about a one to one leverage. They put in about $350 million in incentives, and they got about $350 million back out in matching money. In the five years since they have had the Green Bank, since 2011, they have done a billion dollars worth of clean energy financing, almost all with private money. They are getting 11 to 1 ratios now on private money. Some of the biggest banks in the world are now part of the Connecticut Green Bank, and essentially what they have been able to do is leverage very small amounts of public dollars and de-risk these projects and educate the private banking community on how this works. We believe this is a real opportunity for the State of Alaska.

And Connecticut has really benefited from the fact that there are federal programs out there like USDA, like other loan guarantees, and the things that are supporting people all around the country

are also supporting the people in Connecticut indirectly when the Connecticut Green Bank can use that to de-leverage or to de-risk projects.

We are here to talk about infrastructure, and of course, one of the biggest infrastructures we have got here in the country is our buildings. We have 120 million buildings across the country. It uses 42 percent of our primary energy and about 72 percent of our electricity. And in Alaska, we have evidence now that we can do a lot better. We have an inefficient building stock. The state's housing authority has administered a program over the last ten years or so that has served over 40,000 homes, and the average savings has been 30 percent.

We are spending, in the State of Alaska, collectively, we estimate, about $5 billion a year on energy. That is transportation, heating, and electricity. And just from our experience in seeing how inefficiently some of this energy is being used, we believe we could save 20 percent of that. That is a billion dollars that we could keep in our economy every year if we invest. And those investments, of course, are going to bring all kinds of jobs.

There are three million people working in the renewable energy industry right now in the United States. Last year globally the renewable energy industry grew by seven percent. It is surging. It is one of the biggest industries in the world, and Alaska has an opportunity to be a world leader in these microgrids, which is a huge opportunity. There are 700 million people around the planet, we estimate, on diesel. We have about 50,000 or 60,000, and we are concerned about them. But there are 700 million people on diesel, and there is another 1.5 billion people who do not have any electricity at all. So we have a huge first mover advantage.

But Alaska's opportunity to be that leader in large part depends on the U.S. continuing to be a leader. If the U.S. is not a leader in renewable energy, then China and Europe will rush in. There will be a vacuum, and we will not be able to continue to do the kinds of things we are doing in Alaska. It is very important for us to have the support of the federal agencies, of the federal programs, of the national laboratories. All that is super important for the ability for Alaskans to continue to be leaders.

We think this could be a future part of our economy. We are working very hard on not only the financing, but the work force development part of making this stuff happen because it is not just technology. We have got to make sure that we can operate and maintain it. We are creating a new program now called the Alaska Network for Energy Education and Employment so we can link together the K through 12 and the vocational and the university programs we have got in the state and make them work synergistically and better.

So I really appreciate the opportunity to talk a little bit about this today, and thank you very much.

[The prepared statement of Mr. Rose follows:]

U.S. Senate Committee on Energy & Natural Resources

Testimony of

Chris Rose
Executive Director
Renewable Energy Alaska Project (REAP)

March 30, 2017

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I. INTRODUCTION

Alaska is home to more than 200 villages that are inaccessible by road, and instead rely on their own "islanded" electric grids, most of which are still powered by diesel generators. Diesel power in these villages is at least three times more expensive than electricity in Anchorage, averaging more than 50 cents/kWh before state subsidies kick in. These remote communities are spread over a landmass that is the size of France, Spain and Portugal combined (or the 23 smallest US states combined). Many of these communities are far away from any local source of firewood and thus reliant on imported liquid fuel for heating. Heating oil today can cost these communities more than $8/gallon, roughly three times the cost in Anchorage. Rural Alaskans often spend more than 50% of their income on expensive electricity and heat generated from liquid fuel delivered by barge or airplane. Also lacking in these communities is the technical support and human capacity needed to keep the lights on and homes warm.

The six utilities that serve the state's most populous region between Fairbanks, Anchorage and the Kenai Peninsula are heavily reliant on natural gas to generate electricity; a mere 10% of the region's electricity is derived from hydropower. Two of these utilities own a major portion of the Beluga gas field near Anchorage, one that is expected to run dry in eighteen years. None of the six utilities have identified a source to replace the Beluga field and continue to keep their brand new gas generation units online. Furthermore, while the 550,000 people who live in this so-called "Railbelt" region represent 75% of Alaska's population, they do not represent a large market relative to the state's huge gas reserves. Without an export market, gas cannot be economically produced in Alaska. The result is a broad uncertainty over how much natural gas will cost in 20 years, a fuel that the majority of Alaska's citizens rely upon for electricity and heat.

Southeast Alaska has several large communities that today have adequate supplies of relatively inexpensive hydroelectric power. However, many of these same communities are struggling with relatively high heating oil prices. The natural tendency of consumers to switch over to less expensive hydroelectric heat is putting pressure on the existent hydro facilities. Meanwhile, smaller Southeast communities, not connected to a hydro facility, are confronted by the same high electric and heating costs that trouble rural Alaska.

It is estimated that Alaskans collectively spend more than $5 billion each year on electricity, heating, and transportation. A large percentage of buildings and homes in the state are not energy efficient. Yet, the state programs that have successfully cut home energy costs by an average of 30% no longer have funding. The entire state would benefit from more efficient buildings and more predictably priced, local, renewable energy. Inefficiencies are likely resulting in a 20% waste of the energy currently consumed in Alaska. That is $1 billion dollars of energy wasted every year at a time when the state's economy cannot afford to lose those dollars. Energy efficiency and renewable energy (together, often referred to as "clean energy") can help Alaska reduce that waste, create jobs, keep dollars circulating in the state, diversify the economy and lower greenhouse gas emissions.

Indeed, Alaska has the opportunity to become a world leader in clean energy technologies that can be applied in remote, small grid settings. Alaska now has 70 communities that have

integrated wind or other renewable energy resources to their diesel grids. The success of those projects in reducing diesel dependency has caught the eye of similarly situated rural communities across the planet. With its remote locations and high energy costs, Alaska is also attracting the attention of technology developers from around the world. Alaska is a proven and safe locale for the piloting and testing of new equipment and systems that have the ability to make an immediate impact on the high cost of energy. These developers understand that the world has 1.5 billion people without any electricity and more than 700 million others who, like Alaska's remote villages, are dependent on diesel. As a result, Alaska is increasingly being recognized as a renewable energy laboratory – a recognition that, if supported and nurtured, could be leveraged to the great economic advantage of not only Alaskans, but to citizens of Maine and Hawaii, two states that are also home to "islanded microgrids". Alaska's work on microgrids can also benefit the many entities throughout the urban world that are working to make themselves more resilient through installations of local microgrids.

More than sixty years before the first barrel of oil flowed through the Trans-Alaskan Pipeline, a mining engineer in Juneau was generating hydropower from Annex Creek in 1915 – a facility that still provides Alaska's capital city with 10% of its electricity. Today, Kodiak, Alaska is the envy of the world as it generates 99.7% of its electricity from an integrated hydro-wind hybrid system that includes battery storage and a flywheel. The local Kodiak Electric Association turns on its diesel generators a few times a year, merely to "exercise" them. The Chaninik Wind Group in Alaska's Yukon-Kuskokwim delta is a coalition of five Alaskan villages creating economies of scale by working together in the design, construction, and maintenance of their wind-diesel hybrid systems. The Alaskan Village Electricity Coop, which operates utilities in 57 communities across the state, is now generating more than 6% of its total electricity from wind. And the Alaska Center for Energy and Power (ACEP) at the University-Fairbanks boasts some of the leading engineers and scientists working in the renewable energy field today. With state and federal support for public-private partnerships, Alaska is poised to embrace the worldwide movement toward clean energy. The hundreds of millions of dollars currently wasted on inefficiencies can be reclaimed and re-injected into the Alaskan economy. These partnerships have the potential to create new jobs retrofitting leaky buildings, spur the operation of new technologies and diversify the Alaskan economy. New and innovative Alaskan grown business sectors will be able to export their intellectual capital and serve similarly situated communities across the developing world.

In order to reach that objective, Alaska must not only focus on technology development, it must also focus on building the human capacity to fill the next generation of clean energy jobs. And it must create pathways for public-private partnerships to finance projects. The continued assistance of the federal governments in these areas is necessary if Alaska is to succeed.

This assistance should include:

1) Further research by DoE and the national laboratories to improve the reliability of hybrid renewable-diesel power systems. This includes current efforts such at the Alaska Microgrid Partnership and the Energy Transition Intiative (ETI);
2) Support for training and workforce development across the spectrum, from technicians in rural communities to university graduates;

3) Financial support to help communities understand their options and, in partnership with the public and private sector, develop solutions that lower energy dependence and power costs. This includes government secured loan guarantees that give the private sector the security to bundle isolated power system infrastructure projects, opening up capital markets and;
4) Capital investment subsidies that lower initial required lending levels to ones that are viable for both communities and private sector lenders.

II ENERGY EFFICIENCY: THE FIRST FUEL

REAP has been asked to testify about renewable energy infrastructure in Alaska. However, any discussion of energy production must begin with energy efficiency and conservation (EE&C). Although REAP encourages conservation, we put more emphasis on energy efficiency. Energy efficiency does not require any human behavioral change. Instead, technology simply allows the use of less energy to do the same amount of work. This can be in the form of more efficient lighting, boilers, appliances, automobiles, et cetera.

REAP considers energy efficiency to be a resource. It is the value of each KWh or Btu that does not have to be produced in the first place. Putting energy efficiency measures in place always costs less than generating heat or power, and can happen much faster than building a generation facility. Energy efficiency is our "first fuel" for another reason: by completing all possible energy efficiency measures first, a community or utility can often decrease the size of any necessary new generating unit, thereby saving dollars on expensive up-front capital expenditures. Overall, investment in EE&C is simply risk management: it creates more stable and resilient communities by keeping money that would otherwise be spent on wasted energy in our local economies.

Today, the 120 million buildings in the United States consume 42% of the nation's primary energy and 72% of its electricity. In Alaska, heating accounts for 40% of energy use in the state's commercial buildings. According to Deutsche Bank and The Rockefeller Institute, the US could save $1 trillion by investing in building energy retrofits over the next ten years.[1]

More efficient appliances are also a powerful way to save energy and keep dollars circulating in local economies. The ENERGY STAR program began under President George H.W. Bush in 1992 and has received strong bipartisan support ever since. ENERGY STAR is a voluntary program that typically recognizes the top 25% most-efficient equipment and buildings. The program has built 90% consumer brand recognition. It also spurs the manufacturing and purchasing of ENERGY STAR certified equipment and buildings. Since the program's inception, families and businesses have saved more than $400 billion cumulatively – $34 billion in 2015 alone. The ENERGY STAR program has achieved all of this on a budget of about $50 million a year; enough to purchase about half of a new F-35 fighter jet. REAP strongly supports the continuation of the ENERGY STAR program.

[1] http://www.greentechmedia.com/articles/read/efficiency-retrofits-could-save-u.s.-1t-in-energy/

In Alaska, the state has demonstrated that energy efficiency can save a tremendous amount of money. Since 2008, the weatherization and rebate programs administered by the Alaska Housing Finance Corporation (AHFC) have assisted more than 40,000 households in becoming more energy efficient through measures such as more efficient boilers, lighting and simple building envelope sealing. On average, after energy retrofitting, those residences are now saving 30% on their energy bills, mostly on the thermal side. Collectively, those households are saving the equivalent of more than 25 million gallons of heating oil every year. There are many more households in the state still to retrofit, but with the state's budget deficit, there is no more state grant money to catalyze those investments. REAP supports all public-private partnerships that can keep this fundamental infrastructure work going.

Alaska's public buildings also represent a tremendous energy efficiency resource and infrastructure improvement opportunity. According to a white paper on energy use in Alaska's public facilities published in 2012:

> [i]t is estimated that upwards of 5,000 publicly-owned buildings exist in Alaska. The estimated energy cost equates to approximately $641,245,000 to the public each year. At the average projected savings of $25,000/year/building, this would equal $125,000,000 in annual potential savings."[2] Since 2010, when the legislature mandated that the state DOT&PF work with other state agencies to retrofit 25% of all public facilities that are at least 10,000 square feet and larger (starting with the least energy efficient facilities) the state has accomplished energy savings performance projects in 69 facilities through the use of energy savings performance contracts, achieving a cumulative annual cost avoidance greater than $3.2 million.[3]

If the state were to prioritize funding for energy upgrades in existing infrastructure, it would protect that state's sunken investments and help those buildings realize their fully anticipated life and usefulness. In many cases, energy audits have already been done to public facilities that show tremendous potential savings.[4] However, developing these retrofit projects and securing financing, are often hurdles that local governments cannot overcome. Any federal assistance to help state and local governments develop energy efficiency projects, and then finance them through loan guarantees, would yield tremendous benefits for Alaskans; as well as citizens of the other 49 states and territories. These investments put people to work, spur manufacturing, and keep the benefits local.

Fortunately, a shift is beginning to take shape within Alaska's design community toward more efficient buildings, led by entities like the Cold Climate Housing Research Center (CCHRC) in Fairbanks. Since the cost of construction is only about 11% of the life-cycle cost of a building,

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[2] Armstrong, R.S. et al, White Paper on Energy Use in Alaska's Public Facilities, 10/19/2012

[3] Alaska DOT&PF: Sustainable Energy Act Annual Report to the Legislature, submitted Jan 2017

[4] See linked Potential Paybacks form Retrofitting Alaska's Public Buildings, 12/21/2014. Based on the 327 public facility audits by AHFC as well as the over 65 health clinics, washaterias, and water treatment facilities done by ANTHC.

while operations and maintenance (utilities) are approximately 50%, this shift can save hundreds of millions of dollars over the coming decades.

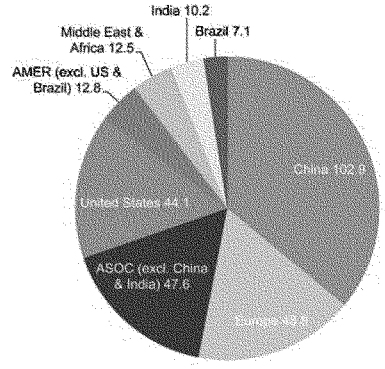
Today, REAP, AHFC, CCHRC and others are recommending that state policy makers adopt and enforce energy codes and minimum standards for all newly constructed residential buildings in Alaska, as well as for state funded buildings at the state, school district, borough and municipal levels; similar to the energy efficiency requirements now used by AHFC through its Building Energy Efficiency Standards (BEES).

Today, the Alaska Legislature is on the brink of passing a bill to create a "Property Assessed Clean Energy" (PACE) program for the state's commercial buildings. This would allow local tax assessment districts to set up programs to lend money to business owners who wish to energy retrofit their buildings, and then pay the loan back through a voluntary special tax assessment on the building. This will give Alaska business owners another financing tool for energy efficiency. It will also allow those businesses to do energy efficiency now, without worrying about whether they will own the building long enough to see a return on investment. That is because the loan goes with the building, not the owner. If a building owner sells an improved building, the next owner continues to pay the special tax assessment. Mortgagors of those buildings must sign a waiver that allows the tax assessment district to take a superior position on the loan, but experience shows that those lenders are more than happy to see their collateral increase in value through energy efficiency improvements. Efforts across the country to apply the PACE concept to residential properties have failed because Fannie Mae and Freddie Mac have refused to take a similar inferior position on loans. Allowing such a position would produce a flood of homeowners from across the nation who would like to use a PACE-type program to finance energy efficiency improvements.

III RENEWABLE ENERGY WORLDWIDE

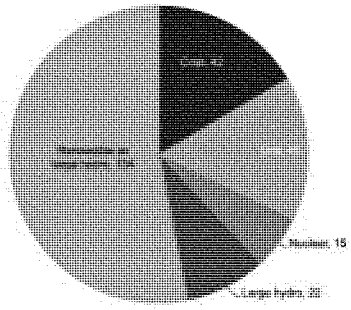
Renewable energy is one of the fastest growing industries in the world. In 2015, more than half of all new electric generation capacity added on the planet was renewable (and that does not include large hydro). As concerns about climate change increase, and technology costs continue to come down, investors are moving their money to what some are calling the next industrial revolution. The choice for the US is clear: continue to compete in the world market through policies and incentives that support renewables, or watch China and other nations fill the vacuum and corner the market on innovative technologies that will provide an enormous source of future revenues and employment.

Figure 1: Fig: Global New Investment in Renewable Energy by Region, 2015, $BN[5]



New investment volume adjusts for re-invested equity. Total values include estimates for undisclosed deals.
Source: UNEP, Bloomberg New Energy Finance

Figure 2: Net Power Generating Capacity added in 2015 by Main Technology, GW[6]



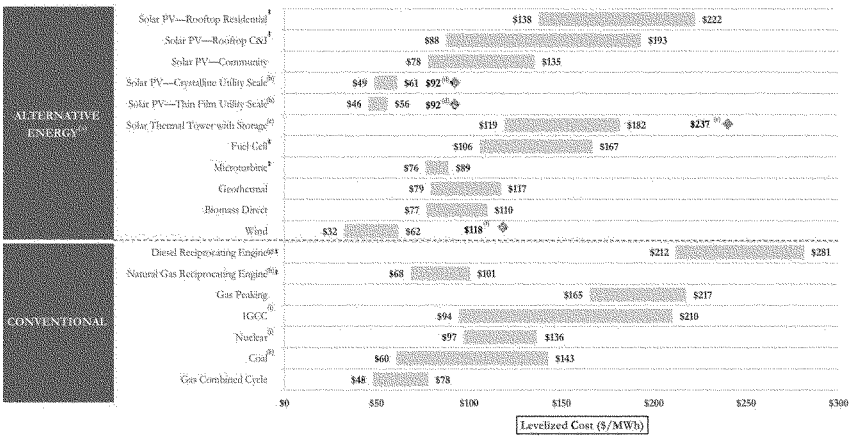
Source: Bloomberg New Energy Finance

[5] See, http://fs-unep-centre.org/sites/default/files/publications/globaltrendsinrenewableenergyinvestment2016lowres_0.pdf, pg. 22
[6] See http://fs-unep-centre.org/sites/default/files/publications/globaltrendsinrenewableenergyinvestment2016lowres_0.pdf. Pg 31; For a general Renewable energy short-term forecast for U.S., see https://www.eia.gov/outlooks/steo/report/renew_co2.cfm

Drivers for Renewable Energy: Economics

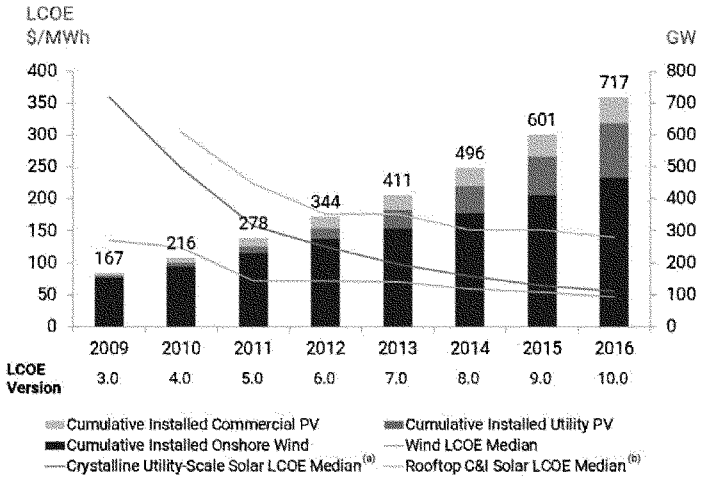
The economics of renewable energy continue to improve at a rapid rate, with both wind and solar prices already reaching price parity with conventional generation sources in some jurisdictions. As technology continues to improve and world demand increases, the price of renewable energy will continue to decrease. Meanwhile, fossil fuel prices remain volatile, and subject to a number of world market factors that the US has little control over.

Figure 3: Unsubsidized Levelized Cost of Energy Comparison, 2016[7]



[7] See https://www.lazard.com/media/438038/levelized-cost-of-energy-v100.pdf, pg. 2

Figure 4: Unsubsidized Levelized Cost of Energy—Wind/Solar PV (Historical)[8]

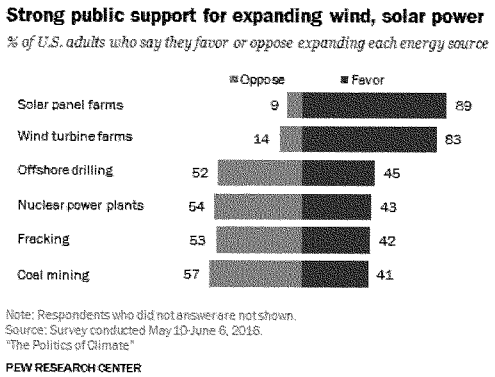


Drivers for Renewable Energy: Climate Change

The majority of Americans support renewable energy projects. A Pew Study published in 2016 found that 83% and 89% of Americans support expanding wind and solar power farms, respectively.[9] This is in contrast to other forms of energy, the study found, such as fossil fuels, which had up to 57% of adults opposed to it, as in the case of coal.

[8] See, https://www.lazard.com/perspective/levelized-cost-of-energy-analysis-100
[9] See, http://www.pewinternet.org/2016/10/04/public-opinion-on-renewables-and-other-energy-sources/

Figure 5: Pew Research, 2016[10]



This public approval can be linked in part to Americans' increasing concerns about climate change. As has been widely publicized, Alaska is at ground zero for climate change, and has been feeling its impacts for some time. With record-low Arctic Ocean ice coverage, thawing permafrost, ocean acidification and increasing incidence and severity of forest fires; Alaska's landscapes and ecosystems are changing.[11]

These changes are likely to be expensive for the state. According to the EPA:

> "[c]limate change leads to more permafrost thaw and disruptions to freeze-thaw cycles that can increase frost heaves and subsidence. This can potentially cause damage to transportation infrastructure in Alaska, including highways, railroads, and airstrips. Uneven sinking of the ground in response to permafrost thaw is likely to add significant costs to the maintenance and repair of transportation infrastructure and buildings. Many of Alaska's highways are built in permafrost areas and are subject to damage if the permafrost thaws. Additionally, warming leads to a shorter period when ice roads are usable and a shorter season during which oil and gas exploration on the tundra can occur."[12]

Drivers for Renewable Energy: National Security

Renewable energy is a national security issue. Increasing the production of domestic energy makes the nation less dependent of foreign energy sources, and the politics that go with that dependency. Despite being at the lowest levels since 1970, in 2015, U.S. net imports (imports minus exports) of petroleum from foreign countries was still equal to about 24% of

[10] http://www.pewinternet.org/2016/10/04/public-opinion-on-renewables-and-other-energy-sources/
[11] Sea Ice: https://www.nasa.gov/feature/goddard/2017/sea-ice-extent-sinks-to-record-lows-at-both-poles
[12] https://www.epa.gov/climate-impacts/climate-impacts-alaska

U.S. petroleum consumption.[13] Various estimates have been made on what the US spends every year on its military presence to continue to access to oil in the Middle East. The cost of military operations in the Persian Gulf in 2007 alone was estimated to be $500 Billion.[14] In addition, the US military has stated over and over that the instability caused by drought, refugees, war and other events attributable to climate change are a prime national security threat. In order to decrease its own dependency on liquid fuel at forward operating based, the military is also leading many efforts to deploy renewable energy in small microgrids.

Utilization of Renewable Energy resources reduces refueling trips to and from the battlefield and therefore the exposure of any given unit or individual. The U.S. Army has a stated goal of deploying 1 GW of renewable energy on Army installations by 2025. The U.S. Navy's aircraft carrier John C. Stennis leads a Strike Group known as the *Green Fleet* because it utilizes a newly developed biofuel and energy efficiencies aboard its ships. As of the 2013 the U.S. Air Force had 261 renewable energy projects located on 96 sites. The push toward renewable energy solutions within all three branches of the military stems from a life or death pragmatism: "There is no mission assurance without energy assurance."[15]

IV ALASKA'S RENEWABLE ENERGY OPPORTUNITIES

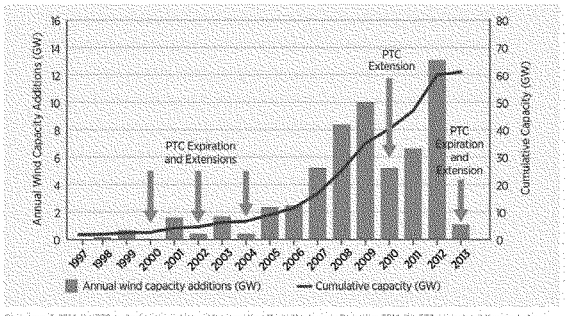
Wind

Wind energy now generates 4.7% of America's electricity."[16] In 2015, the U.S. Department of Energy (DoE) released *Wind Vision: A New Era for Wind Power in the United States.* The report shows that wind energy can supply the U.S. with 10% of the country's electricity by 2020, 20% by 2030, 35% by 2050, and provides a road map for how to get there. *Wind Vision* updates and expands on the DOE's 2008 report, *20% Wind Energy by 2030: Increasing Wind Energy's Contribution to the U.S. Electricity Supply,* which galvanized the nation's rapid growth of wind. Indeed, wind turbine technician employment is on track to see an increase of 108% between 2014 and 2024.[17]

[13] See, https://www.eia.gov/tools/faqs/faq.php?id=32&t=6
[14] See, https://www.princeton.edu/oeme/articles/US-miiltary-cost-of-Persian-Gulf-force-projection.pdf
[15] Melinda Ballentine, Assistant Secretary of the Air Force, Installations and Energy
[16] http://www.awea.org/windvision
[17] See, http://www.aweablog.org/meet-americas-fastest-growing-profession-wind-technician citing U.S. citing Bureau of Labor Statistics: https://www.bls.gov/news.release/pdf/ecopro.pdf.

However, the effect of uncertain federal policy has a large impact the wind market in the United States, as shown in the figure below.

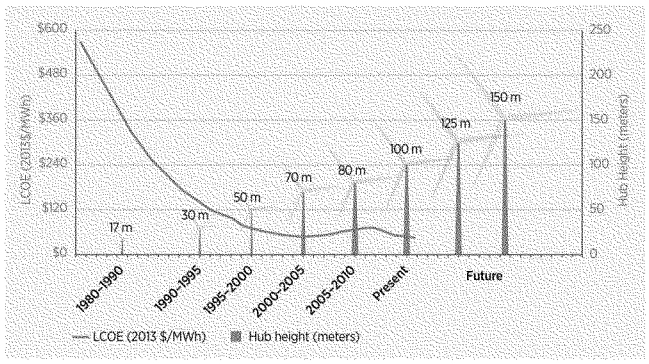
Figure 6:Historical Wind Deployment Variability and the Production Tax Credit[18]



On January 1, 2014, the PTC expired again and lapsed for more than 11 months. In early December 2014, the PTC was extended again, but was valid only through year-end 2014.

Economies of scale and technological advancements are increasingly driving down the cost wind energy. In 2016, the average power purchase agreement (PPA) for wind energy in the Midwestern US was around 2 cents/kWh.[19]

Figure 7: Wind Technology Scale-up Trends and the Levelized Cost of Electricity[20]



Note: LCOE is estimated in good to excellent wind resource sites (typically those with average wind speeds of 7.5 m/s or higher), excluding the federal production tax credit. Hub heights reflect typical turbine model size for the time period.

[18] https://www.energy.gov/sites/prod/files/wv_executive_summary_overview_and_key_chapter_findings_final.pdf, pg. xxxvi

[19] See Berkley Labs report, http://newscenter.lbl.gov/2016/08/17/annual-wind-market-low-wind-energy-prices

[20] https://www.energy.gov/sites/prod/files/wv_executive_summary_overview_and_key_chapter_findings_final.pdf, pg. xxxviii

Wind is not only a consistent and predictably priced energy source, it is also a local economic engine. According to the US DoE:

> "[l]ocal economic impacts of wind power are derived from temporary and permanent employment in construction, engineering, transportation, manufacturing, and operations; local economic activity resulting from wind construction; and increased revenues from land lease payments and tax revenue. A study of economic development impacts for wind power installations between 2000 and 2008 found that total county personal income was 0.2% higher and employment 0.4% higher in counties with installed wind power, relative to those without wind power installations. Another study on four rural counties in west Texas found cumulative economic activity resulting from wind investments in local communities to be nearly $520,000 (2011$) per MW of installed capacity over the 20-year lifetime of the wind plant. In 2013, an estimated total of more than 50,000 onsite and supply chain jobs were supported nationally by wind investments."[21]

The *Wind Vision* report also notes that:

> "[i]ncreasing wind power can simultaneously deliver an array of benefits to the nation that address issues of national concern, including climate change, air quality, public health, economic development, energy diversity, and water security. For example, the 12.3 gigatonnes of CO2-equivalents avoided over the period 2013–2050 in the Central Study Scenario delivers $400 billion in savings for avoided global damages. This is equivalent to a benefit of 3.2¢/kWh of U.S. wind energy produced. The value of long-term social benefits such as these can be provided by wind energy and far exceeds the initial investment required."[22]

In Alaska, large wind on the Railbelt grid has so far been limited to installations at Delta, Healy and near Anchorage on Fire Island. Cook Inlet Regional Incorporated (CIRI) took advantage of the federal Investment Tax Credit (ITC) to build the first phase of Fire Island but structural and governance issues in the Railbelt have limited the ability of independent power producers (IPPs) like CIRI to sell more wind, or other renewable energy, into the grid. The six incumbent Railbelt utilities do not plan new generation additions together as a region. Without regional integrated resource planning in the Railbelt, more generation than is necessary for the region as a whole can be built, without resulting in any diversification of the generation mix. Each utility has the authority to charge tariffs for electrons that move through their respective service territories. These so-called "pancaking" transmission tariffs can ruin the economics of a good wind project quickly. The issue of what constitutes the target price for IPPs is also still unresolved. Defined in the federal Public Utility Regulatory Policy Act (PURPA) of 1978 as "avoided cost," this

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[21] See, https://www.energy.gov/sites/prod/files/wv_executive_summary_overview_and_key_chapter_findings_final.pdf, pg. xxxvii

[22] See, https://www.energy.gov/sites/prod/files/wv_executive_summary_overview_and_key_chapter_findings_final.pdf, pg. lvi

target price is currently being litigated in state court after new Regulatory Commission of Alaska regulations on the issue were promulgated in 2016. Finally, transmission bottlenecks both north and south of Anchorage limit the amount of electricity that can be moved in and out of the state's most populated area. Without the kind of transparent market rules that exist in other parts of the US, it will be difficult for wind and other renewable energy projects like geothermal to be built in the state's largest electricity market.

Outside of the Railbelt, today wind serves at least part of the electric load in more than 30 remote communities across the state. Most of these systems are so-called "wind-diesel hybrid" systems in remote, "islanded" communities that are not connected to a larger grid and rely on imported diesel fuel to generate electricity. Wind's contribution varies considerably in these communities, but many average 20%. However, through the use of advanced controls and energy storage, the goal for these systems is to provide more than 50% of a community's electricity.

Several efforts, including the Alaska Microgrid Partnership (AMP) supported by the US DoE, are working to create pathways for these communities to increase wind's contribution. The AMP is one of 11 regional projects currently under way through the DoE's Grid Modernization Laboratory Consortium (GMLC). The Alaska project seeks to develop more affordable, clean, reliable and scalable islanded power systems for remote Alaska communities, with a goal of reducing imported fuel consumption by at least 50% through a combination of advanced technologies. The Partnership includes four national labs (the National Renewable Energy Laboratory (NREL), Lawrence Berkeley National Laboratory, Pacific Northwest National Laboratory, and Sandia National Laboratory) and a cross-section of Alaskan partners; including REAP, the Alaska Center for Energy and Power (ACEP) at the University of Alaska-Fairbanks, the Institute of Social and Economic Research (ISER) at the University of Alaska-Anchorage and Intelligent Energy Systems, an Anchorage-based small business.

The AMP involves conducting analysis of potential technologies and associated systems that could meet a > 50% fuel reduction goal for two communities: (1) Shungnak in the NW Arctic and (2) Chefornak in the Yukon-Kuskokwim Delta. The team is currently conducting a business case—for consideration by project developers—and will be conducting actual testing of proposed technologies at ACEP later this year. A final task of the project involves upgrading the Alaska Energy Data Gateway (https://akenergygateway.alaska.edu/) with the goal of disseminating community-level technical, financial, and human capacity to undertake new energy infrastructure projects across rural Alaska. All the project reports, data, and related materials will be made available through the Alaska Energy Data Gateway for other communities to learn from and potentially replicate.

REAP has also been working with the Alaska Energy Authority and NREL for years to share information about wind energy across Alaska. For the last three years, REAP and the Island Institute in Rockland, Maine have partnered to facilitate the Islanded Grid Resource Center (IGRC). The IGRC is a growing knowledge hub that allows small grid operators off the coast of New England and in Alaska to share information about their wind-diesel microgrid systems with operators in states like Hawaii, and territories such as Guam and American Samoa.

Alaska's clean energy efforts are further strengthened by DoE's Energy Transition Initiative

(ETI), a program that works with government entities and other stakeholders to establish a long-term energy vision and successfully implement energy efficiency and renewable energy solutions. ETI provides a proven framework of technical resources and action-oriented tools to help islands and remote communities move away from a set of "reports on the shelf" and toward and actual transition to a clean energy economy and clean energy goals. Increasingly, this program, like the IGRC, is connecting stakeholders in some of our nation's most remote areas - Alaska, Hawaii, and islands off the coast of Maine. ETI highlights the need for local capacity and the benefits in learning from one another in order to improve the cost-effectiveness of local clean energy investments.

Communities in the Channinik Wind Group near Bethel are oversizing their wind farms and using the excess electricity to heat individual homes. This application takes advantage of the fact that the wind blows more steadily in the winter, exactly the time to address the even larger community problem of affordable heat. The Alaska Native Tribal Health Consortium (ANTHC) has been installing wind systems in communities with new water and sewer systems to help offset the energy costs of operating those systems. In addition to the AVEC and Kodiak wind farms mentioned above, Kotzebue Electric Association and the nearby northwest arctic communities of Deering and Buckland, are using USDA and other federal funding to install both solar and energy storage onto their already existing wind-diesel grids.

These pioneering systems are in large part responsible for putting Alaska on the map as a world leader in renewable microgrid system architecture. Alaska's high energy prices demand solutions and the innovative projects that Alaskans are implementing are of the sort that hundreds of millions of people in other parts of the Arctic and the developing world are seeking. However, continued support from the DoE and national labs is necessary to continue to hone technical systems, increase human capacity and workforce development, and provide public-private financing solutions.

Solar

In 2016, solar power represented the largest new source of electricity generating capacity in the United States, for the first time beating out both natural gas and wind for new capacity additions. Solar represented 39% of all new capacity added, with natural gas at 29% and wind 26%. [23]

A prime driver for this growth is the speed at which solar prices are dropping. Indeed, prices dropped an amazing 29% in just one year, from Q4 2015 to Q4 2016. Overall, prices have dropped 67% since 2011, with utility-scale PPAs for solar now being signed in the $0.03 - $0.05/kWh range.[24]

[23] See, http://www.seia.org/research-resources/solar-industry-data
[24] See, http://www.seia.org/research-resources/solar-industry-data

Figure 8: Annual U.S. Solar PV Installations, 2000-2016[25]

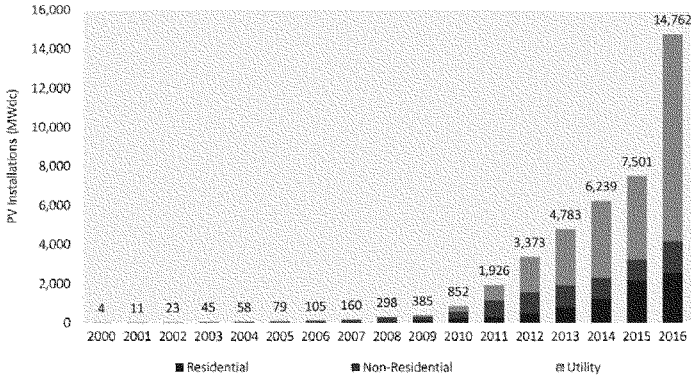
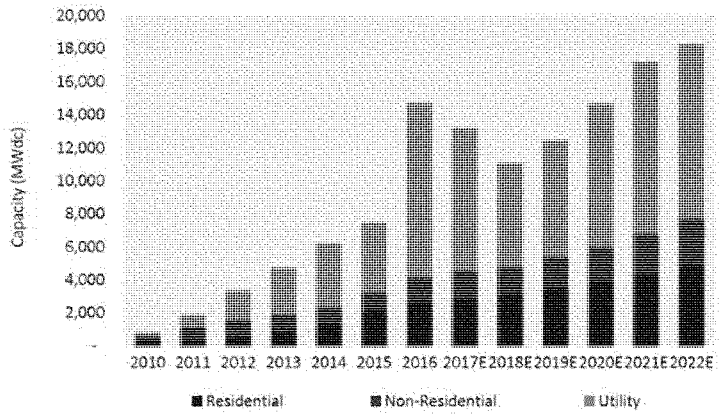


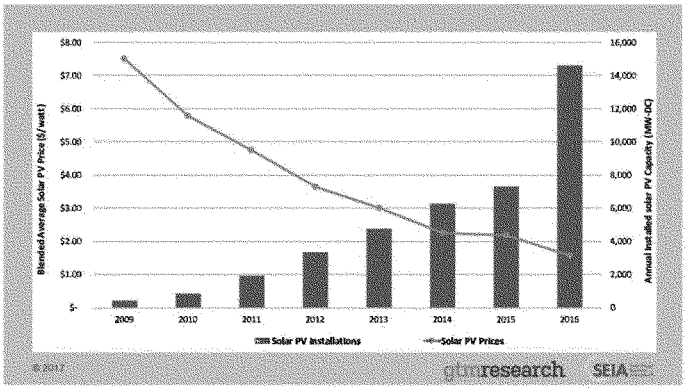
Figure 9: PV Installation Forecast, 2010-2022E[26]



[25] SEIA Solar Market Insight, Executive Summary, 2016, http://www.seia.org/sites/default/files/Dn4u8Zl5snSMI2016YIR.pdf, pg. 6

[26] SEIA Solar Market Insight, Executive Summary, 2016, http://www.seia.org/sites/default/files/Dn4u8Zl5snSMI2016YIR.pdf, pg. 18

Figure 10: Installed Solar compared to cost per watt[27]



In Alaska, besides an increasing number individuals and businesses using the federal Investment Tax Credit to put solar on their roofs; a number of small communities are also taking advantage of the sharp decline in solar prices over the last decade. Contrary to the perception of some, Alaska is not dark all the time. In fact, all places on the planet receive the same amount of sunlight each year. However, the farther one travels from the equator, the more lopsided the proportions of light and dark become. Most places in Alaska that experience a good amount of clear weather (including Southcentral and Interior Alaska where the vast majority of Alaskans live) have an excellent solar resource for about seven to eight months per year. The highpoint of solar production in many places is March and April, when the returning sun reflects off of ground snow and back onto the panels. For small utility systems that have deployed wind, solar can be a complementary resource that further decreases the amount of diesel that must be barged or flown in to generate electricity. The ability of a community to use solar electricity in the spring, summer and fall depends in part on how well it is integrated through advanced controls and energy storage. It also depends on finding new ways to use electricity in places that have not typically needed air conditioning (though this is changing) or a lot of lighting in the summer months. Potential additional uses include: value-added fish processing, ice making and electric vehicles.

Energy Storage

Advances in energy storage continue every year, both in performance and in price. In turn, these improvements are making variable renewable energy sources such as wind and solar more consistent and financially viable for Alaska's isolated grids. Kodiak Electric Association has already taken advantage of both 3 MW batteries (chemical energy storage) and a 2 MW flywheel (mechanical energy storage) to balance its load with its wind and hydro resources, allowing it to

[27] See, http://www.seia.org/research-resources/solar-industry-data

displace over 11 million gallons of diesel since 2009 when all systems were integrated. Several other utilities in remote communities across the state are also either already using energy storage, or planning to do so. Golden Valley Electric Association (GVEA) in Fairbanks has had a large battery for some time for use as backup in the event of a large power outage. GVEA is now looking at battery storage to help it balance the wind in its system, as are other Railbelt utilities near Anchorage.

Figure 11: U.S. Annual Energy Storage Deployment Forecast, 2012-2021E (MW[28]

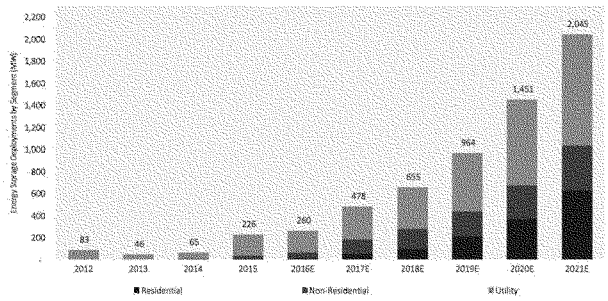
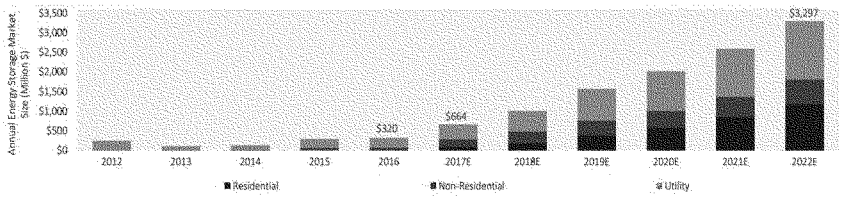


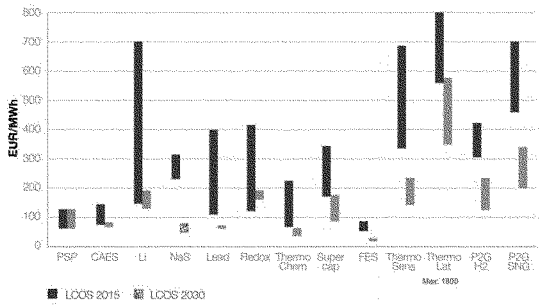
Figure 12: U.S. Annual Energy Storage Market Size, 2012-2022E (Million $)[29]



In general, energy storage system costs are being driven down across the board, even just over the course of 2016.[30] Production size and technological advancement are both moving the cost down, and are forecasted to continue to do so.[31]

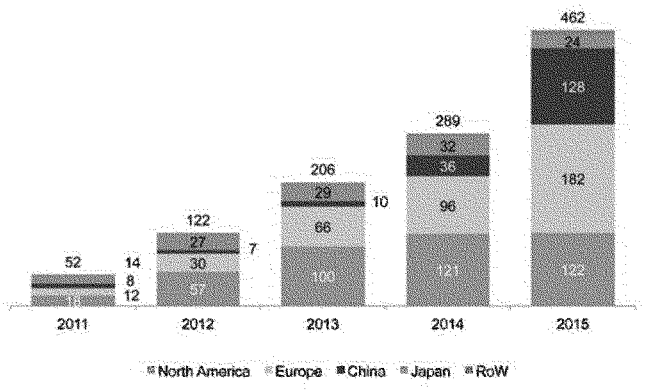
[28] https://www.greentechmedia.com/research/subscription/u.s.-energy-storage-monitor
[29] GTM Research. U.S. Energy Storage Monitor: 2016 Year in Review and Q1 2017 Executive Summary. pg 11
[30] http://energystorage.org/news/esa-news/energy-storage-falling-costs-major-gains
[31] All in Euro's but looks like a pretty great resource: https://www.worldenergy.org/wp-content/uploads/2016/01/World-Energy-Resources-E-storage-wind-and-solar-presentation-World-Energy-Council.pdf

Figure 13: Comparing general levelised cost of storage for 2015 and 2030 (€-2014) [32]



Electric cars are also poised to assist in the energy storage of renewable energies as their sales have continued to trend upward with no sign of slowing down, even during low oil prices. The improved batteries of vehicles, combined with smart grid management, can greatly assist in integrating variable energy through vehicle charging during peak production hours.

Figure 14: Total Electric Vehicle (BEV+PHEV) Sales, 2011-2015, Thousands[33]



[32] Interesting look at cost projection for current energy systems. See: https://www.worldenergy.org/wp-content/uploads/2016/01/World-Energy-Resources-E-storage-wind-and-solar-presentation-World-Energy-Council.pdf, pg. 16

[33] http://fs-unep-centre.org/sites/default/files/publications/globaltrendsinrenewableenergyinvestment2016lowres_0.pdf, pg. 35

In Southeast Alaska towns like Juneau and Sitka electric vehicles (EVs) are already being heavily promoted. Those communities have a supply of clean hydroelectric power and a constrained road system (even though the mileage range of cars like the Chevy Bolt are increasingly greatly). Electric cars also align with the communities' focus on clean energy. Sitka is considering converting the city's municipal vehicle fleet to electric cars and the city has also established a public-private partnership that includes support for manufacturing facilities for the Nissan Leaf in Smyrna, Tennessee.

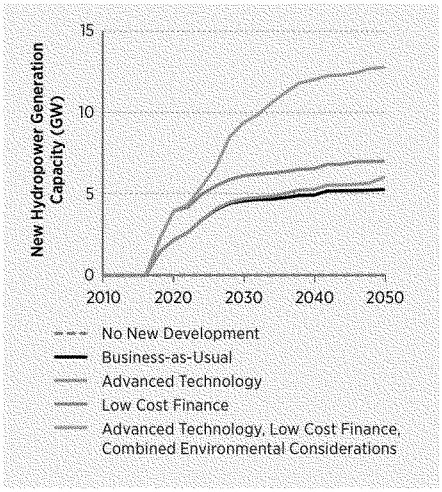
Juneau stands among the national leaders in EV adoption on a per capita basis despite the fact that it is still not possible to purchase a fully-electric vehicle in town. To support the adoption of EVs, a number of facilities owned by the state, city, university, utility, and private businesses now offer public charging stations. The Juneau Economic Development Council provided support for the effort that led to the installation of those public charging locations. Their continued work on electrifying Juneau's transportation sector includes supporting Tongass Rain Electric Cruise, a business intending to build the first marine tour vessel powered by lithium batteries, the first such design to be reviewed by the US Coast Guard. Juneau's electric utility also has the state's first electric vehicle incentive rate, offering customers a lower rate for shifting their charging into evening hours and providing an option to participate in that program through use of utility-owned charging stations. This allows customers to avoid some of the upfront cost of installing Level II chargers at home. To round out community efforts to support EV adoption, a local EV club and Facebook group page offer resources for current and prospective EV owners; including help coordinating Nissan service visits to Juneau (the community does not have a Nissan dealership or service center). Juneau anticipates continued acceleration in the rate of EV adoption throughout 2017.

The power systems integration laboratory at the Alaska Center for Energy and Power at the University of Alaska-Fairbanks is an ideal place for technology developers to test new energy storage technologies before they are deployed in the field.

Hydro

Alaska has already taken advantage of many hydroelectric sites, beginning over 100 years ago. The Railbelt generates more than 10% of its electric power through projects at Bradley, Cooper and Eklutna lakes, all projects that have minimal to no adverse impacts on fish. Such "lake-tap" projects also provide a significant amount of electricity in Southeast Alaska, particularly to Juneau, Ketchikan, Sitka and Wrangell. Other projects in Southeast are currently under consideration. In the Railbelt, Chugach Electric Association recently announced plans to investigate a 75 MW project near Seward at Snow River.

Figure 15:ReEDS Modeled Deployment of New Hydropower generation capacity, selected scenarios, 2017-2050 (GW) [34]



Biomass

A growing number of Alaskan communities in Southeast and Interior Alaska are using local wood to generate heat. These projects are often combined with green houses that increase a community's access to fresh food. As emerging technologies improve, there may also be an opportunity to convert low-value local wood to electricity, or to liquid fuels such as ethanol.

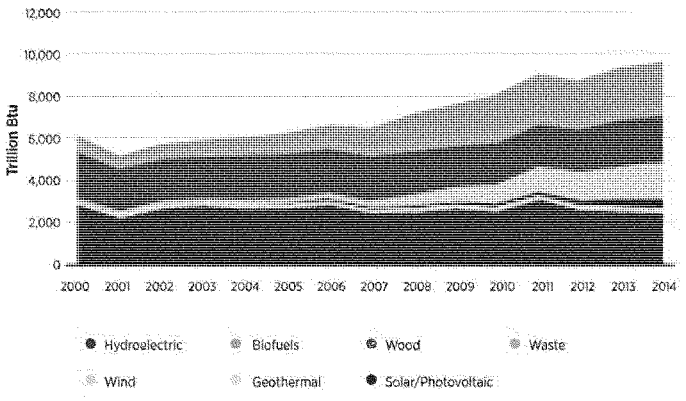
Groundfish processors across the state produce millions of gallons of fish oil every year as a byproduct of fishmeal plants. Since 2001, UniSea Inc. has been using approximately one million gallons of fish oil for power production, displacing the diesel it would otherwise use. The Alaska Energy Authority estimates that there are over 13 million gallons of fish oil thrown back into the ocean every year that are not being utilized.

Alaskans generate approximately 650,000 tons of garbage per year, and technologies to generate energy from such waste continue to improve each year. The Anchorage landfill has been capturing and using a significant amount of methane to generate 2.5 MW of electricity for over five years. As methane capture technologies improve, other, smaller communities may also be able to take advantage of this energy resource.

It is also possible that Alaska's agricultural lands may be used to produce energy crops, such as rapeseed, to produce biodiesel.

[34] https://energy.gov/sites/prod/files/2016/10/f33/Hydropower-Vision-Executive-Summary-10212016.pdf, pg. 16.

Figure 16: Primary Renewable Energy Consumption by Source (2001-2014)



Source: Data from EIA (2015d).

Geothermal

Alaska has tremendous geothermal resources located in the Interior, the Southeast, the Wrangell Mountains and along the "Ring of Fire" volcanoes, which includes the Aleutian Islands and the Alaska Peninsula.

In the Interior, Chena Hot Springs Resort was the first place in the state to utilize geothermal energy for power generation. The resort installed a 400kW binary-cycle power generation unit produced by United Technologies Corporation (UTC), with assistance from state and federal agencies. The generator runs on 165°F water, the lowest temperature for an operating geothermal power plant in the world. In addition to the electric power plant, Chena uses its geothermal resources for outdoor baths, district heating, refrigeration, swimming pool heating, and to provide heat and carbon dioxide to its greenhouses.

Exploration for geothermal potential has also taken place at Mt. Makushin near Unalaska, and at Akutan, where the nearby Hot Springs Valley could produce up to 5 MW of electricity for the city and local fish processors. Perhaps the most interesting geothermal prospect is at Mt. Spurr, a volcano approximately 80 miles west of Anchorage. For several years, Ormat Technologies, Inc., a worldwide leader in geothermal power plants was exploring on a state land lease near the mountain. After it failed to find a sufficient resource in its first set of explorations, it quit operations after the State of Alaska decided it would cease cost sharing on drilling expenses. Mt. Spurr could still turn out to be a significant resource for Anchorage and the adjoining grid. Geothermal energy is ever-present base load power, and the Spurr resource has been estimated at upwards of 50 MW (approximately 8% of the entire grid-connected area's average annual load). If the resource can be located, it would be relatively easy to connect to the grid, which is approximately 35 miles away. Proximity to a large load, or to transmission, is an issue for most

of Alaska's geothermal, and other "stranded" energy resources. If the transmission grid were extended to a future Mt. Spurr project, it could also pick up wind energy from the nearby "western forelands" of Cook Inlet, and/or a potential hydroelectric lake-tap project at Lake Chackachamna.

Tidal Power, Wave Power & In-River Hydrokinetic Power

Many people in Alaska are excited to harness that state's vast amounts of moving water. Since water is 842 times denser than air, a turbine set in the water has the potential to capture far more energy than if it were set up on land to capture the flow of the air. Cook Inlet, which laps the coastline of Anchorage, has the second highest tidal fluctuation in all of North America. The tides can be predicted centuries in advance, making it theoretically possible for multiple tidal energy generators set up along the coast to produce base load power. The state itself has more coastline to harvest wave power from than the rest of the United States combined. And Alaska's many large rivers provide an opportunity to capture the energy of moving water with devices that often look similar to those deployed to capture the energy of the tides.

Worldwide, most tidal, wave and hydrokinetic energy technologies would be considered "emerging" technologies (the exception are tidal "barrages" or impoundments, which have been used successfully for more than 50 years). Developers are, for the most part, still working to perfect the designs of their devices before beginning mass manufacturing. Many compare the place where these technologies are today with where wind power was 45 years ago. At that time, wind power was produced by 50 kW machines for over 90 cents/kWh. Today, wind is a very commercial power source, with much larger onshore turbines generating power that sells for less than 3 cents/kWh. Meanwhile, today Europeans are building offshore wind turbines that have 160 times the generating capacity of the small turbines of 45 years ago. Though today's low oil prices are making it difficult for tidal, wave and hydrokinetic power to commercialize quickly, most observers still don't believe it will take decades for those technologies to reach commercial maturity. Instead, international drivers such as climate change and national security will likely move those technologies along much faster.

Alaska's reputation as a natural energy technology laboratory has already attracted developers who are working to pilot tidal, wave and in-river hydrokinetic power devices. The Alaska Center for Energy and Power runs a hydrokinetic test center on the Tanana River near Nenana. Ocean Renewable Power Company (ORPC) based in Portland, Maine is investigating tidal power for both Anchorage in Cook Inlet and the tiny community of False Pass in the Aleutian Islands. ORPC has also successfully produced power in the Kvichak River in the village of Iguigig. In 2015, its devices sent power produced by the river's strong current back to the village while more than a million migrating salmon swam past it unharmed.

Resolute Marine Energy, based in Boston, Massachusetts, has been investigating the potential for wave energy near Yakutat for several years. Low oil prices are making it difficult for the company and many others in the industry to raise private capital to fund the pre-deployment technical surveys and other project planning initiatives required by state and federal regulators, or to fund important stakeholder outreach activities.

As noted, the state's vast renewable energy resources and high energy prices have made it a laboratory to optimize renewable energy technologies in small-grid hybrid applications. Those same conditions also make Alaskans ideal early adopters of tidal, wave and in-river hydrokinetic technologies that are likely to become mainstream in the coming decades.

V. OTHER NEEDS: HUMAN CAPACITY, FINANCING AND POLICY

Workforce and Training Investments

Cooperation and the development of highly specialized technologies has been part of the Alaskan legacy for more than 10,000 years. The first humans who trekked across the Bering Land Bridge were energy independent innovators destined to export their knowledge throughout the Americas. Then, as now, survival in Alaska is dependent upon access to natural resources, human capacity and applied technology. Alaska is uniquely positioned to capitalize on renewable energy but it must train Alaskans to operate, maintain and optimize the technologies described in this testimony. Why does this matter? Besides improving the lives of Alaskans, many of whom are already spending more than 50% of their take-home pay on energy, there is also a huge world market for efficient homes and locally produced renewable energy systems for remote communities that may never be connected to a grid. There are an estimated 1.5 billion people on the planet who today don't yet have any electricity, and all of them would like to have it. There are also more than 700 million people around the world who rely on diesel fuel to generate electricity. Most of those could use Alaska know-how to integrate local solar, wind and hydro resources into their grids. Alaskans could help people all over the world advance their local grids and reduce their reliance on fossil fuels.

In 2016, the global renewable energy industry experienced a 7% growth rate. The U.S. market now employs 3 million Americans and is valued at nearly $200 billion per year. Nationwide one out of every fifty new jobs added in the United States was created by the solar industry.[35] Alaska's solar industry is in its infancy and experienced a 94% growth from 2015 to 2016.[36] Wind employment in the U.S. increased by 34% in 2016. And yet, according to a survey taken by the DoE as part of the second Annual National Energy Employment Analysis: "73% of all employers surveyed found it "difficult or very difficult" to hire new employees with needed skills." It is imperative for both the nation and Alaska that we possess a workforce not playing catch up, but one reading itself to lead an industry that is so clearly the future of energy production.

Today a number of entities are working to train the technicians, operators and other specialists that will install, maintain and optimize new clean energy technologies in Alaska. The University of Alaska, vocational colleges, public utilities, government agencies and private entities are all exploring, training and innovating programs to further develop Alaska's workforce. But like so many things in Alaska, the state's vast geography and small population act as both catalyst and impediment to future development. Alaska's infrastructure includes cutting edge technologies and 19th century methodologies. Our workforce includes Native rural residents who live

[35] Solar Foundation, 2016 National Solar Job Census, p.5
[36] Solar Foundation, 2016 National Solar Job Census, p.49

subsistence lifestyles and urban professionals from all over the world. Alaska's greatest research university is located in Fairbanks. Our financial center is in Anchorage. Our laws and budgets are made in Juneau. With these different centers located so far apart from each other, Alaska must make a concerted effort to build a vital clean energy business ecosystem.

REAP believes that a clean energy workforce development in Alaska hinges on a connected strategy to unite K-12 education, University and vocational program content and opportunities. Athough many important, discrete energy education and training programs exist in Alaska at all three levels, virtually all operate independently across a state with a landmass so large it would be the 19th biggest country. The state does not have a comprehensive energy education strategy, or a coherent plan to educate youth from kindergarten through job training. To define a workforce development strategy, REAP is bringing disparate energy education programs together under one umbrella network called the Alaska Network of Energy Education and Employment (ANEEE). Launched in 2017, the ANEEE network will collaboratively develop a strategic plan to unite existing programs and build on Alaska's strengths, while also reviewing approaches taken in other jurisdictions. ANEEE will both build energy literacy at all levels, and enable Alaskans to chart careers in clean energy from an early age. It's time to create a similar network for Alaska's energy education sector. Of paramount importance to Alaska's workforce future is greater coordination, communication and cooperation in creating shared efficiencies amongst Alaska's disparate energy stakeholders.

If Alaska wants to maintain its leadership in developing renewable energy technologies, there must also be a commitment to redouble investment in entities with a proven track record of training Alaskans to work in Alaska. Those include the Strategic Assistance Response Team (START) initiative which consists of technical experts from the DoE's Office of Indian Energy tasked with helping rural plant managers, leaders and tribal officials become more efficient in the planning, development and application of renewable energies; weatherization training done by the Alaska Housing Finance Corporation (AHFC) and the Alaskan Native Tribal Health Consortium (ANTHC); the Denali Commission's Alaskan Rural Maintenance Initiative (ARMI) program devoted to teaching rural leaders how to better implement renewable energy sources, maintain generators and repair equipment in order to conserve resources and secure a more reliable future for their communities; and the Alaska Vocational and Technical College (AVTEC), the state's single comprehensive vocational institution which has the herculean task of attracting, housing and educating Alaskans from throughout the entire state.

The Alaska Center for Energy and Power has also recently kicked off the Arctic Remote Energy Networks Academy (ARENA), an effort to make Alaska the world center in microgrid training. The first cohort of 20 students comes from Greenland, Canada, Russia and Alaska.

Gone are the days when Alaska can afford to rely on a skilled workforce that is not Alaskan grown. Expanding a dedicated clean energy workforce through a greater investment in education and training opportunities must be a part of Alaska's future.

Financing

Alaska has become a world leader in microgrid technology, in large part because the state provided significant support to the industry through the Renewable Energy Fund (REF). The State Legislature created the Fund in 2008 to provide grants for renewable energy projects, with an emphasis on projects serving communities with the highest cost of energy. This led to funding more than 150 grants between 2008 and 2015, most of which were for remote, rural communities dependent on diesel for electric generation. The State Legislature appropriated more than $259 million to the Fund during that time, which leveraged another $200 million in private sector and federal funding. The 60 projects that have so far been constructed in part with REF funding are now displacing the equivalent of an estimated 30 million gallons of diesel fuel every year. At a minimum of $2/gallon, the State's investments are saving Alaskans at least $60 million year. As those projects continue to be optimized, that figure will grow larger.

Alaska's budget deficits have ended appropriations to the state's Renewable Energy Fund, at least for now. However, there are still at least 130 remote Alaskan communities that are still not utilizing any form of renewable energy. Groups like REAP are looking for ways to catalyze future private investment in renewable energy projects in Alaska. One direction is to funnel any future state grant money toward essential reconnaissance and feasibility studies that the private sector will not lend money for. These types of studies must be done to identify both good projects, and ideas that are not yet ready for further investment. A complementary concept is a state "green bank." The Connecticut Green Bank was formed in 2011 and has been extremely successful in taking a relatively small amount of state money and leveraging it with the private sector interest and investment. The Green Bank does this by educating the private banking community on ways to structure clean energy loans in ways that are advantageous for both the borrower and the lender. The result has been a huge increase in clean energy investment in Connecticut. In its first five years, the Green Bank put together $1 billion in clean energy investments.

Federal support for clean energy can play an important role in making these investments work. Whether it's grants that can supplement loans, or federal loan gauruntees, the ability of a Green Bank or similar state investment institution to put together financing for renewable energy projects is enhanced when multiple entities work together to structure loans, and share risks.

As an appendix to this testimony, I have attached information on performance and savings from Alaska's Renewable Energy Fund, an example of a project success story and a spreadsheet listing a number of renewable energy projects that have already been vetted by the Alaska Energy Authority and approved for funding that are still waiting to move forward because no state grant funding or other financing has yet been found.

Policy

REAP understands that Congressional agreements have already been reached on phasing out important federal tax credits that support renewable energy, including the production and investment tax credits. At the very least, those phase-out agreements should not be modified or shortened. If the United States of America would like to be a producer of renewable technologies that the entire planet will increasingly demand, the Congress should consider maintaining a level playing field for clean energy technologies vis-a-vis the generous federal support that continues to be afforded to the fossil fuel industry. China and Europe are well on their way to world market dominance in most clean energy sectors, but if the US decided to compete, Americans still have an opportunity to benefit from the millions of jobs and trillions in revenues that world leaders in the clean energy industry will undoubtedly enjoy in the future.

The US can also support emerging energy technologies that will play a crucial role in our future by increasing the amount of resources it directs to national laboratories, state research institutions and federal programs like APRA-E. Without research, development and deployment strategies, new technologies like tidal, wave and in-river hydrokinetics that could play such a crucial role in Alaska will languish. For example, the federal government could consider devoting much more of the DoE's Water Power Program budget to the direct support of marine renewable energy projects in rural areas.

VI. CONCLUSION

Alaska is at a crossroads. The State Legislature is now in the process of restructuring the state's finances. While there has been talk about "diversifying Alaska's economy" for decades, there has never been a more important time to actually do it. What many are calling a "clean energy revolution" is sweeping the planet. The same kind of technology advances that now allow average citizens to hold the computing power of a 1960s supercomputer in the palm of their hand will continue to drive down the price of technologies like wind, solar, energy storage, tidal power and electric vehicles. The economics of clean energy will continue to get better. In addition, concerns about climate change and national security are only going to increase. Cleaner forms of energy are better for our children and grandchildren, and local forms of energy can make America less dependent on the politics of foreign oil.

Alaska is in an excellent position to capitalize on the fact that the energy challenges of its remote communities (imported, expensive liquid fuel) can lead to a huge opportunity to create a new sector of the state's economy based on Alaskan expertise that knows how to deploy energy efficiency and renewable energy technologies.

For this to become a reality, a constructive relationship amongst the private sector, the state government and the federal government must continue to be strengthened. Federal support for programs like the State of Alaska's Emerging Energy Technology Fund (EETF) would help the state promote energy solutions that help Alaskans in high cost areas, and commercialize technologies that will be sought after around the world. On this 150th anniversary of Alaska joining the United States, there is no better time to increase the strategic partnerships between the federal and state governments, and to recognize the common benefit that each will share if both

governments make a concerted effort to increase support of renewable energy development in the north.

REAP thanks the Committee again for the opportunity to testify, and submit this written testimony. I would also like to thank my colleagues at REAP, Henry Hundt, Chris McConnell and Shaina Kilcoyne, for helping me prepare this written testimony.

PERFORMANCE & SAVINGS

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

REF CURRENTLY OPERATING PROJECTS - 2016 Q3

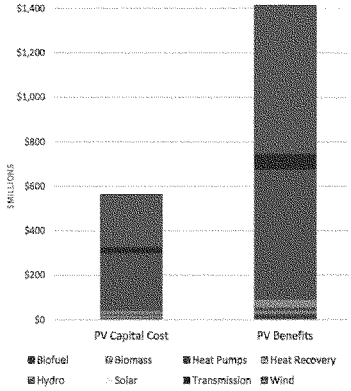


Figure 5 shows the present value (PV) of the 66 projects that are operational at end of Q3 2016.

GRANT AND FUNDING SUMMARY

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

NOTES:

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

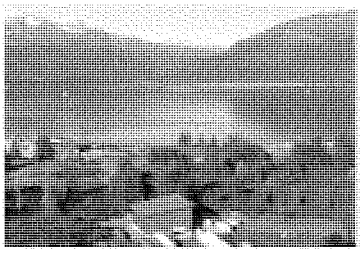
RENEWABLE ENERGY FUND SUCCESS STORY

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

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

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

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



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

Major features of the infrastructure include:

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

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

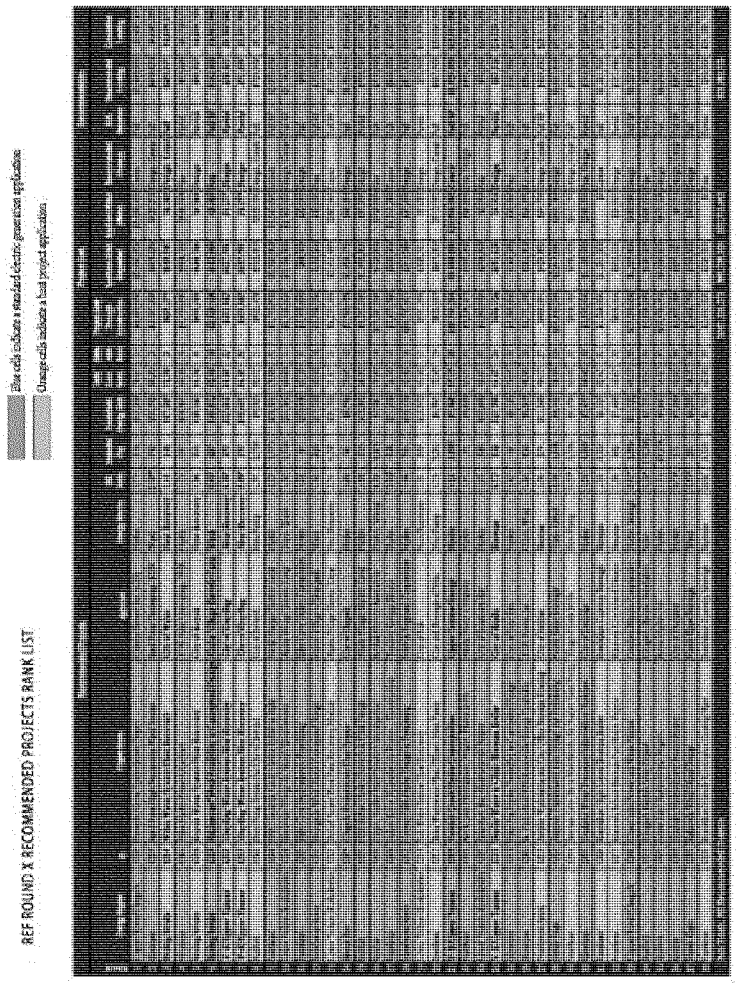
A 700 foot long 16 foot diameter tunnel housing the 36 inch diameter penstock.

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

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

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

Figure 17: Renewable Energy Fund Recommended Projects[37]



[37] See. http://www.akenergyauthority.org/Portals/0/DNNGalleryPro/uploads/2017/1/27/REF%20Round%20X%20Status%20Report.pdf, pg. 10-11

The CHAIRMAN. Thank you.

Last up is Della Trumble. Welcome back to the committee.

STATEMENT OF DELLA TRUMBLE, BUSINESS MANAGER, KING COVE VILLAGE CORPORATION

Ms. TRUMBLE. Thank you. Good afternoon, Senator, Chair Murkowski, Ranking Member Cantwell, and members of the committee. My name is Della Trumble. I am an Aleut from King Cove, Alaska. I am the Business Manager for our village corporation that was created under the Alaska Native Claims Settlement Act (ANCSA). I am also a member of the Agdaagux Tribe of King Cove. And I would like to recognize Stanley Mack behind me, the Mayor of Aleutians East Borough, and Gary Henning, the City Manager for King Cove.

I have lived in and around the Aleutian Islands and the Alaska Peninsula all my life and my ancestors have for 4,000 years. I am proud of my heritage and my connection to this part of the state.

I am also pleased to testify here today since today marks the 150th anniversary of the treaty between the United States and Russia to formally purchase what is now the State of Alaska from the Russian Empire. Residents of King Cove are proud Alaskans and Americans. We are also proud of our community, as we live in harmony with the nature of the seas, land, and resources that surround us.

Together, the unique human and natural environment of rural Alaska brings many opportunities and challenges to improve our lives. I also realize the infrastructure needs in rural Alaska for energy, water, sewer, landfills, and transportation facilities have enormous costs that all levels of government are struggling to deal with these days.

I would like to provide some examples of our forward thinking regarding infrastructure development in King Cove. My community has experienced the positive value of forming partnerships with the city government, the village corporation, and local tribes for developing renewable energy facilities. Since 1994, an environmentally friendly run-of-the-river hydro facility has been providing more than 50 percent of the community's annual energy supply. This hydro facility, Delta Creek, has been the most productive, single-site, renewable energy facility anywhere in rural Alaska. At $0.30 a kilowatt hour, King Cove has the cheapest, a relative term, cost of electricity anywhere in rural Alaska from the more than 150 single-site utility grid communities. In Cold Bay, the closest community to King Cove, they are paying $0.67 a kilowatt hour, which is more than twice the cost that we pay in King Cove. There are 150 single-site grid communities. The average cost is $0.45 a kilowatt hour. So we are very fortunate.

Our Delta Creek Hydro Project was built on land owned by the King Cove Corporation and partially funded by the U.S. Department of Energy grant to the Agdaagux Tribe. The city also borrowed $2 million, one-third of the total project, from the U.S. Department of Agriculture. Since 1994, Delta Creek has displaced over 3.5 million gallons of diesel fuel and saved over $5.5 million in electric utility operation costs. These reductions have translated into an annual household savings of about $1,000 a year. There is

no comparison in rural Alaska where a community for the last two decades has so drastically reduced its dependency on diesel fuel.

We are excited to report that in October 2017 the new Waterfall Creek facility will come online, and this will benefit and aid savings of over 75 percent of King Cove's annual energy demand of 4.5 megawatts. The annual energy production from these two hydro facilities will replace more than 300,000 gallons of diesel fuel a year.

The Waterfall Creek hydro is costing $7 million. It was also built on land owned by the corporation. The city is incurring the debt for about 50 percent of this cost. This is considerable debt for our community to incur, but our experience with Delta Creek has instilled our thinking that the power of renewable energy is a key component to the sustainable future.

I would also like to note that $1.5 million of costs for Waterfall Creek has incurred in the State of Washington with the fabrication of turbine, generator, penstock, and the shipping of this material and construction equipment from Seattle to King Cove. Given our geographic location, we depend on a strong business relationship with the Pacific Northwest, as you stated earlier.

Finally, our hope is that our renewable energy accomplishments in King Cove will further encourage our neighbor communities to move forward with proposed tidal wave energy in False Pass, additional wind generation in Sand Point, and geothermal energy in Akutan.

Madam Chair, this hearing is about infrastructure improvements needed to reduce the cost of living in Alaska. But for those of us in King Cove, the key infrastructure to reduce our cost of living is the 11-mile road connecting King Cove to the Cold Bay Airport.

And how will this reduce our cost of living? If you had witnessed a crash at the King Cove Airport with your daughter on board, as I did a few years ago, you would understand my cost of living comment and that every resident in King Cove is an emotional cost of living with potential danger to our lives and those of our loved ones almost every time we have to fly between King Cove and the Cold Bay Airport to access health and medical services in Anchorage, which cannot be provided in our small clinic.

However, our clinic can provide one thing that many of us do not really want to have, and that is a two-pill prescription of Valium, one to fly out of King Cove and one to fly back. This is indicative of the fear of flying that the majority of our residents have because of our unusual turbulent weather.

This committee is familiar with the status of King Cove and its need for basic transportation infrastructure in the form of an 11-mile, one-lane gravel road connecting our communities.

Madam Chair, we really need this road now and it is a vital element of missing infrastructure in King Cove to our well-being and will change our cost of living so that our residents can have a safe life and not always have to worry about every time we risk our lives traveling for medical and health and safety reasons.

Since the unfortunate decision by the Department of the Interior on December 23, 2013, King Cove has experienced 58 medevacs to save lives, including 17 by the U.S. Coast Guard.

Again, thank you, Madam Chair, for continually championing our cause. We also would like to thank our Governor, Bill Walker, and

our delegation. The Governor's presence is particularly felt because of his vision and commitment to ask the State Legislature for $10 million in state funding to help for paying for this road. All we need is for Congress to say yes one more time for legislation that will finally allow for this lifesaving road to be built.

Again, I thank you, and I hope that our full testimony can be on record. It looks like I went way over the time, and I apologize. Thank you.

[The prepared statement of Ms. Trumble follows:]

Testimony of Della Trumble
Business Manager of the King Cove Village Corporation

Testifying Before
Senate Energy and Natural Resources Committee
Regarding
Rural Alaska Infrastructure Needs

March 30, 2017

Good Afternoon Senator and Chair Murkowski, Ranking Member Cantwell, and Members of the Committee. My name is Della Trumble. I am an Aleut from King Cove, Alaska. I am the Business Manager of our village native corporation that was created from the Alaska Native Claims Settlement Act. I am also a member of the Agdaagux Tribe of King Cove.

My ancestors have lived in and around the Aleutians Islands and Alaska Peninsula for over 4,000 years. I am extremely proud of my heritage and my connection to this region of Alaska.

I am also pleased to be testifying here today since today marks the 150th anniversary of the Treaty between the United States and Russia to formally "purchase" what is now the State of Alaska from the Russian Empire. The residents of King Cove are proud Alaskans and even prouder Americans. We are also proud of our community and how we live in harmony with the rugged nature of the seas, land, and resources that surround us and improve our lives.

Together, the unique human and natural environment of rural Alaska brings many opportunities and challenges to improve our lives, particularly if creativity, determination, and persistence are used to address these needs. I also realize that the basic infrastructure needs for energy, water/sewer, municipal landfills, and transportation facilities have enormous costs that all levels of government funding are struggling to adequately respond to.

Renewable Energy in King Cove

I would like to provide some examples of our successful forward thinking in King Cove. My community has experienced the positive value of forming partnerships between the local government, the village native corporation, and the local tribes for

developing renewable energy facilities. Since 1994, an environmentally friendly, run-of-the-river hydro facility has been providing more than 50% of the community's annual energy supply. This hydro facility, Delta Creek, has been the most productive, single-site renewable energy facility anywhere in rural Alaska. At $.30/kilowatt-hour, King Cove has the "cheapest" (a relative term) cost of an electricity anywhere in rural Alaska from the more than 150 single-site utility grid communities. In Cold Bay, the closest community to King Cove, the cost of a kilowatt-hour of electricity is $.67 – more than twice the cost in King Cove.

Throughout rural Alaska's 150 communities, the average residential cost per kilowatt-hour is $.45/kilowatt-hour. This is 50% more cost than in King Cove. Another interesting comparison is that the average, residential cost per kilowatt-hour in the Lower 48 is $.12

Our Delta Creek hydro was built on land owned by the King Cove Corporation and partially funded by a U.S. Dept. of Energy Indian grant to the Agdaagux Tribe. The city also borrowed $2.0 million, one-third of the total project, from the U.S. Department of Agriculture. Since 1994, Delta Creek has displaced over 3.5 million gallons of diesel fuel and has saved over $5.5 million in electric utility operation costs. These reductions have translated into saving King Cove households about $1,000/year in energy costs. There are simply no parallel comparisons in rural Alaska where a community has so drastically reduced its dependency on diesel fuel generation.

Now, we want more! I am excited to report that our second hydro facility, Waterfall Creek, will come online in next month (April 2017). This facility will also be a run-of-the-river hydro adjacent Delta Creek. Together, these two renewable energy facilities are expected to produce over 75% of King Cove's annual energy supply of 4.5 megawatt-hours (MW) demand. The annual energy production from these two hydro facilities will save King Cove more than 300,000 gallons of diesel fuel a year and significantly reduce the amount of carbon emissions in our community.

The Waterfall Creek hydro facility is costing $7.0 million. It is also being built on land owned by my corporation. The city will be incurring debt for about 50% of this cost. This is considerable, additional debt for our community to incur, but our ongoing experience with our Delta Creek hydro facility has instilled in our thinking

that the "power of renewable energy" is a key component to our sustainable future. One minor frustration I would like to note on the funding of Waterfall Creek was our corporation's expectation, in partnership with the City, that in 2014 we would be award another modest grant, less than $1.0 million, from the U.S. Dept. of Energy Tribal Clean Energy Program. However, we were disappointed to learn that all those grants were awarded for solar energy projects to tribes in the Lower 48.

I would also like to note for Madame Chair and Ranking Member, Senator Cantwell, that approximately $1.5 million of the costs for Waterfall Creek have incurred in Washington State with the fabrication of the turbine, generator, and penstock and the shipping of this material and construction from Seattle to King Cove. Giving our geographical location relative to the Pacific Northwest, and in particular Seattle, we depend on a strong relationship for major steel and equipment fabrication and transportation from our southern neighbors.

Our hope is that our renewable energy accomplishments in King Cove is spurring on our neighbor communities to move forward with proposed tidal wave energy in False Pass, additional wind generation in Sand Point, and geothermal energy in Akutan. The average cost of a kilowatt-hour of energy in these three neighboring communities is about 35% more than King Cove. We are also pleased to know that King Cove's success with our hydro facilities are being used as examples for other communities that are now developing other small, run-of-the-river hydro facilities. Clearly, affordable energy is a key component of our future.

Transportation Infrastructure in King Cove

Madame Chair – this hearing is about infrastructure improvements needed to reduce the cost of living in Alaska. For those of us in King Cove, the key infrastructure to reduce our cost of living is the 11-mile road connecting King Cove to the Cold Bay Airport. How will this reduce our cost of living?

If you had witnessed a crash at the King Cove Airport with your daughter on board as I did a couple of years ago, you would understand that my cost of living, and that of every resident in King Cove is the emotional cost of living with potential danger to our lives and that of our loved ones almost every time we have to fly between King Cove and the Cold Bay Airport to access health and medical services in

Anchorage, which can not be provided at our fine, but very limited, health clinic in King Cove.

However, our clinic can provide one thing that many of us do not really want to have and that is a two-pill prescription of Valium. One pill for when we fly out of King Cove and one pill for the way back into King Cove.

This Committee is very familiar with the status of King Cove and its need for basic transportation infrastructure in the form of an 11-mile, one-lane, gravel road connecting our community to the Cold bay Airport.

Madame Chair – we really need this road now. It is the most vital element of missing infrastructure in King Cove to our well-being and will change our cost of living so that our residents can have a real, safe life and not always have to worry every time we risk our lives to travel for medical and health safety reasons – an activity that Lower 48 Americans take for granted every day of their lives.

Since the unfortunate decision by the Department of Interior on December 23, 2013, King Cove has experienced 58 medivacs to save lives, including 17 by the U.S. Coast Guard. We need this road now.

Thank you, again, Madame Chair, for continuingly championing our cause. We also thank the rest of the Alaska Delegation and Alaska Governor, Bill Walker, whose presence is felt particularly because of his vision and commitment to ask the Alaska State Legislature for $10 million in State funding to help pay for this road. All we need is for the Congress to say YES one more time in legislation that will once and for allow for this lifesaving road to be built. The savings that the emotional and safety factors will contribute to our cost of living are absolutely priceless!

Finally, Madam Chair, I ask that you include my testimony and the testimonies from Mayor Stanley Mayor and President Dean Gould (King Cove Corporation). All of us were born and raised in King Cove. These testimonies were provided at this Committee's hearing last September 21, 2016 on S. 3204 – "The Need for Reliable Emergency Medical Transportation for the Isolated Community of King Cove, Alaska." These testimonies tell our story including the emotional cost of living that is at stake here and why this road is such a vital infrastructure need for our community.

Thank you for this opportunity to testify. I would be happy to answer any questions the Committee might have for me,

The CHAIRMAN. Della, thank you. Yes, you did go over the five minutes, but what you have included as part of the record merely supplements much of what we have heard in this very committee room over the years about the need for that lifesaving road. So know that the commitment is there to work with you and Mayor Mack and all of the fine people of King Cove to assure that this small piece of infrastructure is addressed. I think it is no secret to anyone. We have been talking early with this Administration to make sure they know that it is not only a priority of this delegation, but why it is a priority of so many Alaskans. So we continue in that area.

I really appreciate all that you have provided for the committee today, and I want you to know that while we do not have a lot of committee members here this afternoon, know that it is Thursday afternoon, and we will have one more vote I believe in about 40 minutes or so. But what you are providing today is comment for the full committee record. So while members might not be here to personally question you, what we are laying down here this afternoon helps to form the basis for much of what this committee will be attempting to advance as we work toward legislation.

You all know that last year Senator Cantwell and I and members of the committee worked very aggressively to build a comprehensive energy plan, something that the Congress has not seen in close to ten years now. We were very close to moving that, but we did not get it across the finish line. Well, we started that back up again today. In this morning's Energy Committee Business Meeting, we were able to advance 62 bills across this dais ready to go to the floor to be packaged as part of that comprehensive bill.

Much of what we did last year—you mentioned the efficiencies, Chris, and some of the progress that needs to be made. When you think about the ability to provide for financing and opportunities for things like hydro, being able to identify that as a renewable resource and make available opportunities on the federal side because of its designation as a renewable resource is going to be important to us. So we are picking up where we left off—some of that. But what you have done today has really helped to supplement that.

Now, I want to gain from you information about some of the infrastructure and why it is so significant to us in Alaska because, I will tell you, part of my problem here is when the President is talking about an infrastructure package, he is talking about a big infrastructure package. They are using the T word, that it is going to be trillions of dollars. What they want, what everybody wants, is the big package. They want the big project.

Well, in Alaska, part of our problem is the big project may cost a lot of money, but when they look at it from a cost-benefit analysis, the number of people that you are benefiting there in Sitka is not as many as you would be able to benefit if you were in the Lower 48 and you have a significant hydro project. In the Port of Nome, they look at the population of Nome and they say, well, spending that kind of money, $14 million, here—and how many full-time residents do you have? Then, of course, there is always the story of King Cove. We are talking about a community of less

than 1,000 people. So why are we spending so much money on a road?

So what I would like to ask—I think I will target my first question to you, Bob and Joy and Della. When we are talking about these infrastructure projects, if you can speak to the significance of not only the impact to the year-round residents, whether it is Sitka, Nome, or King Cove, but to the region, the ripple effect that comes when you can get goods delivered cheaper in Nome—how that translates into smaller communities that are more in the interior. I would like you each to speak to how you would educate my colleagues about the benefit of these higher cost infrastructure projects to what on paper would be a difficult cost-benefit analysis.

Who wants to go first? Let's go to Sitka.

Mr. POTRZUSKI. Thank you, Senator.

As I pointed out, Sitka is the 11th largest fishing port in the United States, and we do not eat all that fish. Obviously, it goes elsewhere. And right now we are walking a real thin line with our current infrastructure. Our electric department likes to say that it was new in 1982. If we have a major transmission line disruption, we could literally be without power for months, which would decimate the fishing industry, processing industry, in Sitka. The amount of money that generates region-wide, you know, when you have fishermen that come from all around southeast Alaska and even from the Northwest to fish in Alaska, it certainly would have a deleterious effect on that. So we are desperate to try and figure out how to upgrade our infrastructure so that we can continue to provide that service that Sitka does. Is that helpful?

The CHAIRMAN. Yes, thank you.

Joy.

Ms. BAKER. Thank you, Senator.

I believe that it is clear that the transshipment costs in Alaska are significantly high. They are increased much more exponentially in the western Alaska region. In order to reduce those costs and gets those goods transshipped to the remote coastal communities, we truly need to get the deeper draft vessels into Nome, which will bring increased efficiency through the larger tanker delivery capacity and lower the cost for transshipping in the region of not only fuel, but also for goods and exporting gravel to develop and build these communities and expand. We provide the gravel resource for the majority of the airports, roads in these communities, and they are paying the transshipping costs of a lighter draft barge to come in and load and bring to their community. I think the increased step is extremely important in order to lower the cost of distributing those goods and services to these regional communities to allow them to lower their cost of existence in these remote locations.

The CHAIRMAN. Della, I think you indicated that you had replaced 300,000 barrels of diesel by your project. Is that right?

Ms. TRUMBLE. Senator, I am going to have Gary answer that, but yes, it is 300,000 gallons. I think looking at that, that basically changes into a large savings when you are looking at not only moving that 300,000 gallons from Washington to Alaska, having to use less. But Gary I think could probably answer a little better on anything that needs to be added to that.

The CHAIRMAN. Gary Henning.

Mr. HENNING. Real quickly, Senator. The savings in fuel pays for the debt service that we have had to incur. It has allowed for the community to know that we can have a stable and cheap kilowatt hour for King Cove for at least the next 20–30 years. And we did not talk about certainly taking the carbon out of the environment and what that does for the residents of King Cove as well.

The CHAIRMAN. This is another area of inquiry that I would like to get out on the record. We are talking about cost savings most clearly, but there is clearly an environmental savings. You just mentioned, Della and Gary, that you are seeing a significant reduction in terms of the amount of diesel that you are bringing in. The whole aspect of the carbon—you know, when you think about the transshipment issues that you face in a place like Nome where you are lightering from one vessel to another, whether it is fuel, whatever the resource is, it is an issue that if you have an opportunity for a part where you can tie up to dock, you not only have cost savings, but you have environmental issues that you are able to eliminate as well.

Ms. BAKER. Yes, Senator. The offshore ship-to-ship transfers have significantly increased the last three years. One event that comes to mind is when Secretary Darcy was in Nome last year and noticed the tanker sitting offshore, she asked what they were doing. We shared with her that they were transferring fuel back and forth. And she was surprised and said we need to do whatever it takes to get that gas station back on shore. It needs to be on shore, not on the water. So she made a very quick deduction that that was a risk, which of course it is. I think that is why we have the significant support of some of the regional communities, Bethel Native Corporation, St. Mary's Native Corporation, to expand the Port of Nome and reduce those risks for those offshore transfers and reach the cost savings that they so desperately need.

The CHAIRMAN. We are all reflecting a little bit on Alaska's history today. My grandparents lived in Nome in the mid to late 1920s, and we still have pictures and actually video that my grandfather took of the steamships that were anchored off. And what people did for entertainment was to watch as the small boats were loaded with people as they were coming onto shore basically riding the rollers in, not exactly a fun ride, but that is how people got to shore from the steamships then. That was 100 years ago, yes, and we are still in the same situation where, hopefully, they are not watching that for entertainment.

I want to talk a little bit here about some of what Steve Masterman has advanced with the discussion about what we have with our resources underground, whether it is our mineral wealth, whether it is our oil, and whether it is our gas. We had a hearing Tuesday of this week focused on critical minerals and the reality that as a nation we have done a woefully poor job of understanding that mineral wealth, that resource wealth in terms of mapping it. We were given an updated assessment from USGS on some of Alaska's assets that have been identified.

What do we need to do to ensure that we have a better understanding of what it is that we have? Again, I started off my comments by recognizing that we have really, I think, a good and a

strong atlas of our renewable energy resources, and I think that that is an important thing for us to know where these assets lie. Not everything is situated equally. Wind is not good everywhere. Certain renewables just do not work everywhere. But how are we coming in your view in understanding our inventory of the minerals that we have available to us?

Mr. MASTERMAN. Senator, if you have to leave in 45 minutes, I will have to be brief. [Laughter.]

We are way behind the power curve, Senator. As you may be aware, our state is large. Geological mapping started in our state in the end of the 1800s, and we are right now—two-thirds of our state is mapped to the scale of 63,360 feet to one inch for geology. Sixteen percent of our state is mapped to the scale of an inch to a mile, which is really what we consider to be the usable scale, and about 0.1 percent is mapped at an inch to 24,000.

The CHAIRMAN. What is the Lower 48 mapped to?

Mr. MASTERMAN. I heard that in the testimony that was given here recently that the number was about a third mapped at a usable scale for energy and resource development and infrastructure. I am not sure whether that is an inch to a mile or they are talking about 1 to 25,000. So when you factor in the area of Alaska, the Lower 48 is probably about 50 percent mapped, and our state is 16 percent mapped.

If you look at some of the other data sets that are required for mineral development, airborne geophysics being one that is very rapid to acquire, we are about four percent mapped with regard to that data set.

Geochemical surveys. The Lower 48 recently completed a soil geochemical survey for the entire Lower 48 states. It has not begun in Alaska here, so that is 0 percent complete.

Our stream sediment surveys, which are really an arrow as far as pointing at where mineral occurrences may be present—say you take an element like silver, which Alaska is the largest producer in the nation of silver. Only 15 percent of the quadrangles in the state have an adequate number of stream sediment samples that would allow any modern exploration company to evaluate whether silver might be an economically viable commodity there.

Mineral assessments. Mineral assessments in our state were essentially stopped in the 1980s under the AMREP program and none have really been completed since then. So those need to be updated because many of the commodities that are currently being used—and rare earths being a fine example of that—were not well understood, were not well documented at that time. In order to do those mineral assessments, you really have to do the foundational information. Otherwise, it is garbage in, garbage out. So the basic mapping needs to be completed and then the mineral assessments need to be updated.

The same really can be said for the petroleum systems too. The USGS has done a fine job of assessing their remaining undiscoverable oil and gas potential in the state, but some of those assessments have proved to be inaccurate I would say. They have underestimated the amount of oil and gas that is present. The recent discoveries at Pikka and Willow on the North Slope highlight that, that they do not really account for those recent discoveries in

their estimates of undiscovered, potentially recoverable oil. So I think there is a lot to be done in terms of the petroleum geology to our understanding that, as well as redoing the petroleum assessments for the North Slope.

The CHAIRMAN. Well, thank you for speaking to where we are on land. I think we recognize that offshore we are also woefully unmapped, uncharted. We talk a lot here in this hearing room about how so much of our offshore areas are either uncharted at this point in time, unmapped, or we are relying on lead line readings taken back in the day of Captain Cook. Unfortunately, every now and again, we find a vessel that encounters something that was not on somebody's chart, and we saw that just last year off of Unalaska.

So much of all of this, whether it is an inventory or mapping, all comes down to money, and it is getting tougher on the state side, of course, and it is not really that much easier on the federal side either.

One of the things that I think we learned from Alaska and what Shell was attempting to do in the offshore several years back was they recognized that there needed to be greater mapping. And so what we saw was the private sector industry needing to get the information, doing much of it themselves, and then sharing that information. We saw a partnering, if you will, that allowed for some of the work that I think most would expect has already been done up in Alaska.

I would ask you, Kara, the effort right now on the offshore is pretty quiet after the Obama Administration. We do not know what the incoming Administration is going to be doing with the five-year lease sales. It is my hope that they are going to be relooking at that and that we will see renewed opportunities in our offshore. But can you speak to the collaboration that we have seen between industry and government as we are providing for some of what I call basic infrastructure, which is mapping and charting?

Ms. MORIARTY. Thank you, Senator.

As you mentioned, you gave Shell as the example of how their industry investment led to increased infrastructure around the Arctic, whether it was supporting local communities so that they could support them, assuming that there would be a development. But that is not unusual. As I mentioned in my testimony, industry will invest private sector dollars if they think there is an economical project there and if they have the framework to do so.

And that partnership between industry and whether at the federal, state, or local government frankly, has existed ever since we started oil and gas development in Alaska 60 years ago, starting in Cook Inlet. Some of those initial roads on the Kenai Peninsula were roads for oil and gas, and then they become shared roads. And then they become shared—it is the reason that you have a utility, and now you have a refinery. And the same way with the North Slope.

The state relies an awful lot on our data, whether it is scientific data regarding polar bear denning, and the industry usually has the latest and greatest technologies that they can employ and deploy for whether it is, as you mentioned, mapping or other infrastructure needs. Having a strong partnership is important, and we

view our partnership with the State of Alaska as just that, a partnership. And so there is a litany of examples that happened either during Shell or happen today about how when industry comes, there is a benefit for all.

The CHAIRMAN. Let me ask you, Chris, because you mentioned the Connecticut Green Bank as something innovative. As we are looking to perhaps be a little more creative when it comes to financing because while we are talking about significant projects out of this Congress, it may or may not happen. I do not know. But what I do know is that Sitka is going to continue to struggle to deal with their energy situation. The fine folks in King Cove are paying for that debt servicing.

What do we do? How can we be attractive to the outside when we are talking about microgrids, when we are talking about small systems that benefit small populations? And, again, that was why I asked—is there a bigger impact? I think we recognize that. But when you are looking at it on a spreadsheet, it costs a lot, with few people served. How do we become interesting to those investors? How do we lessen that risk that comes with an extraordinarily high-cost environment that Alaska just is?

Mr. ROSE. Senator, I think that is a really good question a lot of us are thinking about. As you said, there are a lot of communities that do not have a tax base. They do not have a lot of people there, and yet they are struggling every month to pay utility bills. The money is coming from somewhere. So what we want to be able to do is take that cash-flow and somehow be able to use it in a financing scheme.

What the Green Bank has been able to do is really educate private investors, banks that do not really operate in the energy efficient and renewable energy space yet to make them understand how they can structure a deal so that the state can de-risk it a little bit. Maybe there is some federal money in there that helps derisk it.

It is really a no-brainer with energy efficiency. The Governor's office and a couple other folks down in Juneau asked Mr. Hunter this week, what is the pitfall? What do you have to worry about? And he said, "waiting."

The CHAIRMAN. Waiting?

Mr. ROSE. Yes, waiting. Do not wait because we are spending this money. The status quo is we are spending $5 billion a year.

But on the microgrids, we are a natural laboratory. We have these remote places. We have these really high energy costs. And when you are looking at just more mature technologies like wind and solar, it is really about the integration and use of storage. And the price of storage keeps coming down. So what we are really good at is not so much we are building a wind turbine or a solar panel. We are really good at integrating them. So we are like the chef that is putting all those ingredients together.

One of the things we can be doing is exporting our expertise to those 700 million people around the world. We have been invited to several continents over the last couple years to talk about this, because even though we think we have a long way to go, we are seen as world leaders in these hybrid microgrids.

But then there are all these emerging technologies, and storage would still be considered that because the price keeps diving. So there is a lot of new storage technologies coming.

Electric vehicles are still something that is going to explode, but is that kind of a nascent point right now?

Ocean power, tidal wave, hydrokinetics. We believe that those kinds of things are going to be commercialized in the future. But really Alaska is one of the only places certainly in the United States, if not the world, where developers are attracted because they can come in and do a pilot project and save money off the bat. You know, a $0.60 tidal power project does not do anything for you if you are in Boston, but if you are beating $0.70 power in a community, then all of a sudden you have got a little different economics.

So these public-private partnerships for financing are possible. On the efficiency side, again I think they are really no-brainers. We just have to be able to package those deals for the private sector so they understand how to do it.

Right now, for instance, the property assessed clean energy programs that are around the country. Thirty states now have PACE. Our state legislature is about to pass a PACE program, and that is going to allow commercial building owners another financial tool to borrow money from a local tax assessment district and pay back that loan on the retrofit for their building through a tax assessment. But guess what? You know, the municipalities do not want to be the lenders, so the banks come in, and then they are the ones who are providing that money.

And when Connecticut first started doing this, they had a tough time just kind of getting the ball rolling. Now basically the banks just take it all. They have facilitated the process to where now the banks are taking all that because they are making money, and it is a very secure loan.

So I think there are ways for us to do it, but the federal support in R&D is super important. We are not going to benefit on things like ocean power if we do not have also federal support for those kinds of technologies because the Europeans are doing that. I mean, there is a great center for that in Scotland right now, and there are places around the world who see this stuff is going to happen. So for America generally to be supportive of renewable energy on a level playing field is really going to help Alaska do the same thing. We have great relationships with the national laboratories, and we would like to see those continue.

The CHAIRMAN. I think the national labs are key, and what I keep pressing them on is we can be your real-life incubator up here because we have got a lot of good ideas. We have got a lot of people that are not held back by saying, well, we tried that before and it did not work. I think we have a lot to advertise in that way.

I always look at, particularly, our southeast communities that are really powered by hydropower, whether it is Sitka or Ketchikan or Juneau. They are on an island. Why do the electric vehicle manufacturers not say, aha, you are my test case because I know that I am not going to really have to worry about building a system of charging stations that stretches across the country. You only have 14 miles in Sitka. Is that what you said? I think we can do charg-

ing stations along 14 miles. Use these communities that are powered by hydro to figure out how you make it work.

You brought up a point, though, Chris, that we have a renewable energy fund in Alaska. Unfortunately, it has no money. The opportunity to be the great innovator on the state side has really slowed us down.

Again, in Alaska, we are blessed to have an abundance of wealth. We have got the renewables and the potentials, but we also have our traditional fuels. We have our minerals. We have our oil. We have our gas. And we can use that to help fund the opportunities and the build-out for our renewable potential. We need to be unleashed to do just that.

So I want to ask you, Kara. NPRA. We are all talking about how we get that oil pipeline, how we get TAPS full up again. It was four years ago that President Obama approved a new land plan for the National Petroleum Reserve Alaska (NPRA), and he basically put 52 percent of the NPRA off limits. It did leave a corridor for a west-east pipeline. But I guess the question to you is in view of the actions that were taken under the previous Administration and the opportunities that we now have in a new Administration, your thoughts on whether that plan should be revised and revisited.

Can you talk just a little bit about the opportunities that exist within the NPRA? Obviously, there is a great deal that is going on that is exciting on the state side with some of the recent finds, but more specific to the federal aspect and opportunities within the National Petroleum Reserve Alaska, and how we work to make sure that as we develop, we do so with care for the environment, for the wildlife, the waterfowl, just speaking to NPRA here.

Ms. MORIARTY. Well, thank you, Senator.

As you mentioned, the current land use management plan in the National Petroleum Reserve Alaska I would characterize as problematic at best. Even though some can say well over half of it is available, if you look at a map now of NPRA and the land use and where you can and where you cannot, it is like a patchwork quilt. It is hard to decipher. It almost looks like the land ownership map of Alaska as being complicated.

There are a lot of wonderful opportunities. Obviously, we have the first production from NPRA now finally. And that goes to what I was referencing before. Taking seven years to get a bridge across a river really impedes industry's appetite for putting private sector dollars in either federal lands or local lands or state lands. And we think there is more oil around NPRA. We had a very successful lease sale around those same prospects, if you will, of where Conoco Phillips currently is.

But there is also some really exciting developments just outside NPRA. I think Mr. Masterman mentioned it with the Willow discovery of Conoco. That is a 120,000 barrel a day a field. So let us start doing some math. So current production is around 500,000. It might actually be a little higher, 540,000 barrels a day. So we think that field could have 100,000 to 120,000 barrels a day.

Just north of NPRA is a major new discovery called Smith Bay by Caelus Energy. It could have as much oil as Kuparuk. It is a massive discovery. Now, it is 120 miles from TAPS. And the challenge will be with the current land use management plan how will

we build a pipeline because you are not going to do a zigzag, the corridor that may or may not have worked if we get an east-west pipeline across NPRA from the Chukchi—that is not going to work. That corridor did not have Smith Bay in mind. So that could be another 100,000 plus, 200,000, maybe even up to 200,000 barrels a day. So if you go Smith Bay, then you go over to Willow, then you have Armstrong and Repsol have announced a new discovery in the Pikka unit, that is 100,000 barrels a day. Then if you keep going over to TAPS, if I have my map here, just north of that is where the Liberty project is, and that is in federal waters, and that could be 70,000 barrels a day.

So if you put all of those projects in what I call near-term—and near-term in Alaska is five to ten years. But if all of those projects came online in the next decade, which is reasonable—it is not out of the question—we could double our production, which would be absolutely significant not only for the industry but really for Alaska's economy.

So we are very encouraged by the new Administration's interest in looking at some of these previous decisions. We are encouraged by the decision that was made yesterday in looking at other areas around my friends in the coal industry. So we are hopeful that this Administration will revisit what we think are unreasonable expectations and management plan.

But we are not asking for access anywhere and everywhere to do anything we want, and I think that is an important point to emphasize. Of course, we want to protect the environment that we live in and work in, and we want to work with those communities closest to the environment in our projects. And on the North Slope, we are talking about the Village of Nuiqsut. We want to be in lockstep.

But you also have to start thinking about the community of Barrow. They are very excited about what the Smith Bay opportunity could mean for them and actually getting a road from Barrow potentially all the way to TAPS and to connect to the Dalton Highway. They are very landlocked, as the Port of Nome or down in King Cove.

And so there is a lot of excitement, and I think that is why it will be really important that as we look at these opportunities, that all of the stakeholders are at the table together so that we can identify these common core corridors that not just have a benefit for an oil prospect like Smith Bay, but can really benefit the whole community.

The CHAIRMAN. Steve, do you want to add to that?

Mr. MASTERMAN. Yes. Thank you, Senator. I just would like to speak a little bit to add to Kara's comments about the potential inside the NPRA and in the near-shore waters just north of there.

The discoveries by Conoco and by Armstrong and by Caelus are essentially new play types on the North Slope, which means that those play types are essentially unexplored for the rest of the area.

So just to be a little geeky, the Willow and Pikka unit discoveries in deltaic sediments that were deposited by a river that flowed from west to east, and those same sediments have been found in drill core on the west coast of Alaska at Wainwright. That is 200 miles away. They did not have any oil in Wainwright, but those same rocks were highly porous, highly permeable, an excellent res-

ervoir host if oil was present. That is 200 miles of essentially unexplored territory between there and the Willow discovery that is in NPRA.

The same can be said for Caelus' Smith Bay discovery. Those sequences of rocks are also essentially unexplored along the Barrow arch, along that stretch of the coast.

So the potential for additional discoveries in that part of the state is extremely high. And as an economic geologist, that is what we like to call blue sky potential because there is a lot of blue sky there, Senator.

The CHAIRMAN. Good to hear.

You know, when we talk about any kind of a project, though, you need to be able to get your permits, you need to have a little bit of regulatory certainty. That is something that we have heard in all three of the prior infrastructure hearings that we have had. My hope is that we will have a little bit more success with where we are with just moving forward from a certainty perspective and from an ease of permitting, not relaxing on standards, but just making sure that there is a process with some deadlines that you can kind of count on because I do realize that when you are sitting and waiting for the permits and they are not coming, that means you are sitting on the opportunity to advance a project and that costs money. So that makes everything a little more complicated.

I am told that I have less than five minutes on the vote, so I am going to have to excuse myself. Because we are on Senate time, so I think if everybody has like 22 seconds to say one thing that you want this Energy Committee to remember about Alaska and Alaska infrastructure, what would it be? Steve, we are going to start with you. One thing on Alaska infrastructure.

Mr. MASTERMAN. We need a lot more of it, Senator. We need more roads primarily to access the mineral-bearing lands. As I mentioned in my testimony, almost all of the mines and the advanced stage projects are within 50 miles of a road. If you are more than 50 miles away from a road, the economics get a lot harder. So we need more roads, a road west to Nome. A road down along the Kuskokwim River road on the west side of the Alaska Range would open up vast areas of the state to mineral development.

The CHAIRMAN. We are one-fifth the size of the country, and we have less than one percent of the roads.

Mr. MASTERMAN. That is correct, Senator. It is actually less than one-half of one percent of the roads.

The CHAIRMAN. Less than one-half of one percent. I overstated. Okay.

Mr. MASTERMAN. So really more roads. More access equals more development just because it reduces the cost of developing those facilities.

The CHAIRMAN. Good, great.

Bob.

Mr. POTRZUSKI. Capital costs in Alaska are significantly higher than elsewhere.

The CHAIRMAN. And we need to appreciate and understand that up here because it is not always apples to apples, and I really appreciate you bringing that up.

Joy.

Ms. BAKER. Yes. Thank you, Senator.

The Port of Nome is an existing developed port facility. We are ready to move forward with expansion to address the needs of the larger vessel fleet.

The CHAIRMAN. Shovel ready.

Kara.

Ms. MORIARTY. Senator, I think on this 150th anniversary of the Alaska purchase, I think it would be important to remind your colleagues that if there is a cost-benefit analysis done today, like your colleagues are asking you to do for Alaska projects, it probably would not pencil, but it was probably a good deal. And if they are looking for big projects, that is all we do in Alaska is big. We have big mines. We have big fish. We have big timber, and we have big oil and gas.

The CHAIRMAN. It is all good. Big.

Chris.

Mr. ROSE. I would say that the entire world is going toward renewable energy. More than 50 percent of all new capacity worldwide last year was renewable energy on the planet, and that does not include large hydro. And a lot of that is distributed generation, meaning small places. We are the place where we have small, remote communities more than any other place in the United States. We can be world leaders in America and all over the planet in distributed generation and integration of renewables.

The CHAIRMAN. We can be big in the small things.

Mr. ROSE. Right.

The CHAIRMAN. Good.

Della.

Ms. TRUMBLE. Thank you, Senator.

I think I am going to go with the roads and transportation corridors. It is very important. You know, having the renewable energy in our small community helps a lot, but when we are not able to get outside or get in, I think that hurts us more and that cost savings that we have on like the renewable energy has a bigger impact on us to be able to survive as small communities.

The CHAIRMAN. Access. Very, very important. Very much appreciated.

I know that you all took a lot of your time and effort to be here and know that it is greatly and deeply appreciated.

Anything else that you would care to add for the record, we will be happy to do so. Thank you for your presence today, and thank you for contributing to an important hearing. And thank you for continuing to build our state's record when it comes to an amazing and historic place. So thank you very much.

We stand adjourned.

[Whereupon, at 4:10 p.m., the hearing was adjourned.]

APPENDIX MATERIAL SUBMITTED

U.S. Senate Committee on Energy and Natural Resources
March 30, 2017 Hearing: The Potential for Infrastructure Improvements to Create Jobs and Reduce the Cost of Living through All-of-the-Above Energy and Mineral Production in Alaska
Questions for the Record Submitted to Mr. Steve Masterman

Questions from Chairman Lisa Murkowski

Question 1: Landslides Hazards – You noted in his testimony that there is a lot to be done on hazards mapping in Alaska, which can be done jointly with topographic mapping. I know that landslides are a topic of significant concern in Sitka right now.

a. Can you please explain the landslide hazards risks are in Sitka and the threat that they pose to infrastructure?

On August 18, 2015, heavy rainfall and wind resulted in a series of landslides in and around Sitka, Alaska. More than 45 landslides occurred during this event on Chichagof and Baranof Islands. At least three landslides occurred near Sitka, the largest of which, on Harbor Mountain, was 1,200 feet long, killed three people, and caused substantial property damage.

Much of Sitka is built on a narrow strip of relatively flat land between the steep mountains and ocean. Infrastructure on this strip includes numerous community buildings, residential subdivisions, local businesses, and community roads. The local geology of Sitka consists of volcanic ash layers from a nearby volcano (Mt. Edgecumbe), overlying glacial deposits, and bedrock. The volcanic ash weathers to a slippery, clay-like consistency, which, when combined with steep slopes and the wet coastal climate, make areas in Sitka susceptible to slope failure.

Although referred to informally as landslides, the 2015 Sitka slope failures are technically classified as "debris flows." The 2015 debris flows were water-laden, fast moving, and carried a significant amount of large, woody debris. The 2015 debris flows are believed to have been triggered by supersaturated soil conditions from heavy rain in a short period of time (2.5-3.25 inches in 6 hours). The distance a debris flow travels often depends on their speed, size, composition, and the presence of obstructions in their path.

Debris flows have happened before in Sitka, and will happen again. Older debris flow scars, along with drill data showing multiple layers of ancient landslide deposits, suggest the lowland areas (commonly known as "The Benchlands") are, in part, constructed of landslide materials supplied by repeated debris flows that originated on adjacent mountains. Similar geology and topography surrounds much of Sitka. It is not possible or practical to prevent these debris flows from developing, so continued infrastructure expansion in Sitka should look to avoid, minimize or mitigate landslide risk.

Following the 2015 debris flow, the community of Sitka has been actively working to understand and mitigate landslide risks around their community, and to develop a landslide early-warning system. The State of Alaska and federal agencies have been assisting the community in these efforts, to the extent that funding allows.

Very little is known about the actual extent of landslide hazard and risk in Alaska, but studies in other parts of the world show that changes in local conditions, such as increased rainfall and permafrost degradation, can increase landslide frequency. Alaska's warming climate has

already caused many areas to become unstable. Future warming will increase landslide risk in Alaska, especially in permafrost and glacial regions. At the same time, population growth and the expansion of settlements and infrastructure into potentially hazardous areas increases landslide risk.

Unstable slopes regularly threaten public safety and impact infrastructure and can lead to lengthy closures of important transportation routes. The Alaska Department of Transportation & Public Facilities (ADOT&PF) has identified 1475 unstable rock and soil slopes along Alaska's highways; the statewide total for landslides that could endanger communities and infrastructure is likely many times that number.

An Alaskan example of the impact to infrastructure from landslides is the Haines Highway, which has experienced numerous closures from repeated debris flows. According to ADOT&PF, debris flows along this section of the Haines Highway make it the most expensive segment of highway to maintain in the entire state.

Two landslides in Alaska demonstrate the threats they pose to Alaska's principal piece of energy infrastructure – the Trans-Alaska Pipeline System (TAPS):

- The Dalton Highway and the TAPS use the only bridge across the Yukon River connecting the Prudhoe Bay oilfields to the rest of Alaska. A 2012 landslide adjacent to the south bridge abutment raised concerns that additional landslides could negatively impact the bridge, cutting off access to North Slope oil fields, as well as suspending the flow of oil along TAPS. Any compromise to the bridge's integrity would adversely affect the supply of crude oil to west coast refineries. As a result, Alaska and west-coast state economies and the environment would all suffer.
- TAPS, the Dalton Highway, and proposed natural gas pipeline routes in the southern Brooks Range are threatened by slow-moving landslides in permafrost. Although the latest estimates suggest one of these landslides won't reach the Dalton Highway for another 8 years, recent measurements indicate regional warming trends are accelerating this landslide, suggesting it will reach the highway sooner. The only practical remedy is to move the highway at this location.

While the number of infrastructure elements in Alaska is lower than in other states, these examples illustrate the vulnerability of much of Alaska's infrastructure is relatively greater because many elements are single points of failure, without alternatives. For example, a detour of 600 miles may be required to get around a single compromised bridge on the Parks, Glenn, or Richardson Highways. Alternative routes do not exist along other corridors such as the Seward Highway, Dalton, and Alaska Highways, and the Alaska Railroad.

Ocean-entry landslides pose a unique risk in southeast Alaska. These were brought to the forefront by the 2016 Lamplugh Glacier snow-ice-rock avalanche, and the 2015 Tyndall Glacier landslide and tsunami. These massive landslides can and do produce tsunamis that reach heights of more than 500 feet and pose real hazards to communities, the tourism and fishing

industries, and the Alaska Marine Highway System. No mapping exists to characterize these threats.

The August 2015 landslides in Sitka demonstrate the need to better characterize when and where landslides are likely to occur, and to identify high-risk areas not just in Sitka, but also along Alaska's transportation corridors, as well as around communities and critical infrastructure. Except in a few areas of significant concern, where more detailed work has been done, landslides have generally not been the focus of mapping efforts in Alaska and little is known about their distribution, rates, and styles of movement. As Alaska gains additional energy and military infrastructure of national consequence, proactive efforts to understand these risks are required to avoid landslide-related loss of life, as well as impacts to the nation's security, economy and infrastructure. At current rates, it will take hundreds of years to complete landslide mapping for Alaska's infrastructure corridors and communities. Greater federal participation would reduce this timeline and the risk it represents.

Question 2: *You spoke of the need for roads in your testimony. The state, through the Alaska Industrial Development and Export Authority, is currently working to permit a 211-mile road to the Ambler Mining District to allow for the development of a number of mineral deposits south of the Brooks Range to be developed.*

a. *What role does transportation play in the cost of developing a new mine? Is getting equipment in and ore out one of the leading expenses involved in mine development?*

Development and operating costs increase when supplies and personnel have to be flown into mines. In many cases, this cost increase can be enough to remove economic incentives for developing the project. Remote mines need to be higher grade than those closer to infrastructure to overcome increased costs from this locational disadvantage. The lack of transportation infrastructure in the state is often given as a reason not to explore in Alaska, as the costs of exploration are higher, and the higher grades required to overcome higher production costs in remote areas reduces the probability of discovering an economic deposit.

Transportation costs are a significant portion of the cost of discovering, developing and operating remote mines. In a remote mine's discovery phase, all personnel and equipment are usually flown in by helicopter. As exploration progresses, a fixed-wing airstrip is often developed to reduce transportation costs. Further project development often leads to construction of other lower-cost infrastructure, such as barge landings, establishing winter over-land, or over-river routes for hauling exploration and development supplies. Costs are lowest in areas accessible by wheeled vehicles, and increase with distance from existing infrastructure. Helicopter-supported exploration costs in remote parts of the state can be up to several times greater than those with road access.

Constructing a large, remote mine requires transporting very large, earth moving and construction machinery, supplies and construction materials to build lodging, power plants,

ore-processing facilities and equipment, tailings and fresh water impoundments, and other large facilities. This equipment is too large to transport by air, so ocean, river, or land access is necessary to transport this machinery for mine construction and operation.

The means of transportation that provide the lowest operating cost for an individual mine depends on its proximity to the coast, navigable rivers or existing roads, and the length of the year the varying modes of transportation are available (e.g. ice free rivers and ocean, or frozen tundra for overwinter access). Generally, the shorter this distance, and the greater the time the mode of transportation is usable, the lower the costs.

Base metal mines, like Red Dog, and the potential Arctic mine in the Ambler mining district, produce large quantities of concentrates that need to be shipped to a smelter to produce a saleable commodity. In 2015, the Red Dog mine shipped 1.25 million tons of Pb-Zn concentrates to the smelter. The Arctic mine is projected to ship 4.5 million tons of Cu-Pb-Zn concentrates over the life of the mine. The nearby Bornite deposit contains 3.2 million tons of copper metal and other nearby deposits have additional Cu-Pb-Zn resources. The only economically feasible way to ship this volume of mineral concentrates is by surface transportation to existing infrastructure or the coast.

In the case of the Arctic deposit, shallow water in the Ambler River permits only small barge access. That, coupled with only a few ice-free months a year precludes shipping the ore concentrates by barge down the Ambler River. The same river conditions make mine construction and operational support by barge transportation considerably more expensive or impractical. The construction of a road will cost less than a rail connection, and a practical solution to facilitating mine development. Economic analyses by the company developing the Arctic deposit indicate concentrate shipping costs by road comprise 17% of the total mine operating cost. (https://trilogymetals.com/assets/docs/technical-reports/2013_arctic_pea_final.pdf).

b. *Do you know of other specific mineral developments in Alaska that are blocked because of the cost and need for transportation?*

There are several mining projects in Alaska that are economically challenged by their remote locations that increase the cost of transportation.

The largest remote mineral project in development in Alaska is the Donlin Gold project in southwest Alaska. This project needs to construct a port site on the Kuskokwim River, a 30-mile road to the mine/mill site and a 312-mile long gas pipeline to provide natural gas for the power plant and processing facilities. Cost estimates for the gas line alone exceed $1 billion. The port site is required to bring in the mining equipment, supplies for constructing the power and processing plants, and annual supplies for mine operation. Project economics would improve considerably with overland access to Alaska's existing road network.

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Other development or advanced-exploration stage mining projects in Alaska that need road access to facilitate development include:

- Graphite One project requiring a 16-mile access road
- Palmer project in southeast Alaska requires a 15-mile road
- Pebble project requires a port site, 100-mile road to the mine, an electrical transmission line, and potentially a concentrate pipeline

Question 3: *Alaska Gasline - You talked in your testimony about the need for infrastructure, specifically for pipelines to move natural gas from the North Slope to tidewater. I know Governor Walker recently wrote to President Trump with suggestions for what the federal government could do to promote the large Alaska AK LNG project.*

a. Do you or any other state officials have any suggestions about what Congress could do to promote either that project or the Donlin Creek mine's gas line project and its related energy system for Southwest Alaska from a financing, permitting, or land use perspective?

Despite its relatively small population, Alaska has had a disproportionately high impact on the national economy through the development of its energy infrastructure. Prudhoe Bay, for example, became the largest petroleum resource in North American history, and the construction of Trans-Alaska Pipeline System, bringing oil from Alaska's North Slope to market, was the largest construction project in North America in the 1970s.

Alaska, once again, finds itself with the prospect of developing meaningful, financially-attractive infrastructure of economic importance at the state, national, and international levels. By developing the infrastructure necessary to export vast reserves of natural gas in the form of liquefied natural gas (LNG), the U.S. would become a major energy supplier with international partners with whom there is currently a negative balance of trade. Monetizing Alaska's proven natural gas reserves will provide energy security for Alaska, assist with economic security for the U.S., positively impact our trade imbalance, and provide a proven energy supply to our Asia-Pacific trading partners.

The following tools are requested from the federal government to enhance the ability to finance, and, provide a speedy path to implement the Alaska LNG infrastructure project:

- Financing enhancements:
    - modifying the Alaska Natural Gas Pipeline Act (ANGPA) of 2004 to allow existing authority to issue federal loan guarantees for this project
    - allowing for first-loss federal equity investment
    - commercial loan guarantees through the U.S. Export-Import Bank

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  - allowing securitization of the depreciation allowance

- Expeditious and rational permitting:
  - allowing the Alaskan State agencies to take a more proactive and authoritative role
  - providing a centralized federal permitting clearinghouse

- Land conveyances along the proposed pipeline route

Most importantly, the actions requested would show tangible support for a major infrastructure project where a state can work in cooperation with industry to create employment, economic benefit, and wealth for the state, private sector, individuals, and the nation.

Financing enhancements

Federal loan guarantee

To secure a federal loan guarantee for this infrastructure project, Alaska LNG proposes amending the existing loan guarantee provision to the Alaska Natural Gas Pipeline Act of 2004. The original legislation was passed to support an overland natural gas pipeline from Alaska's North Slope to Canada and back to the U.S. to monetize Alaska gas.

Specifically, Alaska LNG suggests adding and modifying language that would allow the legislation to accommodate exporting gas. Since the 2004 legislation provides the pipeline project should move natural gas directly to "markets in the contiguous United States," this provision would need to be modified for Alaska natural gas to be sold to Asian markets and to qualify for this federal loan guarantee.

First-loss federal equity investment

Monetizing Alaska's Gas through an Investable Infrastructure Investments (Triple-I) program should accelerate development. Triple-I may possess attributes that make the underlying assets and systems relatively conducive of managerial control that is privatized, managed as a private public partnership, or generally independent from mainstream government. A Triple-I program that provides a system where federal co-investments on equity positions for infrastructure in the form of "First-Loss Investments" would benefit the project. In this case, in the event of a loss, the federal government, would bear first losses. The amount of loss covered is typically set and agreed upon upfront. This structure improves the infrastructure project risk-return profile, and catalyzes the participation of investors that otherwise would not have participated.

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Commercial loan guarantees through the US EXIM Bank

Creative use of the EXIM Bank's loan guarantees, project and structured finance, and Fixed-Rate Term Financing for international buyers are all areas Alaska would like to explore with the Secretary of Commerce.

Provide for securitization of the depreciation allowance

There are two possible ways federal legislation related to depreciation would benefit the Alaska LNG project. Both methods rely on the fact that public ownership of a physical asset is non-taxable if owned by a non-taxed entity. Alaska LNG is a non-taxed entity since part of its equity is owned by the State of Alaska, through ownership by wholly owned Alaska corporations.

The first method would be through Alaska Gasline Development Corporation's (AGDC) equity ownership in the Alaska LNG project. While AGDC has value from its tax-exempt status, it cannot utilize the value of the infrastructure's deprecation in the manner a for-profit entity could. Therefore, a change in U.S. tax law that allowed a class of non-taxable municipal corporations to securitize the deprecation benefit, and sell it on the free market would benefit the project.

The second method is to incentivize non-taxable entities, for example CalPERS (California public state pension fund), to invest in the Alaska LNG project. Currently, these entities have muted interest in infrastructure projects, because they cannot take advantage of the depreciation deduction. A law that would enable these entities to securitize the depreciable value of their investment would make the investment in the Alaska LNG and other infrastructure project more attractive. The benefit could be limited to state or municipality-owned energy export projects.

Expeditious and rational permitting

The Alaska gas pipeline route is one of the most intensively studied pipeline corridors in the U.S., since it follows the Trans-Alaska oil pipeline route for much of the way, and has been the object of study of various gas pipeline proposals since the 1970s. The Alaska LNG project has spent $600 Million to date on engineering and optimization resulting in a project ready for final permitting, detailed engineering, and construction. The primary requests to facilitate permitting revolve around wetlands jurisdiction and mitigation, and Beluga habitat issues:

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Wetlands jurisdiction and mitigation

The State of Alaska through AGDC, has received preliminary approval for an identical gas pipeline route for a separate pipeline project. That project, the Alaska Stand-Alone Pipeline, did not have an export terminal, and therefore did not fall under FERC jurisdiction. The current project does have an export terminal that brings the new project under FERC wetlands jurisdiction. Having to duplicate the previous right-of-way process will increase the cost unnecessarily without any tangible benefits to the environment.

Alaska requests the project be exempt from Executive Order 11990, which gave FERC additional wetlands authority, and instead, implement the 1986 regulations and applicable guidance (those in effect prior to August 28, 2015) that empower the US Army Corps of Engineers to make jurisdictional determinations or taking other actions concerning wetlands. Further, Alaska requests the U.S. Army Corps of Engineers' 1987 Wetland Delineation Manual and 2007 Alaska District Regional Supplement be modified to ensure that any areas with underlying permafrost not be classified as jurisdictional wetlands.

Beluga habitat issues

There are multiple issues relating to the protection of beluga habitat which do not contribute to the actual protection of marine mammal habitat, but create onerous and time consuming permitting. For example, The Incidental Harassment Authorization (IHA) and Biological Opinion both come from the National Marine Fisheries Services (NMFS). These need to be coordinated and combined, and issued in a timely manner.

In general, the Alaska LNG project should be exempt from the NMFS Cook Inlet Beluga Recovery Program management conditions. Alaskan state agencies are very familiar with the marine species in Alaska and can adequately supervise disruptive activities.

Land conveyances

Alaska LNG requests the Secretary of the Interior to rescind the portion of Public Land Order (PLO) 5150 that is coincidental with the Alaska LNG pipeline corridor. PLO 5150 is a federal withdrawal of land to provide a transportation and utility corridor for the Trans-Alaska Pipeline. Much of the PLO 5150 corridor was top-filed by the State of Alaska during land selections which have been a State of Alaska priority for conveyance. The request is for the portion of PLO 5150, which includes land identified as part of the Alaska LNG pipeline corridor, to be revoked and conveyed to the State of Alaska. This will allow the corridor to be utilized as a gas-line corridor and managed by the state to efficiently permit the construction of the pipeline.

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The measures outlined here constitute meaningful federal actions to facilitate advancement of the Alaska LNG Project. AGDC and I are available to provide additional details or discuss these suggestions in greater detail.

Question 4: *Rare Earths - Earlier last week an official from Ucore, the company that wants to open the Bokan Mountain heavy rare earth element mine on Prince of Wales Island, testified about the need for the government to fund not just basic research, but grants to confirm that new molecular technology techniques can reduce ore processing costs. From what you know of the MRT process of growing molecules that can attract elements and pull them from ore without repeated toxic chemical washes, is this a process that could have beneficial impacts and reduce costs and environmental impacts from the smelting processing of a wider variety of minerals?*

The Molecular Recognition Technology (MRT) process is based on the principal of selective removal of metals from solution. These solutions are passed over a solid media (usually small beads) coated with materials (ligands) that are specifically designed to capture the target compound. The solutions containing the metals to be extracted are often acidic to dissolve the metals. Once the ligands are loaded with the target metal, they can be washed and the target metal chemically removed. The target metal can then be extracted from these "pregnant" solutions for use or sale. The ligand-coated beads are then cleaned and re-used. This process requires the metals or metal-compounds be in solution, and limits application to situations where the metals are already in solution, or can be dissolved.

The smelting process is a reduction process for sulfide minerals to produce metals for further refining. For example, the Red Dog and Greens Creek mines produce a zinc concentrate comprised mainly of the mineral sphalerite (zinc sulfide). Smelting removes the sulfur from sphalerite to produce zinc metal. MRT is not going to replace this aspect of smelting. Metals produced by smelting often contain impurities that MRT may be able to remove to produce high-purity metals. High-purity metals are often required in high technology applications, including military, and medical uses.

Molecular recognition technology (MRT), in addition to its promising potential in processing rare earth elements, has been used successfully to:

- remove bismuth in the production of high-purity copper
- separate platinum group metals
- recover palladium in recycling operations
- remove heavy metals from industrial waste

A process that can selectively remove trace amounts of metals could have significant benefit in recycling for re-use of critical minerals, which are often used in very small amounts in individual products. Removal of metals from effluent streams to meet environmental regulations, for example, could also have economic and environmental benefits.

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Funding for mineral processing methods research that reduces the national dependence on foreign suppliers of mineral commodities should be a national priority. The nation would be wise to invest in technology that can provide essential materials should they become unavailable from foreign sources.

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Questions from Chairman Lisa Murkowski

Question 1: Having visited the Blue Lake project on several occasions, it is a truly impressive achievement and testimony to Sitka's commitment to using renewable energy.

a. Can you discuss the challenges associated with financing large capital projects in communities like Sitka?

When the Blue Lake Hydroelectric project went to the voters for consideration the project was estimated at $49 million but by 2012 construction bid costs came in at $145 million. The original estimate likely did not adequately consider the cost of work in Southeast Alaska including exorbitant shipping rates, difficult access, constraints and unique construction methods required for the project, per diem for workers and other unique features that drive up the costs of projects in remote sites.

b. What impact does that have on the energy bills ultimately paid by your residents?

The Blue Lake project has contributed to a significant rise in electric bills. While the State of Alaska provided grants to lower the debt service there was no federal assistance received. The support of the community has waned as electric rates require increases annually to sustain repayment of the loans. Now, Sitka has other capital needs such as rebuilding the electric substation, rebuilding a major transmission line, overhauling the Green Lake hydro project and rebuilding our emergency fuel back up power system. Federal investment in upgrading infrastructure is essential to the economies of our rural communities. If Sitka would not have invested in the Blue Lake expansion project we were at risk of being without power for months, decimating the fishing industry of not only Sitka but the surrounding region. Infrastructure upgrades will continue to be essential to maintain the utility services Sitka provides.

Question 2: Transmission-Interties - If I understand correctly, Sitka right now has a surplus of electricity. If there were transmission interties in the region, like the $480 million intertie proposed back in the 1990s, what would the impact on rates be to Sitkans?

a. What is Sitka's view of building a regional Southeast intertie? Does it make sense, or does the State's 2011 plan, which switches small towns from diesel-fired generation to biomass heating, make more economic and environmental sense today?

With the completion of the Blue Lake project, Sitka has excess power. Economic development is a priority to continue to attract high consumption businesses to the area. A Southeast intertie would most likely be lucrative for Sitka as we could sell our excess supply, lowering rates for all Sitkans and investing in maintaining the current infrastructure. Sitka and other Alaska communities are blessed with abundant sustainable energy sources. The barriers continue to be the upfront capital costs and lack of federal assistance.

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Questions from Chairman Lisa Murkowski

Question 1: Port Competition - With the expansion at the Panama Canal allowing larger freighters to pass through its new locks, there is a major effort to upgrade most all of America's deepwater ports. What are Alaska's arguments for why it should receive a greater share of federal infrastructure spending on new ports, rather than federal money going to Lower 48 ports from New York and New Jersey, or Baltimore and Charlotte on the East Coast or Galveston or Long Beach or Tacoma on the Gulf and West Coasts?

Alaska is the most undeveloped state in the nation, and its ports are significantly lacking in adequate maritime infrastructure. When compared to the lower 48 coastline, it is clear that federal funding has been expended at a disproportionate level in Alaska's ports versus facilities down south that are already well-developed. Alaska's ports need a greater share of federal transportation funds primarily due to the limited road system that requires goods to be delivered to many of the coastal communities by water, as these communities lack airports with large enough runways to receive cargo jets. Alaska's ports are actually more critical to the regional populations than the facilities in New Jersey, Miami, Galveston or Los Angeles, as their role in the distribution of goods in Alaska is paramount to the viability of the local economies.

Specific to Western Alaska and the Arctic, the Port of Nome plays a critical role in supporting the regional communities in the transshipment of cargo, fuel, gravel and heavy equipment necessary to maintain roads and community infrastructure. These goods must be transported through a transportation hub (Nome), which allows the goods to be transferred through the facility and loaded onto smaller beach landing vessels that can effectively deliver to the coastal communities, many of which lack any type of dock or port infrastructure.

Clearly, upgrades and improvements to Lower 48 port facilities will continue to be necessary into the future. However, there is a growing imperative to inject federal funding into developing and expanding Alaska's inadequate port infrastructure up to a level that is at least equal to that of the Lower 48. Continuing to focus on southern ports, will exacerbate the critical maritime transportation issues in Alaska, and further delay expansion of the intermodal connection opportunities that are necessary to support economic development in the state.

Question 2: Harbor Work - Ports are important, but Alaska also has vast needs for harbors, where fishing vessels and smaller ships to dock. What should be the mix between port spending and harbor-dock spending if a federal infrastructure package is developed? Do you have any suggestions on how Congress can pay for additional port and harbor improvements in a federal infrastructure package?

There are significant needs for both ports and harbors across the state of Alaska, and it is vitally important that the federal government work with the state and each coastal community to determine the needs for that community and region. Many of these facilities have projects that can be developed in the near term, which should be weighed against the overall need within the

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regional and statewide transportation system. It is difficult to assign a percentage, as some communities function more as a port, while others as a harbor, with each supporting a variety of industries operating within that region. Alaska's maritime industries such as, ferry's, tourism, fishing and the transportation of goods are all critical to Alaska's economy and can be specific to a particular region. Particular attention should be paid to each region and specific facility needs, rather than trying to assign a percentage to facility type or area. This is the only effective and productive way to improve Alaska's inadequate port and harbor infrastructure.

As far as Arctic Port infrastructure, Nome is working with the Army Corps and strategic partners for the development of an Arctic Deep Draft Port (ADDP) through expansion of the existing port. The City has cost-share funds, appropriated by the State of Alaska that can support design of the expansion in a shorter timeline through a designation as a Strategic Arctic Port under Section 1095 of the NDAA 2017. This designation could be realized in 6-12 months, with a design ready in a 12-18 month window for construction. This would bring an ADDP on line by 2019-2020, in a location with existing community infrastructure in place, and provide maritime infrastructure to support and resupply U.S. maritime assets and expand Nome's role as the maritime commerce hub in the region.

Federal funds are absolutely critical to develop the nation's Arctic resources, national security, coastal communities, cultural lifestyles and environment. Continuing to investigate, study, plan and contemplate, without taking action with federal investment, will put Alaska and the country at further risk in this remote region that is teeming with maritime vessel traffic.

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Questions from Chairman Lisa Murkowski

Question 1: ANWR - You mentioned in your testimony the importance of opening the Arctic coastal plain to oil and gas development—something I certainly agree with, and am pushing to gain. Some here in Washington, DC argue that the non-wilderness portion of ANWR is not needed because of U.S. oil shale, and because the area is too sensitive—even though they have never actually been there, to see what it looks like and verify whether that is true. Can you speak to the role that production from the non-wilderness 1002 Area could play in our energy future, and what development would actually look like, in a refuge roughly the size of South Carolina?

It is difficult to answer these questions with absolute precision, because the respective geology, reservoir locations, and apportionment of leases will affect the manner of development a great deal. However, I believe it is fair to look at the production of Prudhoe Bay as a general comparison, while noting that technological advancements will allow for greater recovery with less of a footprint (directional drilling, for example, affords operators to increase recovery while decreasing pad size). Given the development of Point Thompson, the majority of the infrastructure needed to get oil to TAPS already exists.

Dated estimates by the USGS put likely recoverable oil from the 1002 area as about 10 billion barrels of oil. To put that in comparison to the North Slope, we have produced over 17 billion barrels and counting. These estimates are outdated so we were encouraged by the Secretarial Order to look at new assessments for this area to get an updated determination of the geological potential.

As far as the need for development, one need only look to the long-term projections of EIA to note that American's will continue to meet the vast majority of its energy demands through oil and natural gas. If we want to gain true energy independence and dominance, it cannot be accomplished without the development of the 1002 Area.

Question 2: OCS Development - Your testimony talked about the need for Congress and the Administration to restore OCS leasing in the Chukchi and Beaufort Seas to the nation's Five-Year Program because the Arctic represents 22% of the Earth's undiscovered oil and natural gas. That depends on a decision by President Trump, who understands the importance of Alaska production. But there are infrastructure needs connected with safely exploring for oil in the Chukchi and Beaufort Seas. You mentioned the report from the Department of Transportation on infrastructure needs over the next decade in the Arctic. What is needed in the area of infrastructure to make oil and gas development both economic and environmentally safe in the Arctic, to get the industry back into exploration in the area following the awful, horribly costly experience that Shell faced in the region under the past Administration?

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In reality, it is the economic costs associated with unnecessary and redundant regulations that will play a large role in the interest in developing in the Arctic OCS. Having a regulatory community and administration that is working in partnership with operators would stand in stark contrast to what we experienced during Shell's Alaska venture. That being said, informational infrastructure is always valuable, and future lease sales would invariably benefit from greater scientific knowledge of the region. In the long-term, access to a deep water port and Coast Guard capabilities (i.e. icebreakers, etc.) would be invaluable.

Question 3: Permitting Issues - There have been a lot of issues with government regulation involving land use plans and also in permitting of wetlands and fill that affect Alaska oil development proposals, such as mitigation policies at the Army Corps of Engineers and other agencies. We have seen that at NPR-A and Greater Mooses Tooth and we saw it in the seven year effort to get a bridge across the Colville River to even access NPR-A. What should Congress be doing to speed permitting and infrastructure development, without harming the environment in Alaska?

True collaboration with operators can provide workable solutions that both encourage development and provide environmental protection. Too often, the relationship between federal agencies and oil and gas operators has felt adversarial in nature, which is both inefficient and discouraging. Developers in Alaska must navigate a wide variety of federal agencies and regulations (NMFS, BOEM, USFWS, USACE, BLM, ESA, CAA CWA, etc). The lack of coordination between agencies results in greater costs and greater delays. Furthermore, the rigidity of some regulations result in counterintuitive and counterproductive outcomes. Too often, agencies have myopic views on how to accomplish an endeavor, a rigidity that discourages investment and ingenuity. Functioning multi-agency work groups, such as existed during Shell's activities, would facilitate timely permitting while industry complies with the multitude of regulations to protect our environment.

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Questions from Chairman Lisa Murkowski

Question 1: Renewable Energy - The State of Alaska has led the way in helping rural and remote communities move from being exclusively reliant on diesel energy to more hybrid energy systems that incorporate local renewable resources.

a. Can you provide more information on how Alaska has pushed to reduce diesel use in rural villages, and the benefits that provides to them?

Alaska has had several programs to reduce diesel usage, both at the building and utility level. As noted in my earlier testimony, the state has invested more than $250 million in renewable projects throughout the state through Alaska's Renewable Energy Fund (REF), administered by the Alaska Energy Authority (AEA). To date this investment has led to 70 active projects displacing the equivalent of more than 30 million gallons of diesel fuel each year.

In addition to grant funding, the state has conducted research, resource assessments, feasibility analysis and technical assistance in project development and integration to assist remote communities in developing renewable energy projects for both electricity and heat. Developing, integrating and maintaining renewable energy in isolated small grids in communities, often hundreds of miles from the closest neighboring community, with small populations is a challenge. The state has worked closely with its federal partners at DoE Office of Indian Energy (OIE), Denali Commission, the National Labs and DoE EERE to help rural Alaska meet this challenge.

The state has also invested more than $600 million in the weatherization and rebate programs administered by the Alaska Housing Finance Corporation (AHFC). Those two programs have saved building owners the equivalent of 25 million gallons of heating oil in 2016. In fact, the average homeowner that took part in those efficiency programs saved an average of 30% on their heating bills. However, all of those programs relied on annual state legislative appropriations to make grants, and today are operating at a fraction of their former capacity. *I am attaching a recent one-page report by AHFC on these programs.*

b. What partnerships did you form with the federal government, as you pursued that?

REAP did not enter into any formal relationships with the federal government to help create or maintain funding for the REF or state efficiency programs. However, a multitude of federal agencies and funding sources have supported these efforts. The Denali Commission helped REAP and others establish the state's Emerging Energy Technology Fund (EETF) in 2010 by providing seed funding for the first round of funding. The Denali Commission's support of the Rural Power System Upgrade program, while focused on diesel powerhouses, has also facilitated upgrades to those systems which allows the integration of renewable resources.

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Other federal support has provided matching support for REF grants. Though the REF has never required matching funds, federal and/or other matching funds make a project score higher in the competitive REF grant-making process.

REAP has formed many collaborative partnerships with federal agencies to educate the public about renewable energy and further the technical and workforce capabilities of Alaskans to deploy renewable energy. REAP had a contract with the National Renewable Energy Laboratory (NREL) for many years to educate Alaskans about wind energy through the *Wind Powering America* program. When that program ceased to exist, REAP won a competitive award with NREL to begin collaborating with the Island Institute in Maine to form the Islanded Grid Resource Center (IGRC). The IGRC is a growing knowledge hub designed to share information about how to integrate renewable energy into diesel grids in American states and territories. REAP has also worked under a very modest contract with NREL to promote the *Wind for Schools* K-12 math and science curriculum in Alaska. REAP worked with the Denali Commission years ago on a contract to increase training opportunities for renewable energy. More recently, REAP received a three-year grant from the Office of Naval Research to launch the Alaska Network for Energy Education and Employment (ANEEE) to align existing K-12, training and university clean energy programs in the state. *There is more information on ANEEE in Question number 2, below.*

Alaska also enjoys support for clean energy, especially technical assistance, through the efforts of the U.S. Department of Energy's Office of Indian Energy. The Alaska Energy Authority has worked with DOE OIE to make adjustments to their technical assistance program to make it more used and useful. Other federal agencies that are helping Alaska build a strong clean energy sector include the National Science Foundation, which has supported applied research at the Alaska Center for Energy and Power (ACEP).

AEA has acted as DoE's Energy Efficiency and Renewable Energy (EERE) lead on the Remote Alaska Conservation and Energy Efficiency competition (RACEE). In that role, AEA has assisted the DOE in creating an initiative that met their objectives and provided the highest value possible to remote communities.

While not a renewable program per se, the Environmental Protection Agency's Diesel Emissions Reduction Act (DERA) has provided funds to improve diesel efficiency in remote powerhouses, thereby reducing diesel consumption.

USDA Rural Development has also provided very important support to renewable energy projects across the state in the form of grants and loans.

Other National Labs have also supported technology development in Alaska. Today, REAP is engaged with NREL, Sandia National Lab, Lawrence Berkeley National Lab and Pacific Northwest National Lab, as well as ACEP, Intelligent Energy Systems and the Institute of Social

and Economic Research (ISER) at the University of Alaska Anchorage in the Alaska Microgrid Partnership (AMP). The AMP is an effort to help define pathways for microgrid development in Alaska in the areas of technology, financing and workforce development. The goal of the AMP is to design systems that can reduce the overall reliance on imported fuel in communities by 50%, or more. Alaska also benefits from advances in research and development at a number of other federal agencies, including the Advanced Research Projects Agency-Energy (ARPA-E).

This list is not exhaustive. However, over the years, it is safe to say that federal support for renewable energy and energy efficiency efforts in Alaska have been extremely important. Without those continued federal partnerships and support, it would be very difficult for Alaska to continue to lead efforts to increase the contribution of renewable energy in islanded microgrids, advances that have significance and application not only for microgrids in cities across the U.S., but also for over two billion people in the developing world who are either today dependent on diesel to generate electricity, or have no electricity at all.

Continued and increased support of national laboratories and energy related agencies would strengthen the ability of the United States, and Alaska, to compete for clean energy business with the rest of the world, including China and Europe.

c. What lessons have you learned along the way to facilitate new projects in the future?

There are many answers to this question. Here are some of the most important:

* **Energy projects in small communities need energy champions.** Those champions need to be inspired early (through programs like DoE's *Wind for Schools*), supported consistently (through various technical assistance efforts) and made to feel like they belong to something bigger (though efforts like ANEEE).

* **Energy efficiency is the first fuel.** If communities don't first do everything not to waste energy, unnecessarily large projects will be built at higher costs. Energy efficiency always has a better and faster return on investment than generation, but is rarely put first. Communities that wish to exploit local renewable energy resources must look at efficiency first, and government should look for ways to incentivize it.

* **Data collection and analysis is crucial.** Without data collection, there is no starting point, and no way to measure success from a baseline. Without data analysis, efforts to improve technology will stall. Money for data collection and analysis must be part of a project's budget.

* **Technology isn't everything.** Projects must be operated, maintained and optimized over time. This means support for the right types of training, in settings that are conducive to

success. Money for operations, maintenance and training must be part of a project's budget.

* **Communities need "skin in the game."** Communities where projects are 100% grant funded have a different incentive to operate and maintain a project than communities that have provided even a modest investment in the project. This can have long-range impacts on system performance.

* **Renewable energy is far easier to integrate in small systems that have modern diesel generators.** Islanded communities that wish to exploit local renewable energy resources must upgrade their diesels first, or at least increase diesel operating efficiency.

* **Planning is important.** Whether it is a small utility wishing to integrate renewables into a diesel system or a large utility in the road and grid connected area of Alaska known as the Railbelt that is considering renewables, planning into the future is necessary. The Railbelt in particular needs to move to an integrated resource planning process that looks at the entire region as a whole, rather than discreet, local utility service areas. Planning must also include life cycle cost analyses that take into account long-term fuel costs and enable apples to apples comparisons of alternatives.

* **Financing is difficult, but not impossible.** We know that Alaskans are somehow scraping together the cash every month to pay some of the highest energy costs in the nation. REAP and others are working to find ways to leverage that cash flow to pay for projects with loans.

* **Energy does not exist in a vacuum.** Energy is the lifeblood of every community. The food and transportation systems that we take for granted are totally dependent on accessible, affordable energy. Educating consumers about how energy is related to economic development, food production and natural resource management is crucial to produce energy literate citizens that understand the implications of their energy decisions.

* **Policy matters, and programs are not policy.** Alaska's Renewable Energy Fund is an example of a program, not a policy. When funding for it ran dry, its effectiveness diminished greatly. Policies that set expectations for the business community are much more effective in the long run in providing predictable guidance for where markets are going. This is better not only for technology developers, but also financiers and workforce training programs.

Question 2: Human Capacity - My guess is you could probably fill an hour's time talking about human capacity as it relates to our communities and their general lack of technical support and knowhow to not only install energy upgrades, but also operate and maintain them into the future. I could not agree more with your stance that we need a continued

and stronger commitment to train Alaskans to work in Alaska in the energy sector. REAP and others are doing good work, but can you tell me what other opportunities you see in the short- and long-term to ensure we have a homegrown, skilled energy workforce in Alaska?

Building a Network to Align Resources

Occupational opportunities within Alaska's renewable energy sector are expanding in both scope and number – due in no small part to Alaska's growing reputation as a "living laboratory" for renewable energy. As the demand for renewable solutions increases, Alaska needs to continue to innovate new training programs that address industry needs, and retool existing programs so that they remain not just relevant, but at the vanguard of change. The pace of emerging technologies is brisk and there is a real need for Alaskan institutions to respond in kind - to be nimble in identifying skill sets, training, education and investment that will allow Alaskans to leverage the advantages inherent in a vast state rich in renewable energy resources.

REAP and other Alaskan organizations have long sought to identify, inventory and connect the many disparate agencies, schools, businesses, utilities and individuals working toward creating a homegrown, vibrant, innovative and flexible clean energy workforce. This year, REAP launched the Alaska Network of Energy Education and Employment (ANEEE) in order to create a clear sense of what a pathway toward a renewable or energy efficiency energy occupation can and should look like in Alaska.

The "High Road" in workforce development is an approach that seeks to find local solutions to industry needs, to keep the best workers and students from leaving the community, and to foster a more productive, more competitive workforce. Industry, schools, community organizations, government agencies, private individuals and non-profits need to partner together and build a competitive Alaskan workforce. The silo model of operation is inefficient and obsolete. There is no longer room for redundant or unsustainable trainings – too many organizations are spending too many resources and too much time attempting to solve workforce problems that require an informed network working toward defined goals. ANEEE seeks to be a conduit for coordination and cooperation.

STEM Education

Alaska's Railbelt and more remote, rural areas call for differing strategies in terms of workforce development, but it is instructive to look at where there is a glaring crossover need. The persistent STEM underperformance of Alaskan K-12 students continues to be an impediment in the development of Alaskans prepared for specialized education and training programs in the energy sector. Researchers found that between 2006 and 2016, approximately 60% of Alaskan high school graduates required remedial coursework upon enrolling at the University of Alaska. Anecdotal interviews with staff and instructors at Alaska Vocational and Technical Education

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Center (AVTEC) seem to confirm these numbers, and identify an area in great need of improvement. Specifically, the inadequate grasp of Intermediate Algebra and the basic concepts of abstract mathematical thinking are a real barrier toward advancement in gaining both occupational certificates, and associate and bachelor degrees. All pathways toward a more skilled and robust Alaskan workforce face a bottleneck until the inadequacies of K-12 STEM education are addressed. The Alaska Native Science and Engineering Program (ANSEP) at UA provides a model of support that addresses this very need.

REAP and a wide variety of state agencies, utilities and Alaska Native corporations have partnered together and actively reach out to K-12 students via the AK *EnergySmart* and *Wind for Schools* programs. In addition, REAP works with partners like the DoE's Office of Indian Energy to buttress efforts to build curricula that seeks to connect with and educate Native Alaskans, whose reliance on a single individual running their power plant is both potentially instructive and inspiring.

University Programs

Some of the more exciting renewable energy opportunities in the short-term are found in research, academia and pioneering entrepreneurial endeavors. Programs and personnel at UAF, especially the Alaska Center for Energy and Power, are innovating systems, tools and testing techniques through applied research that attract talent from around the world to ACEP's Power Systems Integration Laboratory. UAF and ACEP have a reputation for innovation and collaboration that serves as a counter to the perennial Alaskan problem of "brain-drain." Young Alaskans interested in geothermal, wind, solar, biomass and hydro technologies live in a state possessed of all of these resources – and a University dedicated to advancing state of the art renewable energy research. UAF must be able to continue and expand in its efforts.

The relatively recent relationship between Alaska Pacific University (APU) and the Alaska Native Tribal Health Consortium (ANTHC) provides a new opportunity to develop and deliver targeted training for operating and maintaining energy infrastructure in Alaska. ANTHC is currently working on curriculum for APU, which will address some of these issues, including the "business" of energy, which focuses on the operational and financial systems needed to operate a healthy utility.

Complimenting the work at UAF is the science and testing being done at the Cold Climate Housing Research Center (CCHRC). The particularities of building in extreme environments comprise an exportable knowledge base. Building materials experts, construction workers, tradesman and unskilled workers benefit from the existence of the CCHRC. Relationships within the building industry and its proximity to the UAF campus make CCHRC a nexus of opportunity. The vast geography of Alaska has inhibited the growth of traditional "research triangles" where university, industry and investment are able to spur growth and innovation, yet Alaska is rich in possible opportunities. For example, the nearly 200 islanded microgrids in

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Alaska provide a highly attractive proving ground for technology and business leaders looking to penetrate the ultra competitive smart-grid industry. Smart grids are just a single example of where young Alaskan engineers and researchers should be encouraged to cut their teeth and build the groundwork for future Alaskan industry. If Alaska is intent on creating the sort of synergies that launch new ideas, careers and industries – the work of ACEP and CCHRC must expand and continue.

Mapping Energy Occupational Pathways

The majority of strictly defined renewable energy jobs in Alaska are people who are working for a utility company – and most involve what is referred to as "cross-cut training." Hydro and wind technicians in Alaska are rarely just that – they have been trained in various aspects of electricity generation and spend only a portion of their time on renewable-specific tasks. Within Alaska, the utilities provide the bulk of on-the-job specialized renewable energy training for their employees. The definition of a "renewable energy" occupation is ever expanding, and as the sector grows there is a need for more fully fleshed out training programs. Renewable energy is more than just wind, solar, geothermal, biomass, hydrokinetics and traditional hydro. All human efforts can be reduced to a fundamental need for energy. As renewables increasingly become the affordable and reliable choice of the future nearly every occupation will be transformed. Alaskan workers outside of the utility industry will need to be well versed in energy efficiency, weatherization, battery technologies, heat-pump systems, advanced material construction, diesel-renewable integration, building operations and maintenance, etc. These future skilled technicians, mechanics, operators and instructors are currently being trained at the Alaska Vocational and Technical Education Center (AVTEC) and to a lesser degree, at other regional Technical Vocational Education Programs (TVEP) around the state. AVTEC maintains a gold standard, and is a vital training partner to several organizations throughout the state including the Alaska Energy Authority, the Alaska Native Tribal Health Consortium (ANTHC), the Alaska Housing Finance Corporation and several Native Corporations – just to name a few. There is a great potential for streamlining training efforts and greater coordination with industry to address specific skill training needs. All efforts should be taken to preserve and expand the AVTEC model if Alaska is to develop a pipeline of skilled energy workers.

AEA and DOE OIE are exploring methods to conduct improved training for utility staff and clerks relating to proper rate setting, utility management, and reporting for the Power Cost Equalization program. The Denali Commission has also been working with many partners on methods and means to ensure proper operations and maintenance of rural infrastructure, including energy infrastructure, conducted by local or regional Alaskans.

A successful training program geared toward rural Alaskans should also include a "soft skills" (professional demeanor, responsibility, home economics, pride of craftsmanship) component. A great many talented individuals are unable to join the workforce not because of a lack of aptitude – but because of an assumption that these soft skills are in place.

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Looking Forward

In the immediate future, REAP is working through ANEEE to convene representatives from the more than 40 Alaskan agencies and organizations responsible for the lion's share of renewable energy trainings within the state. In addition, industry representatives will be included with the express purpose of identifying "hard to hire" occupations – and in some cases identifying newly defined positions that require a unique skill set. The goal is to transform one-off or limited training regimes into sustainable programs that prepare Alaskans for careers that currently exist, as well as careers of the future.

Question 3: Alternative Financing Mechanisms - In your verbal testimony you talked about the Connecticut Green Energy Bank. Are there other new financing mechanisms available to help stimulate renewable energy developments iu Alaska?

It is worth noting that many of the federal tax incentives that have successfully advanced energy projects in the lower 48 have not been effective in Alaska. Most of Alaska's utilities are co-ops or owned by local governments, making them ineligible for tax incentives. In addition, Alaska's small markets have not so far generated many projects that are large enough to absorb the substantial costs associated with utilizing the federal tax incentives being offered.

Of course, energy efficiency performance contracts with energy efficiency service companies (ESCOS) have been around for some time. However, ESCOs do not typically work with the types of smaller projects that are so ubiquitous in Alaska. Today, Green Banks, or slight variations of them, seem to be the mechanism that other states and nations are pursuing to finance energy efficiency and renewable energy. Green Banks take a small amount of state money and use it to de-risk projects to attract and leverage the capital of the private sector. Green Banks make clean energy business happen with private sector banks that might not otherwise have occurred.

Green banks directly address some of the primary barriers to securing private financing for clean energy that exist today including:

1) A relatively short track record for clean energy financing. In context, clean energy projects have not been financed for a long time, resulting in a shortage of data for banks to determine the level of risk involved with a loan. The result is a judgment that the project is high risk, therefore attracting a higher interest rate.

2) The large volume and relatively small size of projects. Banks, and even ESCOs, tend to stay away from small projects with relatively low returns and high transaction costs.

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3) The lack of liquid, secondary markets for clean energy loans. Banks know how to re-package car and mortgage loans, and sell them into the secondary market. This is not yet the case for clean energy loans.

4) Inertia and human nature. New ideas and loan products take extra time to learn about, and pursue.

Bankers at Green Banks can talk the language of private sector bankers. They can find out what it will take to lower the perceived risk of a loan for a private sector banking institution. This can take many forms, including the formation of a loan-loss reserve fund and loan guarantees. A Green Bank can also use and leverage federal incentives like grants and loan guarantees to help de-risk a transaction. The result is lower interest rates and longer loan terms that incentivize participation by private banks. Particularly for home energy efficiency loans, extending the number of years that the borrower has to pay the loan back can be the difference between no deal and a loan product that costs the borrower less every month than the borrower's energy savings, making it cash flow positive from the first day. As the number of these types of transactions increases, private banks acquire data on loan performance, see profits and build up critical mass for secondary markets.

Green Banks can also provide the capital for Property Assessed Clean Energy (PACE) programs. Available in over 30 states, and so far designed primarily for commercial buildings, PACE programs provide another financing tool for commercial building owners to find easy and affordable financing to make their buildings more energy efficient. PACE programs give authority to local tax assessment districts, typically municipalities that levy property taxes, to loan money to building owners for energy efficiency and renewable energy upgrades, and then pay the loan back through a special tax assessment on the building. This means that the next building owner takes on any remaining debt when they purchase the building, and continues to pay the special tax assessment. Municipalities set up PACE programs voluntarily, and building owners participate voluntarily.

PACE works well because the re-payment mechanism is so secure. People do not want to default on their property taxes and risk losing their property. A similarly secure re-payment mechanism is known as "on-bill financing," where a local utility finances efficiency improvements and the homeowner pays the loan back as a portion of their monthly electric or heating bill. Again, people don't want their electricity shut off.

Unfortunately, once a state legislature authorizes a PACE program, things often do not happen as fast as anticipated. The bottom line is that municipalities are not banks, and often do not know how to proceed to set up and administer a PACE program. Enter the Green Bank, which can backstop the PACE program with capital and administrative capabilities while maintaining the crucial relationship between a building owner/borrower/property taxpayer and the municipality. Green Banks can also backstop and finance utility on-bill financing programs. The Alaska

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Legislature just passed a Commercial PACE bill on April 16, 2017 and Governor Bill Walker is expected to sign it. There is also a high likelihood that a bill to authorize utility on-bill financing programs will be introduced in the Alaska Legislature. An Alaska Green Bank could facilitate high uptake on both types of financing programs by providing the capital necessary to jump-start them.

For further information, I have attached a 20-page white paper on Green Banks produced by the Coalition for Green Capital. I also recommend materials and information on the Connecticut Green Bank website. http://www.ctgreenbank.com/about-us/

Connecticut is the nation's first Green Bank, and is held out as a success story and a potential model. REAP has been working closely with the Connecticut Green Bank for the last several months to educate lawmakers, the administration and local officials about the benefits of a establishing a Green Bank in Alaska.

One of the recommendations of the Alaska Energy Authority's recently published Alaska Affordable Energy Strategy is the creation of a Community Energy Fund for Alaska (CEFA). The CEFA would be a one-stop-shop source of financing for renewable, efficiency and traditional energy projects. The CEFA would match communities with appropriate funding sources and facilitate access to those funds. CEFA funds would create cost efficiencies by offering a single portal to a variety of funding sources - state, federal and private. The CEFA does not yet exist but AEA is working to connect communities with project financing and is seeking out additional new means (both grants and loans) to provide remote communities with access to capital.

Conclusion

Thank you for the opportunity to submit this supplemental testimony. I want to thank my REAP colleague Chris McConnell, Cady Lister and Sean Skaling at the Alaska Energy Authority, and Scott Waterman at the Alaska Housing Finance Corporation for their assistance.

Growing Clean Energy Markets with Green Bank Financing
White Paper
Coalition for Green Capital

Executive Summary

Green Banks are public finance authorities that use limited public dollars to leverage greater private investment in clean energy. Their goal is to accelerate clean energy market growth while making energy cheaper and cleaner for consumers, driving job creation, and preserving taxpayer dollars. Green Banks deploy public capital efficiently through financing to maximize private investment, and lower the costs of clean energy to spark consumer demand. Rather than rely strictly on grants that cannot bring markets to scale, Green Banks use limited public funds to offer financing that attracts private investment. This way each public dollar goes further and can be recycled. Green Banks also facilitate market development by working with originators and lenders, and offering the information consumers and businesses need to confidently purchase clean energy. By connecting capital supply and customer demand, Green Banks grow markets.

Green Banks produce a number of benefits for states beyond just growing clean energy markets:

- Low-Cost Market Growth – Green Banks aim to make energy cleaner *and* cheaper, and do it by using public dollars for financing, rather than grants, which is less costly for taxpayers
- Private Sector Leverage – Green Banks seek to "crowd-in" private investment currently on the sidelines, and can leverage $10 of private capital for each public dollar used
- More Efficient Government – Green Banks preserve and recycle public dollars through financing, allowing government to get greater "bang for the buck"
- Job Creation & Economic Development – 100% financing reduces barriers to demand, so investment in energy efficiency and in-state renewables means more jobs and growing businesses to meet that demand
- More Money Back in Citizens' Pockets – Green Bank financing allows more citizens to lower energy bills through deep efficiency retrofits, and offers a way for government to lower reliance on expensive grants

Connecticut created the first Green Bank in the country in 2011, and has already achieved tremendous growth. In FY15, the Green Bank facilitated $365 million in total clean energy investment. This is 10x greater than total investment in the state only 4 years earlier under the prior grant-making policy regime. And this investment flowed simultaneous to reducing solar grants by more than 50%. The Green Bank has created thousands of jobs, and expects to stimulate over $600 million of investment next year alone. New York, Hawaii, California and Rhode Island also have Green Banks. And Maryland, Washington, DC, Delaware, Virginia, Colorado, Nevada and others are currently exploring Green Bank creation.

Green Banks are a win-win-win situation: consumers save money by choosing clean energy; businesses and investors have new growth opportunities; and governments can replace expensive grants with value-generating loans. And because Green Banks enable clean energy deployment at low cost to customers and the public, a Green Bank is an ideal tool for enabling low-cost compliance with the Clean Power Plan.

Introduction

This paper provides an overview of the concept of Green Banks and the benefits they produce. Green Banks are designed to accelerate the growth of clean energy markets in a cost-effective manner that focuses on reducing energy costs for citizens. This paper will specifically answer the following questions:

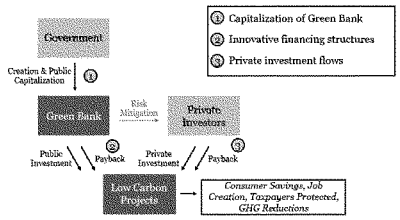
- What is a Green Bank & Why is it Necessary?
- What are the Benefits of a Green Bank?
- What do Green Banks Do?
- What Green Banks Already Exist?
- What Have Green Banks Accomplished?
- What States are Exploring Green Banks?

This paper was prepared by the Coalition for Green Capital (CGC), a 501(c)(3) non-profit based in Washington, DC that is the nation's leading expert on Green Banks. CGC is an advocate, advisor and consultant for policymakers, helping them understand how a Green Bank could work and be created in a given state. CGC drove the creation of the Connecticut and New York Green Banks, and supported development and operation of similar institutions in California, Hawaii and Rhode Island. Today, CGC is working in Vermont, Massachusetts, Maryland, Washington, DC, Colorado, Illinois and Nevada, all of whom are at various stages of Green Bank exploration and development.

What is a Green Bank & Why is One Necessary?

A Green Bank is a public or quasi-public institution that finances the deployment of renewable energy, energy efficiency, and other clean energy projects in partnership with private lenders. Green Banks are capitalized with public funds, which are then used to offer loans, leases, credit enhancements and other financing services to close gaps in the private capital markets for clean energy projects. Green Banks invest in the project deployment of mature, commercially viable technologies – not in early stage tech or in clean energy companies. The goal of a Green Bank is to accelerate the deployment of clean energy by removing the upfront cost of adoption, leveraging greater private investment in clean energy, and increasing the efficiency of public dollars. Through Green Banks, consumers and businesses can install clean energy technologies with no upfront cost while reducing energy costs. And because public dollars are used for financing, rather than grants, all public dollars are preserved through loan repayment.

Figure 1: Green Bank Structure



For a number of reasons, economically viable, low-risk clean energy projects are often unable to access affordable private financing. Green Bank financing methods "crowd-in" private capital to fill financing gaps by reducing real and perceived risk, and allowing private investors the chance to learn about a new market opportunity with the security of government partnership. As private lenders gain experience and information about the processes, risks and addressable market size in clean energy, they can become increasingly comfortable and confident lending into these markets. Green Banks have shown that with experience and data, private investors are more eager to enter clean energy markets at scale, ultimately without any Green Bank support.

Green Banks and public clean energy financing programs are increasingly common across the U.S., as governments recognize the importance of financing in addition to traditional grant models. Historically, many governments have supported the adoption of mature clean energy technologies by offering incentives, rebates, tax credits and other forms of subsidies. These programs have been generally effective in improving the economics of clean energy installation (primarily for renewables) and stimulating demand among consumers. However, rebate programs have two primary weaknesses that financing can address. The first is that rebates traditionally only cover a small portion of a project's cost. If a rebate covers $2,000 of a $15,000 efficiency project, for example, then the customer still must find $13,000 in cash. This requirement for upfront, out-of-pocket cash stands as a significant barrier to adoption. The second problem with grants is that they are expensive, as they are permanent expenditures of taxpayer dollars. To bring clean energy markets to meaningful scale using grants would require more public expenditure than is available or politically viable. Therefore new program solutions are needed that address upfront costs for consumers and the expense of public capital.

Ideally, private lenders would step in to the market today to cover the remaining upfront cost of clean energy adoption beyond what is covered by rebates. However, there are capital market inefficiencies and inherent challenges to financing clean energy that have resulted in inadequate investment by private lenders. And those private lenders that do offer capital typically charge interest rates that are relatively high and terms that are short. This erodes the economics of a clean energy project, which ideally will be cash flow positive from day one. In this context, "cash flow positive" means that the energy cost savings achieved on a monthly basis as a result of the clean energy installation exceed the monthly financing charge. Under a cash flow positive project, the borrower is able to, on net, save money every month without paying any upfront costs, making the project highly attractive. This kind of cash flow structure is only possible with loan terms that match the expected lifetime of the projects savings, and with rates that are commensurate with the risk. Therefore private capital offered at unfavorable terms (if it is available at all) undercuts the economic attractiveness of the project for the customer.

Private financing gaps exist for several reasons. The first is that there is a relatively short track record for clean energy financing, and therefore there is little data for lenders to rely on. Without data, banks are left with high amounts of uncertainty over how well different types of projects perform and how often borrowers repay their loans. This uncertainty leads to either hesitation to enter the market or unfavorable lending terms. The second cause of financing gaps is that many clean energy projects are small and fragmented. Building efficiency upgrades and rooftop solar projects are inherently small investments that are geographically disperse, with varying credit among project off-takers. These types of investments are relatively expensive to underwrite for a private lender, making the loan potentially uneconomical to offer.

A third cause of financing gaps is the lack of capital market liquidity and maturity. If a commercial bank provides an energy efficiency loan, it is unknown to the bank if it will be able to sell that loan to another lender or if it will have to hold that loan on its balance sheet, tying up capital. Mortgage and auto lenders don't have this difficulty, because there

are highly liquid secondary markets for home and car loans. These kinds of secondary markets are just now forming for clean energy technologies. And the final cause of private underinvestment relates to human and organizational behavior. In order to begin lending into a new market, a bank has to hire new staff, learn about the risks and processes of a new market, and determine a precise "box" of what kind of project and credit they are willing to lend to. This process takes time, commitment and money, all of which will only come with a greater understanding of market potential and risks.

What are the Benefits of a Green Bank?

Green Banks produce many benefits for government, for consumers and for businesses, and are a win-win-win approach to clean energy market growth. These key benefits include:

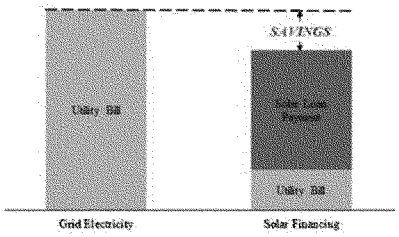
- Low-cost market growth;
- Greater leverage of public capital with private co-investment;
- More efficient government;
- Job growth & economic development; and
- More money back in citizens' pockets.

These benefits are explained in greater detail below.

Low-Cost Market Growth

Green Banks aim to bring clean energy market to scale by focusing in price – the only way to stimulate broad demand for clean energy is by offering consumers a way to save money on energy. The combination of upfront lending technology costs and financing at affordable interest rates that consumers and businesses can now use clean electricity and/or lower overall usage with no upfront cost and lower overall energy spending. Financing that is appropriately structured can be net cash flow positive, meaning a customer can save more money each month than they owe for financing repayment. Grants are a helpful tool for lowering the technology cost, but not cover all upfront costs and do not enable cash-flow positive clean energy. By offering financing, Green Banks unlock demand and give customers an attractive means to save money on energy.

Figure 2: Green Bank Positive Cash Flow Structure



This is a low-cost method for market growth because, by using financing, the government preserves its capital and reduces overall expenditure. The amount of grant dollars needed can be reduced when it is paired with 100% financing, and the overall cost the government of supporting clean energy markets can be reduced. And because the Green Bank focuses on products and solutions that ensure reduced energy costs, there is no increased cost of energy pushed either on participants or citizens.

Please see the attached *Appendix A* for a detailed discussion on how Green Banks can lower the price of clean energy by transitioning from grants to loans.

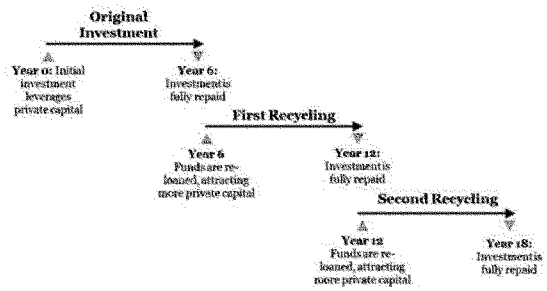
Private Sector Leverage

Green Banks leverage public dollars with private investment through public-private partnerships. Green Banks use a range of financial techniques and structures to achieve this leverage (described below), but across products, Green Banks can draw in multiple private dollars of investment per public dollar. For example, a loan loss reserve credit enhancement may enable $10 of private lending per $1 of public investment put in reserve. This 10:1 ratio stands in stark contrast to typical grant programs. Through Green Bank structures, public dollars go farther, getting more "bang for the buck" on public investment. And because public dollars are lent and repaid, the same public dollar can be recycled and used to draw in more private dollars again in the future.

More Efficient Government

Green Bank financing makes government more efficient in a number of ways. The first is that by offering financing, rather than grants, Green Banks preserve public capital and reduce total public expenditure while still driving positive market outcomes. Financing is critical to achieving broad market uptake, yet public dollars used for financing are far more valuable to the public sector because they do not represent an expense. For example, $10 million in public funds put toward a grant program are spent in a given year. This becomes a recurring expense that requires more public funding every year. However, the same $10 million invested in a Green Bank would still be worth $10 million in the future because the funds are preserved through financing.

Figure 3: Green Bank Recycling



Green Banks represent more efficient government because they use public dollars in a way that is able to achieve greater market outcomes. Specifically, a public dollar put towards financing rather than grants will enable deeper energy efficiency retrofits to occur. Deep, multi-measure efficiency or clean energy projects have long payback periods, and therefore are only viable with 100% upfront financing at long terms. A public dollar used for a grant cannot facilitate this kind of project unless grants will pay for the most of or the entire cost of the project, which is an extremely expensive approach to market growth. However, that same public dollar used to financing can achieve greater energy savings and dollar savings for energy users because financing is the key to unlocking deeper retrofit projects.

Green Banks can also help government operate more efficiently by helping to coordinate cross-agency efforts to engage with and stimulate clean energy markets. By offering technical assistance to potential clean energy adopters, providing easy and clear information, and guiding customers to the appropriate state program, whether housed in the Green Bank or not, a Green Bank can ensure that government support is effectively reaching market actors. Presently the wide range of government programs offered can create market confusion, with customers unsure how to access government support, or which agencies to reach out to. A Green Bank can spur greater coordination among government programs in order to present a more unified and simple face for customers to interact with.

Job Creation & Economic Development

A Green Bank would also be an engine for economic growth and job creation, spurring direct investment in the state. The availability of financing removes barriers to adoption and helps increase demand for clean energy technologies and installations. This in turn drives new businesses to develop and existing businesses to grow to meet this demand. A growing clean energy economy means more contractors, more installers, more engineers and more employees in other related services. Through its first three years of activity, the Connecticut Green Bank created nearly 4,000 direct and indirect jobs.[1] And because clean energy projects are typically located at buildings or other local sites, jobs created through Green Bank investment cannot, by definition, be outsourced. Installing new technologies will require local jobs with boots on the ground at the point of installation. And because Green Banks leverage public dollars with greater private investment, each public dollar can cause more clean energy deployment and, therefore, more job creation than under current grant programs.

A Green Bank can stimulate economic activity in another way, by opening up new and profitable investment opportunity for the lending community. Presently, cost-effective, low-risk and profitable clean energy investment lay fallow for lack of capital. By working with local lenders, Green Banks draw in more market participation and increased market understanding for credit unions, community banks and other local lenders. Green Banks allow lenders to learn about the risks and processes of clean energy investment while operating with a safety net that comes with a credit enhancement or government co-investment. As demonstrated in other states, initial Green Bank investments can quickly lead to huge in-flows of private capital. For example, the Connecticut Green Bank seeded a $5 million solar loan fund in 2013 to demonstrate market potential. Within a year, that pool of dollars had been expended, and the private origination partner had been able to source its own private capital. Because the Green Bank shined a light on the market opportunity, the Digital Federal Credit Union created a new $100 million warehouse for solar loan investment, allowing the Green Bank to pull back its capital and let the private sector take over.[2] This is a perfect example of how Green Bank activity can increase business opportunities for the state's lenders.

[1] Connecticut Green Bank Comprehensive Annual Financial Report Fiscal Year Ended June 30, 2014.
[2] Reporter's Notebook, "Green Bank partner lands $100M solar investment," Hartford Business Journal, November 10, 2014.

More Money Back in Citizen's Pockets

The bottom line benefit of a Green Bank is that it can save money for taxpayers and ratepayers, putting more money back in their pockets. A Green Bank can do this in two ways. The first is that by using dollars for financing, rather than grants, Green Banks can preserve public dollars and reduce the amount of annual expenditure that must be used to stimulate market growth. Where grants and collected, expended, and lost every single year, a Green Bank retains its value, preserving dollars through financing. Those dollars could conceivably be return to taxpayers at some point in the future, or repurposed for other government needs. And because the public dollars used for financing are also able to leverage far greater private investment, the public sector burden for clean energy market growth can be reduced.

The second way that Green Banks can return dollars to taxpayers is by achieving deeper energy savings and expanding cheap, clean energy opportunities. Financing is critical to penetrating deep energy efficiency retrofit markets. So a Green Bank can extract more energy bill savings for businesses and residents by allowing more comprehensive energy retrofits. And more broadly, financing creates access to all sorts of clean energy projects that otherwise were inaccessible to those without the ability to pay large upfront costs. A customer who can pay a lower price for rooftop solar electricity than for grid electricity can only access those savings with upfront financing. Today private lenders are serving that market, but only a portion, specifically those with high credit scores. A Green Bank can democratize access to cheaper clean energy and energy savings.

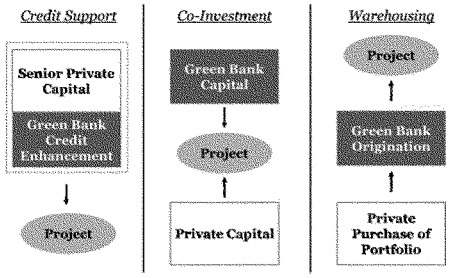
What Do Green Banks Do?

Green Banks generally use a common set of techniques and structures to offer public financing and leverage private investment in clean energy. These methods form the basis of many specific Green Bank activities and applications, and are adaptable to fit multiple markets segments and technologies. To complement financing, Green Banks also spur demand and develop markets to lower barriers to market penetration.

Financing Techniques

The following techniques form the three fundamental categories of forms of Green Bank financing activity. All Green Banks are using some derivation of these fundamental categories.

Figure 4: Green Bank Financing Techniques



Credit Enhancement

A credit enhancements is a tool offered by a Green Bank with the goal of increasing private lending activity and/or improving the terms of private financing. Green Banks accomplish this through multiple means, but loan loss reserves and loan guarantees are most common. This technique is suitable for a market where private lenders are interested in entering the market but are hesitant due to perceived risks. Or, a credit enhancement can be used when private lending is available, but at terms and rates that reduce the viability and market potential for clean energy projects. These kinds of investments can achieve high leverage ratios, stimulating many dollars of private investment per public dollar spent.

Co-Investment

Co-investment involves direct Green Bank investment in a clean energy project alongside a private investor. Unlike credit enhancements, where public dollars are not actually invested in the project technology, co-investment can take multiple forms and structures of actual project investment. A Green Bank may provide senior debt, subordinated debt, or equity in a project, which is then paired with multiple potential forms of private investment. For instance, a Green Bank and private bank may each make a 50% debt investment in a project. Or, a private investor may offer 80% of the debt needed for a project, and the Green Bank makes a 20% subordinated debt investment. This structure both fills financing gaps *and* acts as a credit enhancement for the senior debt. The leverage achieved on these co-investments depends on the precise product structure, and by its nature requires the presence of a private lender willing to at least make some level of investment in a project.

Warehousing/Securitization

In the event no private lender is willing to underwrite loans, even with a credit enhancement, it may be suitable for a Green Bank to underwrite 100% of a loan itself. This situation may arise if the technology itself is perceived as too risky or new, if the market segment is viewed as having more credit, or if the investments themselves are not cost-effective to underwrite. This final challenge is a significant barrier to private investment in small and geographically disperse projects like residential or small business energy efficiency projects. By their nature the projects are relatively low cost and may differ in terms of credit, technology and location. This makes the projects relatively expensive to underwrite for a bank and – on an individual basis – not worth the trouble. However, if a pool of these kinds of loans were bundled together to diversify risk and achieve scale, the projects then become far more attractive to lenders. A Green Bank can accomplish this by underwriting loans directly and warehousing them until scale is reached. At this point the Green Bank can sell the loans to private investors. This can be done either through a private placement of the whole loans, a private securitization, or a public securitization. If the Green Bank is able to sell its entire stake in the portfolio of loans, then 100% of public dollars are replaced with private capital, effectively achieving infinite leverage. This technique is critical to allowing small clean energy projects to access the low-cost capital that can be found in publicly traded debt markets that are tapped through securitization.

Financing Structures

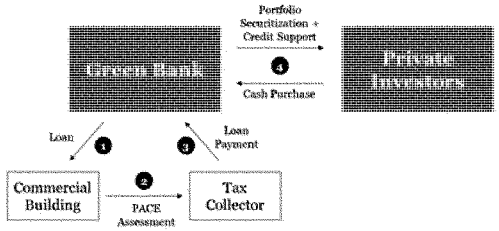
Green Banks can use the described financing techniques through a number of structures that the clean energy financing industry has developed as new delivery mechanisms. These delivery mechanisms were created to increase the security for a lender that otherwise would be making an unsecured loan with a perceived risk of repayment. These structures can be used with or without the involvement of a Green Bank, but it has been found that Green Banks are a suitable manager and implementer of these structures.

Property Assessed Clean Energy (PACE) Financing

PACE Financing is a structure through which a building owner repays an energy upgrade loan through property taxes via a new lien on the building. PACE liens typically sit senior to all other non-tax liens on a building, including the

mortgage, significantly reducing repayment risk. In any state that has passed legislation and any municipality that then allows PACE, technically a PACE loan can be made by any lender. The lender would provide a loan to a building owner to implement energy efficiency, for instance, and then the tax-collecting agency would place a new lien on the building equal to the loan repayment. That repayment is collected by the taxing agency and remitted to the lender. Though simple in concept this is difficult to execute and has struggled to attract private lenders in many states. However, Connecticut has found that the Green Bank is an ideal PACE program administrator *and* lender. A Green Bank could also offer a credit enhancement to entire private lenders into the PACE market. Many states that have relied entirely on private lender origination and underwriting have failed to create active PACE markets. Green Banks present a successful solution.

Figure 5: PACE Financing Warehouse



On-Bill Financing/Repayment

On-bill financing or repayment is a structure through which an energy upgrade loan is repaid through the customer's utility bill. Similar to PACE, this structure creates greater security for the lender because historically utility bills have a very high rate of repayment. On-bill financing has additional benefits, too, because it addresses the split incentive between building owners and tenants. By attaching a loan to a utility meter, rather than the customer, a tenant can reap the benefits of efficiency, repay only the portion of the loan that is due while still a tenant, and then hand the remaining payments to the next tenant who continues to benefit from the efficiency. This has the power to open up many new markets for efficiency financing that otherwise would be unsuitable. Like PACE, a Green Bank could act as a program administrator and/or a lender for on-bill programs. (Note: On-bill financing typically refers to programs where the utility itself uses its own capital to issue the loans. On-bill repayment refers to the programs that allow non-utility lenders to issue loans, where the utility merely acts as a collection platform.

Market Development

Increasing the flow and availability of affordable capital is an essential element to market growth. But capital cannot be offered in a vacuum. Consumers and businesses must become engaged and understand the benefits of clean energy. And because the process of purchasing clean energy can be complex and multi-faceted, customers greatly benefit from a simplified process with a minimal burden for project management. Green Banks can play a central role in facilitating this kind of market maturation and information transparency.

Technical Assistance

A Green Bank can provide critical know-how, guidance and information to market actors to understand how to acquire clean energy technology and take advantage of state programs. For most market participants, the mere idea of choosing how to use and consume energy is a new concept. Therefore there is a sizable need for education and information. Consumers and businesses need to learn about technologies, clean energy economics, and adoption or purchase options. Procuring clean energy technologies, even in a straight-forward energy efficiency building upgrade, can be incredibly complex and daunting for new customers. The Green Bank can address these market challenges with a technical assistance program.

A green can offer a range of forms of market support. A "concierge service" can direct customers, contractors and businesses to the appropriate place in government to access various forms of support and information. A new website can provide clear, simple and comprehensive information about clean energy technology and the state's current programs. Staff can help municipalities understand the project development process and direct them to engineers or contractors. And staff can give detailed guidance on financing options from the Green Bank or other potential sources. By streamlining information and creating a single point of access to learn about state programs, a Green Bank can greatly reduce market confusion and make clean energy seem more accessible. This initiative could be part of a broader state branding effort around clean energy, unifying all state clean energy programs under a single banner.

Turn-key Product Design & Delivery

Green Banks can help ensure that customer face a minimal complexity when considering a clean energy purchase. Today, adopting clean energy is typically a long, multi-phase and possibly intrusive process. This naturally stifles demand and discourages adoption. Part of the challenge is that the economic benefits are not clearly understood and harder to discern when faced with large upfront costs of adoption. Therefore Green Banks can help build the bridge between available capital and consumer demand by developing a turn-key, seamless adoption process. By asking customers to do little more than sign on the bottom line to immediately begin saving money, Green Banks can greatly reduce barriers to adoption.

Efficient and easy product delivery means designing easy-to-understand financing products that can be easily explained. It means pairing financing and clean energy as a unified offering, presented to the customer at a single point in time. It means training contractors to speak the language of financing and know how to sell clean energy with financing. And it means providing project management and technical assistance to give customers confidence that their project will be delivered and produce as promised. For instance, a Green Bank can provide the technical assessments needed to determine that a multi-measure project is indeed cash-flow positive. By using savings-to-investment ratios (SIRs), Green Banks can give customers confidence in an otherwise complex project. These kinds of demand-generating activities can and frequently are done in partnership with private actors.

Central Website & Access to Information

A simple solution is a single website that is the face of all Rhode Island programs. The site can inform customers about their options, understand the purchase process for clean energy, and then direct customers to the right program/entity, depending on the clean energy technology they want to adopt. From a customer perspective, clean energy is unknown and complex. The technology is new, the purchase is expensive, and the process of purchasing and installing can be incredibly cumbersome. The state can greatly minimizing these significant hurdles with an attractive and clear website that provides a roadmap for customers, and can identify suitable technology and programs to pursue. If prompted to answer just a few simple questions, a website can fare more accurately guide a customer to appropriate clean energy solutions and minimize confusion. For instance, simply by asking if a customer lives in a multi-unit apartment building, a website can be programmed to eliminate rooftop solar options from consideration.

A website can also work as an interactive hub for information about contractors and other providers of clean energy solutions. This kind of information can give customers confidence that they are working with a trusted partner that has been vetted by the state. Often, programs run by different entities will have a separate lists of approved contractors. These separate lists should be consolidated and unified into one list to make the process simple for customers. From the opposite perspective, contractors should be trained and educated on the full range of programs available that can be offered to customers, as they are the primary go-to-market channel for larger projects. Specifically, they may require training to understand the state's financing programs and learn how to sell a clean energy solution with financing (i.e. how to sell the savings and cash flow, not the loan).

What Green Banks Already Exist?

In the United States, five states and one county have state Green Banks and similar finance authorities. Abroad, four nations have national Green Banks. In the United States, Connecticut, New York, Hawaii, California and Rhode Island have state clean energy finance institutions. And Montgomery County, Maryland recently created the first county-level Green Bank.

Connecticut Green Bank

The Connecticut Green Bank was created in 2011 as the first state Green Bank in the U.S. Originally named the Connecticut Clean Energy Finance & Investment Authority; it was created through bi-partisan legislation that was initiated by newly elected Governor Dannel Malloy. The new Green Bank institution was born out of the existing grant-making institution, the Connecticut Clean Energy Fund. The Fund was repurposed and turned into a deployment financing entity. The Green Bank was created as a quasi-public agency, with a board of directors that are a mix of government officials and independent directors.

The Connecticut Green Bank is capitalized by two sources, both of which were identified in the legislation. The first is a systems benefit charge that collects roughly $20 to $25 million dollars per year. This was an existing system benefits charge, already in place in the state prior to the creation of the Green Bank. Previously the entire ratepayer collection went towards state-managed grant programs. The re-allocation of those funds to the Green Bank represents only a portion of the total collection, with the remaining funds still going toward grants. The new split in funding between grants and financing was based on a desire to build market-based mechanisms for clean energy growth. This re-allocation of funds was also driven by a desire to maximize private leverage from public funds and get the greatest "bang for the buck" for each public dollar. The second source of Green Bank funds are the state's proceeds from the sale of emission allowances through the Regional Greenhouse Gas Initiative (RGGI) Program. This repeated and perpetual capitalization means that the Connecticut Green Bank's balance sheet, and capacity to issue loans, continuously increases.

In addition to these public capital sources, the Connecticut Green Bank is authorized to issue its own bonds based on its own balance sheet. The Bank also has limited ability to issue bonds that are supported by a state bond reserve fund. This is not equivalent to full faith and credit, but does enable borrowing at lower rates based on the state's credit rating. The Bank has not yet issued bonds of this type to increase its lending capacity.

The Green Bank operates a number of residential and commercial financing programs, including a Solar Lease, a credit enhancement to enable private loans for residential upgrades, and Commercial PACE financing program. C-PACE is by far the most successful commercial PACE financing program in the country. These programs are explained in greater detail in *Appendix B*. The Green Bank also manages Solarize campaigns, trains contractors, and provides a number of other forms of support for market development

New York Green Bank

The New York Green Bank (NYGB) was created in December 2013 with the approval of funding by the Public Service Commission. It opened for business in February 2014 with the release of its open-ended RFP, seeking proposals for funding. Unlike the Connecticut Green Bank which offers specific retail products, the NYBG operates more like a wholesale infrastructure bank, working with lenders and developers who will then originate deals and offer retail financing. An ideal application to the NYGB will come from a private lender and developer together, who have a specific project that is only partially financed and needs the NYGB to fill the financing gap. The NYGB has no prescribed financing structures. However it will offer capital in the forms and structures outlined above, including loan loss reserves, guarantees, senior debt, subordinated debt, insurance, warehousing and securitization. The NYGB reviews and scores applications as they are received, and will only fund deals that (1) have the ability to scale, (2) can prove that private financing is unavailable for the entire project, and (3) can serve to transform clean energy capital markets. In the fall of 2015 the NYGB announced its first set of transactions, using $49 million in public funds to leverage $178 in private investment.[3]

Hawaii Green Infrastructure Authority

In 2014 Hawaii created a new Green Infrastructure Authority to manage clean energy financing programs. This first of these programs is called the Green Energy Market Securitization (GEMS) program, which will provide rooftop solar lease financing. GEMS uses a unique capitalization structure and is focused on narrow market segments, specifically the low-to-moderate income (LMI) market. Hawaii has the highest electricity prices in the country, making solar relatively cheap compared to the grid. This also means that increasing the availability of solar is a critical solar welfare issue in Hawaii. The advent of solar financing mechanisms like solar leasing enabled a huge portion of Hawaii homeowners to put solar on their roofs, with total market penetration above 10%. However, there was a huge difference in market adoption between high and low income households, as traditional solar leasing products were unavailable to low income and/or low credit households. The GEMS program was built to serve this specific market.

California CLEEN Center

The California CLEEN Center is a new financing initiative based within the state's existing Infrastructure Bank. It was created in fall of 2014 at the direction of the Governor. As described in the business plan, the objective of the CLEEN Center's programs is to "drive down the cost of EE projects and retrofits, leverage existing public programs, encourage private investment and earn investment returns for the IBank and partner with market intermediaries." This statement encompasses the broad set of objectives typically held by a Green Bank. The CLEEN Center's first two programs will be the Statewide Energy Efficiency Program (SWEEP) and the Commercial & Industrial Energy Efficiency Programs (CEEP). The programs will fill market gaps where viable efficiency projects are unable to access reasonable financing, specifically targeting the municipal, university, school and hospital (MUSH) market, as well as the Commercial & Industrial (C&I) market. The CLEEN Center is also designing a specialized LED street lighting program that will enable municipalities to swap out old street lights for LEDs while remaining cash flow positive throughout the term of the loan. Through each of these programs, the CLEEN Center will offer senior debt, subordinated debt, or credit enhancements to enable private sector investment

Rhode Island Infrastructure Bank

Recently-elected Governor Gina Raimondo campaigned and was elected on a pledge to create a state Green Bank. Rhode Island determined that the best path to creating its Green Bank was through legislation. And rather than build an entirely new institution, the Green Bank would be built upon an existing entity with a track record of success. The

[3] Press Release, "Governor Cuomo Announces Three NY Green Bank Transactions to Improve Access to Clean Energy and Reduce Greenhouse Gas Emissions," October 21, 2015.

state's Clean Water Financing Authority (CWFA), which had financed water projects in the state for many decades, was tapped to become the Green Bank. The CWFA would be given expanded authorities to address clean energy markets, and be renamed as the new Rhode Island Infrastructure Bank (RIIB).

This new organizational structure was passed into law in June 2015 as part the Governor's fiscal year budget legislation. The RIIB was assigned responsibility for two specific financing programs in the legislation, which are to become the first Green Bank products in early 2016. RIIB has responsibility for designing, administering and possibly financing both commercial and residential PACE in the state. RIIB chose to follow the Connecticut model with a single, state-wide PACE administrative authority. The RIIB was also tasked with designing and implementing an Efficient Buildings Fund (EBF), which will finance energy upgrades for municipal buildings in the state. RIIB activities are funded through a combination of RGGI proceeds, system benefit charges, remaining federal ARRA funds, and a small amount of re-directed operating funds. The RIIB also has the authority to issue state qualified clean energy bonds (QECBs). In sum, these funds are intended to both serve as an equity portion of a broader bond issuance, as well as support a larger agency operation. The bond issuance, the proceeds of which will finance the EBF program, is estimated to raise $20 million. RIIB, like the CWFA before it, is a quasi-public agency with a board of directors, where the chairman is appointed by the Governor.

What Have Green Banks Accomplished?

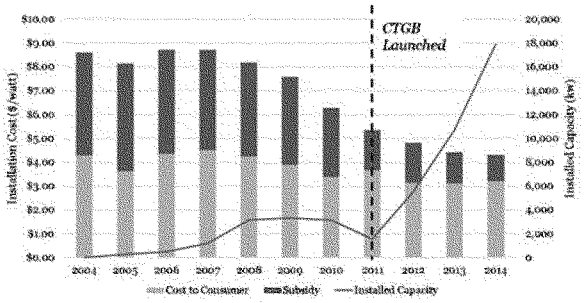
The Connecticut Green Bank is the most mature and developed Green Bank in the country, and has achieved incredible results after four years of operation. The Connecticut Green Bank has sparked remarkable growth in the state's clean energy markets. In FY2015, the Green Bank sparked $365 million in total clean energy investment in the state, while achieving a private: public leverage ratio exceeding 5-to-1. This stands in sharp contrast to the market condition prior the Green Bank's creation. In the eleven years of operation of the prior Clean Energy Fund, a total of $350 million was invested during that whole time period. And of that total, approximately half of the funds were public dollars, and nearly all were in the form of grants. Under the Green Bank, markets have grown quickly through greater private investment. And the public dollars that are used are returned to the Green Bank through repayments on financing. The Connecticut Green Bank is now developing new products to expand its market coverage to include the low-to-moderate income (LMI) sector and clean transportation.

Table 1: CT Green Bank Outcomes V. Prior Grant-Making Entity

	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	11	3	1
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]

The solar market, specifically, has grown dramatically since the Green Bank's creation. By law, the Green Bank was assigned the responsibility for winding down the existing state solar rebate program, and transitioning toward a financing based model. Under this approach, residential rooftop solar penetration has increased rapidly despite a consistently falling solar grant amount. This is because financing is now consistently available and affordable, covering all the upfront costs of adoption. With financing, the amount of grant offered falls, as solar can be economically viable *and* attractive to customers without enormous subsidies.

Figure 6: CT Green Bank Residential Solar Market Growth



What Other States are Exploring Green Banks?

CGC is working with many other states that are currently considering or actively developing Green Banks and state clean energy financing authorities.

Maryland
In the spring of 2014, the Maryland state legislature passed a bill directing the Maryland Clean Energy Center to conduct a formal study of the need for a Green Bank in the state. The study will also identify specific Green Bank financing products and structural options for the state. CGC is completing this study on behalf of the Clean Energy Center.

Delaware
The Delaware Sustainable Energy Utility (SEU) is working with CGC to identify ways that the SEU could increase its financing activity, modelled on Green Bank principles. The SEU currently receives a large portion of RGGI proceeds, and wants to develop methods for better leveraging those funds to grow clean energy markets.

Washington, DC
In the spring of 2015, the District Department of Energy & Environment issued an RFP for the completion of a study to assess the need and potential for a District Green Bank. CGC won the contract and is currently working on the study. The first phase of the study was completed which found a significant need for greater clean energy investment in order to meet existing renewable end climate goals. Phase 2 will be completed by March 2016.

Nevada
In the summer of 2015, the Nevada state legislature directed the interim Legislative Committee on Energy, in partnership with the state energy office, to complete a study of a potential Nevada Green Bank. CGC is slated to complete this study in partnership with the state energy office, which a scheduled completion in summer. Legislation to create a Green Bank could be introduced in January 2017.

Virginia
In 2015, the Governor formed a Climate Commission, made up of leading policymakers, advocates and market participants, to propose climate-related solutions that were market-oriented and could be implemented with little political opposition. The number one recommendation to come from that Commission, as voted on by members, was the creation of a state Green Bank to increase financing for clean energy and resiliency. The Governor is now considering next steps for implementation.

Vermont
In Fall 2014, Vermont energy and economy leaders formed a steering committee to oversee a Clean Energy Finance Initiative, aimed at uncovering the need and opportunity for increased public financing for clean energy deployment. The Committee includes the state's Secretary of Commerce, Treasurer, Deputy Director of the Public Service Department, and other key actors. Work on this initiative is on-going, led by CGC with other in-state partners.

Massachusetts
There are currently two bills pending in the Massachusetts state legislature that propose creating a state Green Bank. Both bills are scheduled to be heard in committee in January 2016.

Colorado
The Colorado state energy office has received approval from the Governor's office to explore the Green Bank concept and prepare a formal proposal for Green Bank creation for the Governor's review. If approved, the Governor would introduce Green Bank legislation in 2016. Green Bank discussions in Colorado have included the potential for including water, transportation and other infrastructure. CGC has been advising the energy office as it prepares its proposal.

Appendix A – Grant & Financing Optimization and Design to Lower the Clean Energy Price

A helpful framework for assessing appropriate grant and finance levels is to examine the economics of a specific transaction and the relevant value flows. The value flows for renewables and efficiency are different, though the fundamental economic benefit to customers come from savings on energy bills. Through this transaction-specific lens, policymakers can better understand the level of grants and/or financing needed to spur adoption of clean energy solutions.

Energy Efficiency

Energy efficiency technology, generally, is net-present value (NPV) positive. This means the discounted present value of the savings on energy bills that come from energy efficiency are greater than the cost of the efficiency measure itself. Therefore, effectively in any energy market, energy efficiency is economically viable and cost-competitive with grid electricity without any incentive, grant or rebate. This does not mean rebates are entirely unnecessary, as they are a proven tool for attracting customers and generating demand. However it is important to note that energy efficiency rebates are *not* necessary for economic reasons, but purely for marketing reasons.

A rebate, then, may attract a customer to purchase efficiency technology, but the customer in most cases still must pay cash out of pocket for the purchase (assuming the rebate doesn't cover 100% of the cost). This has two consequences. The first is that customers may still hesitate to purchase efficiency technology because out-of-pocket payment is still required. A deep energy retrofit on a home may cost $25,000. A $5,000 rebate is helpful, but still leaves $20,000 in upfront costs. The second consequence of requiring upfront cost is that the customer will necessarily consider the efficiency investment in terms of *payback period*. Payback period is the amount of time it takes for the cumulative savings of an efficiency project to equal the total upfront cost the customer paid. The problem with this framing is that most customers require incredibly short payback periods in order to go through with an efficiency transaction. If the payback is more than 3 years, for instance, the customer may decline the purchase. Therefore, upfront cost and payback period are inversely related.

This may lead to the conclusion that a larger rebate is necessary, but this is economically expensive for the state and economically unnecessary since the role of the rebate is purely to attract customers. Instead, if financing can be offered to cover the upfront cost remaining after the rebate, then the customer will face zero out-of-pocket cost. 100% financing is critical because it entirely alters the framework through which the customer assess the project. Payback period is no longer the relevant metric. As the customer has zero out of pocket cost, there *is no payback period*. Rather, the metric for consideration is now cash flow. Specifically, do the monthly energy savings exceed the monthly loan repayment. If the loan can be structured to achieve this cash flow, then the project is net cash flow positive from the outset of the project. The customer must make no cash out lay and begins saving money immediately. The customer does not have to wait for a date long into the future to begin seeing savings.

Three lessons of program design flow from this important reframing of efficiency purchases. The first is that the optimal level for an efficiency rebate is the lowest possible amount that still attracts customer adoption. The state should want to minimize rebates to save money for ratepayers/taxpayers, without disrupting market growth. The second lesson is that any upfront cost not paid for by a rebate should be paid for through financing. This financing can be either public or private, but the objective should be to give the customer efficiency with no upfront cost. (It is likely the case that when paired with 100% financing, rebate levels can be reduced from current levels without disrupting market growth.) The third lesson is that the financing offered will need to be at terms that generate a net cash flow positive stream over the course of the project. This means the loan term ideally matches the expected life of the efficiency measures, and

the interest rate offered will be at a level that allows monthly payments to be below the amount of monthly energy savings. If private lenders are unable or unwilling to offer financing at such terms, a Green Bank or clean energy financing authority can facilitate financing as needed.

Renewable Energy

Renewable energy generation, unlike energy efficiency, cannot be assumed to be NPV positive – it is not necessarily cost-effective for a customer. The common framework for assessing the economic viability of renewables is to compare the effective price of a given generation system to the cost of grid electricity. If the effective price of generation, or the levelized cost of electricity (LCOE) is below the cost of grid electricity, then it makes sense for a customer to choose renewable power over grid electricity. This framework is commonly applied to distributed solar generation, whether installed on rooftops or for community solar installations. Through this lens a state can precisely identify the level of rebate needed, if any, to make solar economically attractive to customers.

To calculate the LCOE of a specific solar system, all upfront and lifetime system costs are discounted to present value, and then divided by the lifetime generation of the system. This produces a dollars/kwh metric that can be compared to grid power. The upfront costs of solar includes the cost of the technology and installation. These costs need to be offset, though, by any rebates or other incentives offered by state or federal government upfront. There are effectively no long-term, on-going costs to solar, unless the system is financed. In that case, there is no upfront cost to the customer, but rather a stream of on-going payments that need to be discounted to prevent value. There may also be on-going benefits, in the form of performance based incentives or renewable energy credits. These benefits would need to be discounted and offset against the upfront system cost.

The common set of costs and benefits to be considered in a solar LCOE analysis are:

- the upfront cost of the system if it is not financed through a lease or loan;
- on-going financing payments (lease or loan) if the system is not paid for entirely upfront;
- the federal investment tax credit, worth 30% of the system cost;
- the tax benefits of accelerated depreciation if the system is leased, worth approximately 25% of the system;
- the value of renewable energy credits generated by the system; and
- the value of any additional state-specific rebates, performance incentives, or tax breaks.

Each of these value streams can be estimated, discounted to present value, and summed, and then divided by the expected generation of the system to determine the effective price of solar.

Through this framework, a state can easily determine how much rebate is necessary to produce a price of solar that is price competitive with grid power. In theory, if customers were perfectly rational, a state could adapt its rebate policies to produce an LCOE that is marginally less than the grid price and expect all viable customers to convert to solar. Evidence suggests, though that a more noticeable price advantage is necessary to drive conversions. So, for instance if the grid price of electricity is 18 cents per/kwh, a state may set its policies to produce a price of solar that is 16 cents/kwh, rather than 17.99 cents/kwh.

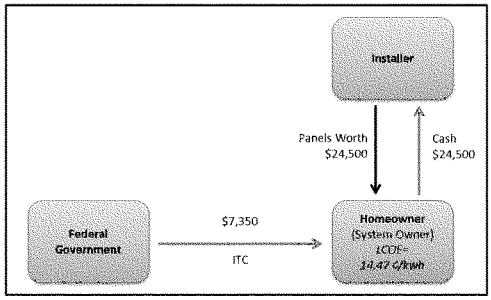
Economic analysis may reveal that a sizable rebate is necessary, or possibly that no rebate is necessary at all. Rebates set above the necessary levels are an unwarranted expense for the public, and rebates offered in the absence of private or public financing options may unintentionally act as a wealth transfer. If financing is not available, a $5,000 rebate on a $25,000 system is likely to only attract very wealthy customers who can pay $20,000 out of pocket. Alternatively, a

lower grant may still produce solar at a competitive LCOE, and public dollars can instead be put towards offering financing to those that cannot get it through private capital sources. This not only eliminates all upfront costs for consumers - the number one barrier to adoption - but also has the added benefit of preserving taxpayer dollars through loans that are repaid.

It is important to consider the cost of financing. The interest rate, or cost of capital, can be a significant lever on the effective price of electricity from the solar system. A drop in the cost of capital of 3.5 percentage points can reduce the LCOE of solar by nearly 30%. Therefore any public financing solution, whether in addition to or in place of a grant, will need to carefully asses the economic impact of various costs of capital on the solar deal.

In Rhode Island, for example, the price of residential electricity in July 2015 was 17.59 cents/kwh. Today, under any purchase model, the LCOE of residential solar is equal to or less than grid power *without any state subsidy or REC value*. Accounting solely for the federal tax credit and accelerated depreciation (MACRS), residential solar is cheaper than grid power in Rhode Island whether purchased with cash or a loan, or used via lease. Under a cash purchase, the estimated LCOE of solar in Rhode Island is 14.47 cents/kwh. If purchased with a loan, the LCOE of solar is 16.56 cent/kwh. This assumes a loan at 6% and 15 year term. And a system that is owned by a third-party and leased to a resident has an LCOE of 16.02 cents/kwh, assuming an effective cost of capital of 9% and 15 year term.[4]

Figure 7: Example RI Solar Cash Purchase



[4] Assumes installation cost of $3.50/watt. The national average for residential installation at the end of 2014 was $3.48/watt, according to the Solar Energy Industry Association and Greentech Media.

Figure 8: Example RI Solar Loan Purchase

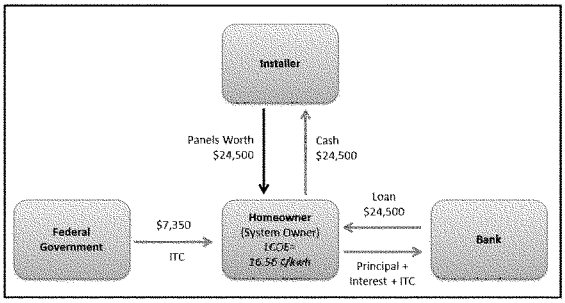
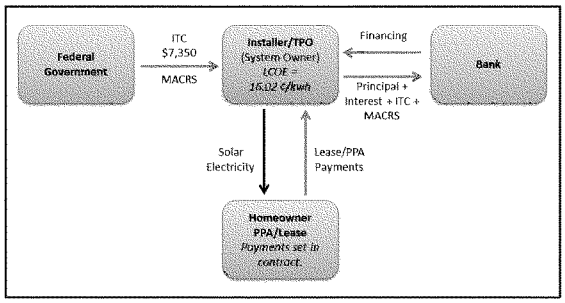


Figure 9: Example RI Solar Lease



Again, this means residential solar is competitive in Rhode Island without any additional rebate from the state in the form of a cash grant, a performance based incentive, or a feed-in tariff. With or without an additional state subsidy, the system owner is also generating and entitled to getting value for RECs. The price of a REC today in Rhode Island is approximately $50/REC. If a customer were able to sell the system's RECs on a 15-year, fixed price contract at $30/REC, that would give the system owner another $3,556 in value, further reducing the LCOE of the system by approximately 3.0 cents/kwh. Therefore under current market rules a customer purchasing solar with cash and getting value for their RECs pays an effective price of solar of 11.47 cents/kwh, which is 35% cheaper than grid power.

This analysis demonstrates that in Rhode Island, public dollars devoted to rebates are an unnecessary public expense. Solar economics in the state do not require a rebate, meaning that as the state considers optimal solar program design, it may choose to devote limited public resources to financing rather than rebates. Dollars put towards financing can eliminate the primary barrier to adoption – the upfront cost – and are preserved as a public asset, rather than an expense. Broadly, no matter the market specifics, this LCOE-based framework that focuses on value flows can help optimize a program design that allocates public resources appropriately between rebates and financing.

Appendix B – Connecticut Green Bank Products & Programs

The Connecticut Green Bank effectively acts as a retail lender, working closely with end borrowers to either directly lend or enable direct lending for renewable energy and energy efficiency projects. It offers four primary products, two of which are being transitioned to private lenders.

Smart-E Loan – Residential Energy Upgrades

The Connecticut Green Bank provides a standard-offer loan loss reserve fund to enable local banks to make "Smart-E Loans" to residential customers to perform building upgrades. Rather than make loans directly to homeowners, the Green Bank seeks to spur greater activity and market understanding about retail lenders in Connecticut. To move these banks into the building energy upgrade market or entice those banks to offer more favorable terms, the Green Bank set up a loan loss reserve credit enhancement to cover a portion of potential losses a bank may have on those energy loans. This is technically a second loss reserve, where the bank bears the first dollar of loss, and the Green Bank takes a portion of losses after that (but not 100% of losses). In exchange for receiving the benefit of this credit enhancement, the participating banks agree to offer loans at extended terms with "not-to-exceed" rates that ensure borrowers can be cash flow positive on their energy projects. This has been found to be an essential component of project viability, and is only possible with long terms and reasonable interest rates. This form of credit enhancement is more efficient that an interest rate buy down or a full guarantee. An interest rate buy down is effectively a grant, as the Green Bank would have to make permanent cash payments to the banks to reduce their rates. Under the loan loss reserve, the Green Bank must only set aside cash that is drawn from only in the event of a loss. If there is no loss, then public dollars are preserved and can be used for other lending activity. And the reserve is more efficient than a guarantee because fewer dollars must be set aside to support the reserve than the guarantee. To date the product has been adopted and used by dozens of banks, many of which have partnerships with contractors that originate deals for the banks. And losses, with the resulting draw down from the Green Bank's reserve fund, have been minimal.

CT Solar Lease II – Residential PV Solar Lease Product

The Connecticut Green Bank created the first state-sponsored solar lease fund in the country when it began offering the CT Solar Lease in 2008 through its predecessor agency. This product found initial success and was built again at greater scale in 2013 after the Green Bank was created. The purpose of this product was to provide local installers a financing product they could offer customers who could not buy a solar system with cash out of pocket, and didn't want to own the panels themselves (as with a loan). As major national third-party owners (like SolarCity) began offering solar leases and PPAs, local installers in Connecticut that were too small to build their own financing products were left unable to serve the growing customer base in the state.

The Green Bank built a sophisticated tax equity-based lease fund to serve this specific market. The Green Bank formed a new special purpose vehicle (SPV) that would technically own the solar systems on homeowners' roofs. The Green Bank made both an equity and subordinated debt investment in the SPV. A syndicate of banks, led by First Niagara, made senior debt investments, and US Bank was the tax-equity provider that would receive the federal tax benefits provided to solar investors. The Green Bank also provided a loan loss reserve credit enhancements using leftover federal ARRA funds to support the senior debt investors. The solar lease was offered with panel insurance and a warranty, removing any burden from system management from the customer who only had to make monthly payments for the use of the panels. This product has been a huge success and funds have almost been entirely expended. This product also created a strong base of political support for the Green Bank among the local installers who could not have survived without being able to offer financing to customers.

CT Solar Loan – Residential PV Solar Loan Product

When the Connecticut Green Bank was formed in 2011 no solar loan option was available in the state. If a homeowner wanted to own the panels on their roof, but didn't have $25,000 in cash on-hand, that consumer had no way to adopt solar. To address this the Connecticut Green Bank launched the CT Solar Loan product, using $5 million in public dollars to finance loans through its private origination partner, Sungage. The Green Bank then took two steps to draw in private capital. First, the Green Bank found a private investor, the crowd-sourcing platform Mosaic, to purchase 80% of the loan portfolio, immediately replacing public capital with private dollars.[5] Second, after showing market potential, Sungage raised a private financing warehouse from Digital Federal Credit Union, who provided $100 million for Sungage to originate far more solar loans across many more states.[6] The Connecticut Green Bank pulled back its own capital, and allowed the private market to take over at greater scale.

Commercial PACE – Commercial, Industrial & Multifamily Building Upgrades

Through Commercial PACE, CT offers whole-building commercial energy retrofits. The whole-building approach to energy upgrades has long been viewed as the most effective way to significantly curtail energy consumption, but the projects are hard to execute and finance. They include multiple energy efficiency technologies and can also include roof-top solar when appropriate.[7] The Connecticut Green Bank is able to finance these projects through its Commercial Property Assessed Clean Energy, or C-PACE, program. PACE is a structure that allows a borrower to pay back a clean energy loan directly through their building's property taxes. This makes payback easier for the customer and increases security for the lender, thus enabling more and lower-cost lending.

PACE is legally authorized in over 30 states, but Connecticut is one of only a two states to achieve significant scale with the program. Unlike in most states where each local government is charged with creating their own program, the Connecticut Green Bank is tasked with administering the program across the entire state. Through central administration the Green Bank implements programmatic consistency and standardization, critical elements for private investment. And the Green Bank also ensures that every loan offered can be paid back entirely through the savings generated by the project, as stipulated in the state's legislation. The Green Bank uses a standardized and rigorous technical underwriting method to ensure that every project has a savings-to-investment ratio ("SIR") greater than 1.

PACE programs all over the country have stagnated and failed to attract private capital because of program complexity and small investment scale. But the Connecticut Green Bank was able to kick-start the market by originating and underwriting PACE loans itself using public dollars and build scale by aggregating projects. Loans are offered at approximately 6%, which is low enough to expand the addressable market and make projects cash flow positive, but high enough to attract private investors who want to buy the loans from the Green Bank. After building a portfolio large enough to attract private investment, the Green Bank sold 80% of the PACE loan portfolio through an auction, drawing in $24 millions of private investment.[8] This was the first commercial efficiency securitization in the country, attracting specialized and institutional investors to participate in the market. Without Green Bank investment and coordination, the market would have remained dormant as it has in many other states.

Now that the Green Bank has demonstrated the mechanics and potential of PACE, private investors are preparing to enter the market at far greater scale. To satisfy the growing pipeline of projects, the Green Bank is raising an external warehouse of at least $50 million in private capital that will be used to originate loans. Those private dollars will be paired with public debt and/or credit enhancements, and the loans will then be securitized in public markets. After only

[5] Trabish, Herman K., "Will Crowdsourced Loans for Rooftop Solar Overtake Third-Party Ownership?" Greentech Media, February 19, 2014.
[6] Reporter's Notebook, "Green Bank partner lands $100M solar investment," Hartford Business Journal, November 10, 2014.
[7] To date, roughly 50% of projects are PV only, 25% are EE only, and 25% are both PV and EE.
[8] Lombardi, Nick, "In a 'Watershed' Deal, Securitization Comes to Commercial Efficiency," Greentech Media, May 19, 2014

one portfolio sale, the Green Bank has demonstrated market opportunity to draw institutional investors eager to originate the loans, reducing the need for public investment. Recent securitizations of residential PACE loans in California suggest that this new private capital will come with ever lower interest rates.[9]

Residential Solar Investment Program – Converting Grants to REC Financing

As part of its founding legislation, the Green Bank was tasked with managing and winding down the previously-existing residential solar rebate program, called the Residential Solar Investment Program (RSIP). RSIP is a grant offered in two forms – an upfront payment for host-owned systems, and a 6 year performance based incentive for third-party owned systems. This grant was intended to reduce the effective cost of electricity from the solar systems and make solar more attractive. By design, though, the RSIP was meant to be stepped down, reducing the amount of benefit as the cost of solar fell and the availability of financing increased. Through this transition, the state support for solar would move from an expense to an asset, eliminating permanent expenditure of public dollars.

The Green Bank team carefully managed the step down of the RSIP, pegging reductions to the achievement of market goals of installed capacity. The RSIP was designed to generate 30 MW of installed capacity in 10 years. However, the increased availability of financing for solar from the Green Bank allowed the 30 MW target to be reached in just 3 years while reducing the RSIP level by more than half.

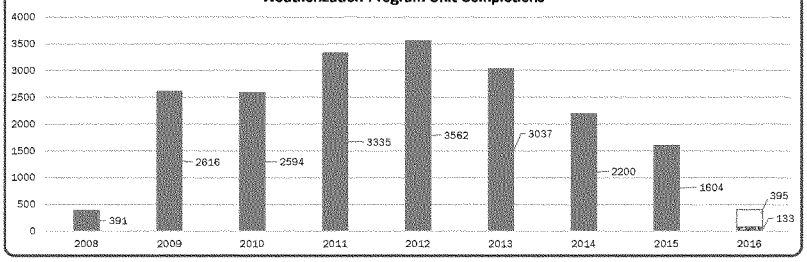
Also built into the enabling legislation was the programmatic rule that any homeowner receiving the RSIP must automatically transfer ownership of their Renewable Energy Credits (RECs) to the Green Bank. The Green Bank in turn was free to manage and sell the REC portfolio as desired, which would in effect recoup a portion of the RSIP cost. Though not initially viewed as such, the Green Bank realized they were effectively offering a REC financing program for residential customers, where the upfront grant acted as lump-sum payment for the future stream of RECs from customers. If the Green Bank assumed an implicit 15-year contract term, it could calculate the effective REC price that Green Bank was paying to the customer through the RSIP grant. While the initial RSIP grant level produced an effective REC price far higher than the REC market would offer, the Green Bank quickly realized that as RSIP declined, the effective REC price was actually below the market price. This meant the Green Bank was stimulating solar development at far lower cost to the ratepayers than the REC procurement methods used by the utilities, who set the market price.

Through this analysis, the Green Bank conceived of a new program through which the utilities would sign 15-year REC purchase contracts with the Green Bank at a REC price *below* what they would otherwise pay on the market. This new program generates numerous benefits. It saves dollars for ratepayers as utilities are able to acquire RECs at a lower price, and therefore pass on less cost to customers. It creates more market certainty for the Green Bank, which does not have to sell its REC on the spot market. And it means that the RSIP program, once viewed as a grant, was now a self-sustaining REC financing program that entirely paid for itself and had no permanent cost. This innovative and entirely unique structure was formalized and approved through new legislation in summer 2015, and is now known as the Solar Home Renewable Energy Credit program, or SHREC. This sets a blueprint showing any state how it can stimulate solar market growth by increasing the availability of financing, reducing grant levels and eliminating permanent expenditure of public dollars.

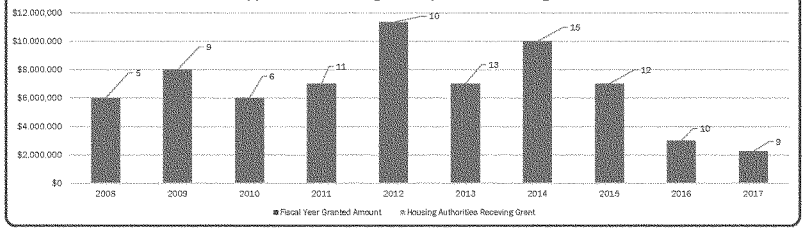
[9] Roselund, Christian, "Renovate America and 400 Capital complete $129 million PACE securitization," PV Magazine, November 20, 2014.

Research and Rural Development

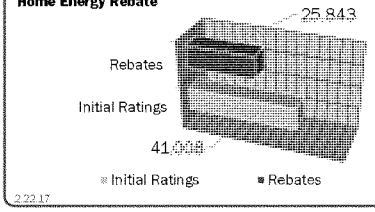
Weatherization Program Unit Completions 1.31.17



Supplemental Housing Development Grant Program



Home Energy Rebate



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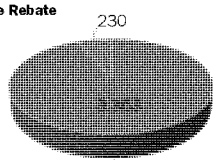
New Home Rebate



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EE NOW

EE NOW, the third annual energy efficiency building conference hosted by Research and Rural Development, will be held March 29 & 30 at the Captain Cook Hotel in Anchorage.

AK EnergySmart Curriculum Development

AK EnergySmart, a free energy based curriculum targeted at K - 12 students, gets promotional video on energy literacy. The video can be accessed here -- https://www.youtube.com/watch?v=7SsOePJi4Y8

March 28, 2017 Board Report

23 February 2017

Bruce Sexauer
Alaska District Corps of Engineers
Civil Works Project Management Branch
CEPOA-PM-C
P.O. Box 6898
JBER, AK 99506-0898

Alaska Congressional Delegation
Congressman Young
Senator Murkowski
Senator Sullivan

RE: FURTHER SUPPORT FOR THE ARCTIC DEEP DRAFT PORT AT NOME

Dear Honorable Members of Congress, Mr. Sexauer, and members of the U.S.C.G. delegation,

Alaska Response Company, LLC (ARC) and Aleutians Spill Control, Inc. (ASCI) strongly support immediate action Arctic Deep Draft Port at Nome as per my prior letter (attached hereto). I write to further emphasize a couple of critical points.

We must prepare for the new reality that is dawning in the Arctic. The math backs up this new reality: traffic to the Nome port is increasing, despite the lack of suitable new infrastructure. The only question is how soon will be too late. Many infrastructure projects are based on a Field of Dreams thought that if it's built, they'll come. In this case, they are already coming, the globe is changing, routes are opening, and *we must build it.*

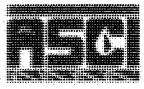
We understand that there has been some hesitation with Shell's pullout and the recent drilling ban. But there is more to this than oil and gas exploration. There are global shipping routes involved, and each vessel on that journey, while not carrying oil as cargo, carries substantial oil and diesel for fuel. Every one of those vessels is a risk, a necessary one, but a risk nonetheless. We must proceed with the Artic Deep Draft Port at Nome in order to help mitigate that risk and build up the response infrastructure needed to be prepared for all probabilities.

We strongly urge that immediate action be taken.

Yours sincerely,

Erik S. Newton

Erik S. Newton
Alaska Response Company, LLC &
Aleutians Spill Control, Inc.
TEL: (907) 222-7500



Bruce Sexauer
Alaska District Corps of Engineers
Civil Works Project Management Branch
CEPOA-PM-C
P.O. Box 6898
JBER, AK 99506-0898

Alaska Congressional Delegation
Congressman Young
Senator Murkowski
Senator Sullivan

RE: SUPPORT FOR ARCTIC DEEP DRAFT PORT AT NOME

Dear Honorable Members of Congress and Mr. Sexauer,

Alaska Response Company, LLC (ARC) and Aleutians Spill Control, Inc. (ASCI) strongly support immediate action be taken by the Army Corps of Engineers' to restart and complete the *Alaska Deep Draft Arctic Port Study*, to fully capture the intent of the additional provisions contained within the Water Infrastructure Improvements for the Nation (WIIN) Act of 2016, and the National Defense Authorization Act (NDAA) of 2016. ARC and ASCI operate an approved Alternative Planning Criteria for oil spill prevention and response under the Oil Pollution Act of 1990 in Western Alaska.

ARC and ASCI's goals, along with prevention and response, include the social and economic development and support for rural Alaska. The protection of this area, its people, and its economy are central to our mission. Section 2006 of the WIIN 2016 specifically provides for consideration of the long-term viability and welfare of the communities in a region, as well as a project's social and cultural value to those regional communities. This is a major factor in showing justification for an Arctic Deep Draft Port at Nome. There are numerous communities in Norton Sound and the Bering Strait region that rely heavily upon the Port of Nome as a transshipment point for fuel, equipment and supplies. Many of these communities are legitimately threatened by the high price of fuel and goods to the region, and would greatly benefit by lower cost commodities to be realized by allowing larger vessels to call at Nome, for transshipping throughout the region. ARC and ASCI want to help contribute to lower costs for the citizens of this region, and we strongly support the Arctic Deep Draft Port at Nome as a large step in that direction. Demand is already outstripping capacity; it is time to act.

ARC and ASCI see port development in Nome as a critical initial step in a much larger system of Arctic infrastructure that is ultimately necessary to cover the expansive area of Arctic waters and exposed coastline. Development of trade routes and national security risks is outpacing our preparedness to handle the traffic and/or place the assets needed. Therefore, we believe these first steps must be taken quickly if the Arctic is to become a safe maritime corridor for vessels to

transit with reduced risks to life safety, the environment, and cultural food resources. The promise held by the Arctic deep draft port at Nome is huge for Alaska and the nation as a whole.

Section 1095 of the NDAA 2016 brings the strategic importance of Arctic infrastructure into the discussion by requiring an assessment of the future security requirements for one or more strategic ports in the Arctic be compiled by the Secretary of Defense in a report delivered to Congress within 180 days after becoming law. The results of this effort will clearly highlight the growing capabilities at Nome and further justify federal investment into the development so critically needed to protect the Alaska coastline and U.S. national security. We believe that it is in all our interests to continue to invest in support for the critical Bering and Arctic areas.

Maritime activity at the Port of Nome is exponentially growing. It makes sense. Arctic Ice Melt and many other factors are driving more traffic and increasingly highlighting the importance of development at the Port of Nome. ARC and ASCI fully support the evolving scope of design concepts that deepen the existing basin to -28 feet, and extend the Causeway out to a depth of -36 feet for constructing at least one deep water dock to allow for resupply and shore access for the deeper draft fleet, working in, and transiting through, Arctic waters. The expanded facility would not only provide more efficient resupply of the larger vessels, but significantly reduce the risk of moving people and supplies via small boats to ships anchored offshore of Nome. This would significantly reduce schedule delays experienced even in the mildest, yet typical 2-3 foot swell at Nome. And ARC and ASCI are committed to any support we may provide as a prevention and response organization to reduce these risks as part of a Deep Draft Port project.

Therefore, we at Alaska Response and Aleutians Spill Control strongly support the construction of a deep water port at Nome. As maritime commerce in the Arctic continues to grow, which nature itself is driving, the need for a deep water port in Western Alaska is becoming critically important to ensure operational safety and efficiency of the vessels and souls traversing the waters. In addition, the strategic placement of military assets and other resources necessary to the nation are becoming much more critical in this area as routes open up to additional vessel traffic. We want to join with you in support Alaskan and American preparedness for growth in economy and risk. We urge a restart and completion of the *Study* and quick move to construction of an Arctic Deep Draft Port at Nome.

Yours sincerely,

Erik S. Newton

Erik S. Newton
Alaska Response Company, LLC &
Aleutians Spill Control, Inc.
TEL: (907) 222-7500

BERING SEA ALLIANCE, LLC
BOX 100
UNALAKLEET, ALASKA 99684
907 625-1711

Bruce Sexauer
Alaska District Corps of Engineers
Civil Works Project Management Branch
CEPOA-PM-C
P.O. Box 6898
JBER, AK 99506-0898

Alaska Congressional Delegation
Congressman Young
Senator Murkowski
Senator Sullivan

RE: ARCTIC DEEP DRAFT PORT AT NOME – SUPPORT PROJECT STUDY RESTART AND DESIGN

Bering Sea Alliance, LLC supports immediate action be taken by the Army Corps of Engineers' to restart and complete the *Alaska Deep Draft Arctic Port Study*, in order to fully capture the intent of the additional provisions contained within the Water Infrastructure Improvements for the Nation (WIIN) Act of 2016, and the National Defense Authorization Act (NDAA) of 2016. We cannot stress enough the urgency to take immediate action.

Section 2006 of the WIIN 2016 specifically provides for consideration of the long-term viability and welfare of the communities in a region, as well as a project's social and cultural value to those regional communities. This is a major factor in showing justification for an Arctic Deep Draft Port at Nome, in that there are numerous communities in Norton Sound and the Bering Strait region that rely heavily upon the Port of Nome as a transshipment point for fuel, equipment and supplies. Many of these communities are legitimately threatened by the high price of fuel and goods to the region, and would greatly benefit by lower cost commodities to be realized by allowing larger vessels to call at Nome, for transshipping throughout the region.

Section 1095 of the NDAA 2016 brings the strategic importance of Arctic infrastructure into the discussion by requiring an assessment of the future security requirements for one or more strategic ports in the Arctic be compiled by the Secretary of Defense in a report delivered to Congress within 180 days after becoming law. The results of this effort will clearly highlight the growing capabilities at Nome and further justify federal investment into the development so critically needed to protect the Alaska coastline and U.S. national security.

The exponential growth in vessel traffic transiting the Bering Strait and calling at Nome is clearly discernible, based on the statistics below provided by the Marine Exchange and Port of Nome, respectively:

	2010	2011	2012	2013	2014	2015	2016
Bering Strait Transits	242	239	316	344	255	452	369
Port of Nome Vessel Calls	296	271	444	496	498	635	751

BERING SEA ALLIANCE, LLC
BOX 100
UNALAKLEET, ALASKA 99684
907 625-1711

These figures make it clear that maritime activity is increasing, with little indication of slowing.

Our organization fully supports the evolving scope of design concepts that deepen the existing basin to -28 feet, and extend the Causeway out to a depth of -36 feet for constructing at least one deep water dock to allow for resupply and shore access for the deeper draft fleet, working in, and transiting through, Arctic waters. The expanded facility would not only provide more efficient resupply of the larger vessels, but significantly reduce the risk of moving people and supplies via small boats to ships anchored offshore of Nome. This would significantly reduce schedule delays experienced even in the mildest, yet typical 2-3 foot swell at Nome.

Therefore, BSA, LLC strongly supports the expansion of the facility through the construction of a deep water port at Nome. As maritime commerce in the Arctic continues to grow, the need for a deep water port in Western Alaska is becoming critically important to ensure operational safety and efficiency of the vessels and souls traversing the waters, as well as the strategic placement of military assets and other resources necessary to the nation.

We believe there is a need to propel this project forward, Nome has many positive attributes above all other port sites and this alone calls for the Nome project to be expedited and moved rapidly without hesitation. We support multi ports, but do not support any process the slows down or hinders the immediate funding and construction for the Nome project.

We hope you take our convictions seriously.

Sincerely,

Art Ivanoff

Cc; BSA, LLC Board of Directors
Honorable Richard Beneville
Governor Bill Walker

Bethel Native Corporation

Subsidiary Companies
Bethel Services Inc.
Bethel Solutions Inc.
Bethel Builders LLC
Bethel Contracting LLC
Bethel Engineering and Consulting LLC
Bethel Environmental Solutions LLC
Bethel Federal Services LLC

Bruce Sexauer
Alaska District Corps of Engineers
Civil Works Project Management Branch
CEPOA-PM-C
P.O. Box 6898
JBER, AK 99506-0898

February 16, 2017

RE: SUPPORT FOR ARCTIC DEEP DRAFT PORT AT NOME

Dear Mr. Sexauer,

I am writing to renew support for the proposed Arctic Deep Draft Port in Nome, Alaska. As a fellow coastal community reliant on shipping for commerce and development, Bethel Native Corporation is in full support of Nome's efforts. The coastal communities of Alaska serve as life lines to nearby villages and full functioning ports bring goods and services needed for construction, health delivery and trade diversity. Deepening the basin at the Port to -36 feet to provide a deep water dock for accessing shore would enhance overall safety and provide the community of Nome and the region with opportunities for economic growth and sustainability.

In addition to accommodating deep draft cargo vessels, this expansion would provide opportunities for cruise vessels to moor at the facility, bringing new opportunities for tourism and marketing to Nome. This valuable improvement within the community of Nome will bring long term viability to the region. The benefits of this port will be immediate.

Bethel Native Corporation strongly supports the expansion of the facility through the construction of a deep water port at Nome. There is a significant need for this port in Western Alaska to ensure safety and propel our state for growth. The proposed location to service the Northwestern region in Nome is strategic and necessary to protect people, resources and the environment. Benefits from this proposed port in Nome would be felt across Western Alaska.

Sincerely,

Ana Hoffman, President/CEO

COLD CLIMATE HOUSING RESEARCH CENTER
CCHRC

March 29, 2017
Fairbanks, Alaska

Senate Committee on Energy and Natural Resources
Senator Lisa Murkowski Chair

Dear Senator Murkowski and members of the committee:

The Cold Climate Housing Research Center (CCHRC) has been made aware that there is a hearing tomorrow 'to examine the potential for infrastructure improvements to create jobs and reduce the cost of living through all-of-the-above energy and mineral production in Alaska.' Senator Murkowski is very familiar with CCHRC's efforts throughout Alaska to find solutions toward improving the lives of people in underserved communities across our vast and challenged state.

In many rural communities basic human necessities including clean water, sanitation, adequate shelter (homes as well as public buildings), food resources, transportation, communication, and economic opportunity are severely lacking. While this situation has been well known and documented for decades, very little has been done to address these problems. Also well-recognized is the fact that a number of communities are facing relocation due to environmental changes and severe weather events. While this reality presents onerous challenges we see it as a great opportunity to demonstrate successful strategies of adaptation that can be applied anywhere on earth. The lessons learned by the people and villages of Alaska should be of great national interest.

I urge the committee to consider what we call "A Holistic Approach to Sustainable Northern Communities" as an example of a successful path forward. This strategy begins with the people of community defining their vision of quality of life and building through multi-agency, multi-stakeholder commitment to a plan of action that will have positive results. In the context of your hearing, keep in mind the connections each element has to another. Infrastructure improvements create jobs, but for who at for what value? Are they local jobs building infrastructure that is appropriate, affordable in the long term, complement lifestyle and need, or disconnected and destined for eventual failure? In the development of our vast mineral and fossil fuel wealth, are the interconnected pieces considered and the benefits and risks weighted appropriately? The people who understand the environment, cultures, values, traditions and needs should be first at the table in an inclusive process that involves experts and leaders of private, public and non-profit entities so that wise decisions are made. In CCHRC's experience problems solved through strong collaborations have greater success than what has historically been

P.O. Box 82489, Fairbanks, AK 99708 + 907.457.3454 + Fax: 907.457.3456
www.cchrc.org

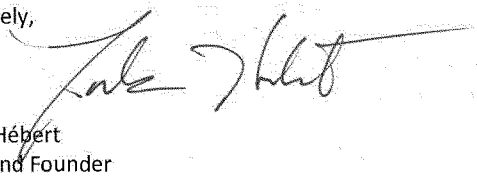
accomplished through a siloed and disconnected process.

Following the "Holistic Approach to Sustainable Northern Communities" each element is carefully vetted on its effect to the interrelated whole. Revenues generated by energy and mineral production need to be invested in ways that will benefit future generations. Infrastructure priorities, set by the communities themselves, should be carefully selected for addressing the basic human needs of water, food and shelter. Economic benefit should as well be carefully defined, understanding economy is more than just cash and jobs created. The rich subsistence economy in Alaska, very much a reality yet valued at zero from the Western perspective. The vitality of a community has its roots in the traditions, spirituality, and culture of its people. How will jobs, infrastructure improvements, cost of living and resource development positively complement and add to this vitality?

CCHRC would be honored to provide information about projects and identified needs in the context of resource development and infrastructure at your request.

Thank you for the opportunity to express some thoughts to the committee.

Sincerely,



Jack Hébert
CEO and Founder
Cold Climate Housing Research Center

Cook Inletkeeper
3734 Ben Walters Lane
Homer, Alaska 99603

p. 907.235.4068
f. 907.235.4069
www.inletkeeper.org

March 27, 2017

Senator Lisa Murkowski, Chair
United States Senate
Energy and Natural Resources Committee
304 Dirksen Senate Building
Washington, DC 20510

Dear Senator Murkowski:

Please include this letter in the record for the March 30, 2017, hearing on Alaska infrastructure projects before the Senate Energy & Natural Resources Committee.

I'm writing to ensure you're aware of an important infrastructure opportunity in Cook Inlet which would create jobs and protect Alaska fisheries.

As you are likely aware, an aging pipeline has been leaking methane in Cook Inlet for the past several months. Leaks and spills are nothing new in Cook Inlet, however, because much of the infrastructure supporting oil and gas production is over 50 years old, and well-beyond its service life.[1]

While there remains an overarching need to address aging infrastructure in Cook Inlet, there's a specific opportunity today that deserves special attention.

On the west side of Cook Inlet lies the Drift River Oil Terminal (DROT). The facility was built in the mid-1960's, and it gathers and stores oil produced in Cook Inlet before loading it onto tankers for transit to processing facilities on the east side of Cook Inlet and elsewhere.

The facility is problematic for several reasons. For example, it is located at the base of an active volcano (Mt. Redoubt), and eruptions in 1989-90 and 2009 have created heightened risks to workers and local fisheries. Next, the facility necessitates oil tanker loadings, transits and unloadings in and around Beluga whale critical habitat, without the aid of escort tugs similar to

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1 Inletkeeper produced a report in 2002 which highlights various concerns surrounding Cook Inlet's aging oil and gas pipelines. Lois Epstein, *Lurking Below: Oil & Gas Pipeline Problems in the Cook Inlet Watershed* (Sept. 2002) (available at: www.inletkeeper.org/resources/contents/lurkingbelow). Inletkeeper also produced a report in 2013 discussing the inadequacy of surety and bonding levels to successfully dismantle, remove and remediate (DR&R) antiquated oil and gas infrastructure. John Talberth, *Aging Oil & Gas Platforms & Pipelines Pose Clean-Up Risks to Public* (Sept. 2013) (available at: https://inletkeeper.org/press-room/press-releases/drr)

Prince William Sound. Finally, the aging piping and other infrastructure at the facility are increasingly vulnerable to leaks and spills.

A state-of-the-art modern pipeline across Cook Inlet would address all these concerns, while creating Alaskan jobs and providing a much safer alternative for our fish and whale habitat then continuing to rely on the Drift River Oil Terminal.

Thank you and please feel free to contact me if you have questions at 907.299.3277 or bob@inletkeeper.org

Yours for Cook Inlet,

Bob Shavelson
Inletkeeper

DIESEL TECHNOLOGY FORUM

March 29, 2017

The Honorable Lisa Murkowski
Chairman
Committee on Energy and Natural Resources
United States Senate
Washington, DC 20515

The Honorable Maria Cantwell
Ranking Member
Committee on Energy and Natural Resource
United States Senate
Washington, DC 20515

Dear Chairman Murkowski and Ranking Member Cantwell:

On behalf of the Diesel Technology Forum, we would like to submit this statement concerning the hearing to examine the potential for infrastructure improvements to create jobs and reduce the cost of living through all-of-the-above energy and mineral production in Alaska. We would like to highlight the important role of diesel technology in completing infrastructure, supporting the Alaskan economy and contributing to U.S employment. Today, the overwhelming majority of construction and mining equipment is powered by diesel technology. The latest generation of equipment employs state of the art clean air technologies that reduce emissions to near–zero levels while next generation technologies are at work enhancing productivity and saving fuel. Many Alaskan communities are familiar with diesel technology as the equipment provides prime power generation to many rural communities across the state.

The Diesel Technology Forum represents the manufacturers of diesel engines, vehicles and equipment including small passenger vehicles and pickups to large commercial vehicles and off-road equipment, locomotives and stationary engines. The Forum is a not-for-profit educational organization dedicated to raising awareness of the clean air and economic benefits of diesel engines, vehicles and equipment along with cleaner diesel fuel including biodiesel and renewable diesel fuel. More information is available at www.dieselforum.org.

Diesel Technology is the Workhorse of the Construction and Mining Industries

Diesel fuel has the highest energy density of any transportation fuel and the diesel engine is the most efficient technology to transfer this power into work. For this reason, diesel is the technology of choice powering construction and mining equipment. Job sites and mining sites across the state deploy a wide variety of diesel equipment to get the job done.

5291 Corporate Drive • Suite 102 • Frederick, MD 21703 • Phone (301) 668-7230 • Fax (301) 668-7234
www.dieselforum.org

Thanks to decades of innovation and research, the latest generation of diesel equipment meet near-zero emission standards. Through the availability of ultra-low sulfur diesel fuel along with advanced engine designs and a variety of emission control solutions, clean diesel technology meets the latest "Tier 4" emissions standards required of new equipment manufactured beginning in 2014. Clean diesel powered equipment on job sites and work sites across the state will get the job done while reducing emissions for nearby communities.

Advanced Technologies Improve Efficiency and Save Fuel

While there is much discussion of needed policy changes to support future deployment of autonomous and other advanced vehicle technologies, many of these technologies have been developed and deployed on construction and mining equipment. Fully autonomous mining trucks have been developed by equipment maker Caterpillar and mining operators in Australia report that the technology delivers a twenty percent improvement in productivity.[1] Equipment can be remotely controlled and even pre-programmed for 24 hour operations to precisely maneuver through rough locations to minimize fuel consumption and boost worksite safety.

Other advanced technologies including the latest GPS enable devices found on construction equipment also boosts productivity. Digging and leveling equipment can accurately perform tasks often in one pass while previous generations of equipment may have required multiple passes. These technologies, in the aggregate, can help reduce the time to complete projects for public agencies, minimize disruptions for commuters and reduce fuel costs for contractors and equipment owners. The latest clean diesel equipment can reduce emissions that benefit urban and rural l communities and workers at job sites.

Diesel Technology is an Economic Engine

In 2009, the manufacture of diesel technology, including engines, vehicles, equipment, affiliated components and fuel, directly contributed $183 billion and 1.25 million jobs to the U.S. economy. Average weekly wages in the diesel technology industry, at $1,398, are also 60 percent higher than the national average at $876.[2] The Association of Equipment Manufacturers recently estimated that the production of heavy equipment supports 1.3 million jobs and $158 billion in economic value. In fact, the average wage in the industry exceeds the national average paying workers about $78,000 per year.[3] Much of this equipment is powered by diesel technology.

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[1] "*Autonomous Mining Is Coming to the U.S.*" Fox Business, January 2017.

[2] "Diesel Powers the U.S. Economy", Diesel Technology Forum, 2011. http://dieselforum.org/files/dmfile/DTF_economrpt_full.pdf

[3] "The Market Size and Economic Contributions of the Off-Highway Equipment Industry", IHS Economic, February 2017.

Diesel technology is also an export powerhouse. In 2009, over $46 billion of diesel engines, trucks, equipment and fuel was exported representing over 4 percent of all U.S. exports.[4] Exports of refined diesel fuel is the leading petroleum product export from the U.S. 368 million barrels of ULSD were exported abroad by U.S. refiners.[5]

Diesel Powers Many Rural Alaska Communities

Many rural communities across Alaska rely on their powerhouse that very often includes a diesel generator to provide prime power. The Alaska Energy Authority estimates that rural communities throughout the state are served by small or very small energy cooperatives that derive their power from diesel generators. Older generators are subject to equipment failures, reduced efficiency and higher fuel costs. As a result, these communities experience electricity costs that are five times higher than the national average.[6] The Alaska Energy Authority is engaged in a program to boost the efficiency of these powerhouses by deploying newer diesel generators along with efficiency improvements. In many instances, electricity is derived, where possible, from renewable sources including wind and solar through microgrids. These renewable sources do not displace the use of a diesel generator. Rather, the diesel generator may backstop reliance on renewables when they are off-line. These microgrid applications help communities reduce high electricity costs while maintaining electricity availability and reliability.[7]

We thank you for the opportunity to provide these comments concerning diesel technology in meeting infrastructure and energy needs throughout Alaska. Clean diesel technology is ready and available today to reduce emissions for communities and workers near job sites. The latest advanced technologies are already in the field helping to make the most of clean diesel engines by boosting productivity to help complete infrastructure projects on time and under budget. The clean diesel engine and off-road equipment industries are economic engines helping to boost U.S. economic output, higher wages and boost exports. Alaska is also home to diesel generators used for prime power in many rural communities and this equipment is vital to sustain these local economies. Greater efficiencies and microgrid applications can help reduce high energy costs and contribute to economic sustainability for these communities.

Respectfully,

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[4] "Diesel Powers the U.S. Economy", Diesel Technology Forum, 2011.
http://dieselforum.org/files/dmfile/DTF_economrpt_full.pdf

[5] U.S. Exports of Crude and Petroleum Products. U.S. Energy Information Agency, U.S. Department of Energy.

[6] 2016 Annual Report. Alaska Energy Authority.
http://www.akenergyauthority.org/Portals/0/Publications/AEA2016AnnualReport.pdf?ver=2017-03-01-180130-100

[7] "At the Mouth of the Kusko, A Pioneering Wind System", Alaska Public Radio, February 25, 2016.

Allen R. Schaeffer

Allen Schaeffer
Executive Director

Written Testimony of Rada Khadjinova
Alaska General Manager, Fugro

Following the U.S. Senate Energy and Natura Resources Committee hearing to examine the potential for infrastructure improvements to create jobs and reduce the cost of living through all-of-the-above energy and mineral production in Alaska

April 12, 2017

I. INTRODUCTION

Chairwoman Murkowski, Ranking Member Cantwell, and members of the Senate Committee on Energy and Natural Resources, thank you for the opportunity to provide written testimony on the benefits of infrastructure development for energy and mineral projects in Alaska. As a long-time Alaska resident and a member of the local business community, I followed with interest the public testimony provided to your committee on March 30, 2017. I strongly agree with the statements made by Mr. Steven Masterman from the Alaska Department of Natural Resources, Ms. Joy Baker from the Port of Nome, and Ms. Kara Moriarty of the Alaska Oil and Gas Association.

My own perspective comes from 23 years in Alaska's public and private sectors, working primarily on environmental permitting, engineering design, and construction management projects. I am the General Manager of the Alaska office of Fugro, an international company providing geo-intelligence and asset integrity solutions for large construction, infrastructure, and natural resource projects.

Over the past four decades, Fugro has supported oil and gas development projects in Alaska's Outer Continental Shelf, on the North Slope, and in Cook Inlet. This experience includes marine site characterization programs for Shell and other explorers in the Beaufort and Chukchi Seas, as well as marine and land site characterization work for the proposed monumental Alaska LNG project. Additionally, we have a long record of providing hydrographic charting services to the National Oceanic and Atmospheric Administration in Alaska, and we have had the privilege of participating with the U.S. Geological Survey and the State of Alaska to update the state's mid-accuracy topographic base maps, contributing both to its imagery and elevation components.

II. COASTAL ZONE MAPPING: A CRITICAL INFORMATION INFRASTRUCTURE NEED

Alaska holds proved energy and mineral resources that have already placed the region on the world stage. Geological Survey (USGS) estimates that Alaska's undiscovered resources may be several times the size of those already discovered. Developing these assets will necessitate investments in both physical and information infrastructures, with the latter being requisite to the former. Baseline data (information infrastructure) contributes not only to identifying the exploration potential of natural resources, but also to the planning, design, construction, and maintenance of roads, bridges, pipelines, cables, shipping lanes, and coastal facilities (physical infrastructure), which are needed to develop and deliver these goods to market.

As Mr. Masterman pointed out in his testimony, there are many types of data layers that contribute to the state's overall information infrastructure. My comments here are focused solely on coastal zone mapping. This term may require some explanation, so I will start with a definition of the coastal zone, as described by the Interagency

Working Group on Ocean and Coastal Mapping (IWG-OCM). They define the U.S. coastal zone as, "...the region along the national coastline that extends from the seaward limit of the Outer Continental Shelf to the fall line that demarcates the inland limit of the coastal plain and resident low-gradient coastal watersheds." Coastal zone mapping, then is a framework that merges shallow water, shoreline, and coastal elevation datasets for seamless depictions of the land-sea interface.

These data, when acquired, support a wide range of users across the government spectrum on applications that range from resource development to physical infrastructure to maritime safety to coastal hazards monitoring. Following are a few examples of how these data are used.

- **Resource Development:** Modern survey technologies allow bundling of multiple acquisition sensors to identify hydrocarbons, minerals, characterize fish habitat, and obtain engineering-grade bathymetric (seafloor mapping) data simultaneously. As such, coastal zone mapping can provide the first step toward resource evaluation in those regions, while also contributing to its subsequent exploration and development through siting of support infrastructure.
- **Physical Infrastructure:** Marine geophysical data enables proper siting and installation of linear marine infrastructure, such as telecommunications and electrical cables, pipelines, as well as planning of ports and harbour facilitates and their associated shipping lanes. Numerous high priority Arctic projects will require these data before moving ahead, including the deep draft port expansion project in Nome, the transformation of Port Clarence into a maritime support base, and the dock expansion at Cape Blossom.
- **Maritime Safety:** A significant portion of Alaska's economy is driven by maritime transportation of marine resources, people, and goods. The value of commercial fishery landing in Alaska accounts for over 30 percent of the total US fishery landing, making safety in navigation a perennial priority in the coastal zone where thousands of commercial fishing and charter vessels are joined by passenger, cruise ship and vessels of various class and designation to conduct work. Bathymetry data is the foundation of a navigation chart.
- **Coastal Hazards Monitoring:** Coastal hazards management, from flood to tsunami inundation to erosion to submarine landslides, is a pressing concern as Alaska pushes forward with large physical infrastructure programs to support energy and mineral development. A comprehensive coastal zone mapping program would provide a baseline for assessing these hazards and for monitoring change over time, protecting people and property along our coastlines.

III. TECHNOLOGY ADVANCEMENTS MAKE ALASKA COASTAL MAPPING POSSIBLE

The need for a coastal zone mapping program in Alaska is clear. But despite existing federal statutory authority and established coastal mapping programs in the contiguous-48 states and Hawaii, Alaska does not have such a program and the majority of coastal mapping data that is available is decades old. Some may recall that until recently, Alaska faced a similar situation with regard to its topographic base maps. It was pointed out that the surface of the planet Mars is better mapped than Alaska. In 2010, federal and state agencies joined forces to update these fundamental datasets, and part of the solution was right-sizing technology to the problem. Alaska is a massive state with largely unpopulated holdings. While the rest of the nation is mapped to high accuracy standards, it was determined a mid-accuracy solution would suit Alaska's base mapping needs overall. High accuracy

topographic maps are still part of the state's information infrastructure, but they are being developed over particular regions. This same concept can be applied to coastal zone mapping.

Despite a coastline of 44,000 miles, recent technology advancements make it possible to design, implement, and manage an efficient state-wide coastal zone mapping program. In the past, obtaining hydrographic data in shallow water areas has been a time consuming, expensive, and often dangerous process given charted and uncharted shoals that require careful manoeuvring during vessel-based surveys. Satellite and airborne technologies are proven to streamline this data acquisition process, either by providing reconnaissance of difficult to survey areas (satellite techniques) or by providing an alternative mechanism for obtaining the high resolution data outright (airborne techniques). Limitations on these newer techniques remain, especially related to weather windows and water clarity. However, when used in combination with traditional vessel-based platforms, multi-sensor, multi-platform regional scale coastal zone mapping programs have proven safe, efficient, and accurate.

IV. THE PARTERNSHIP MODEL AS A PROVEN APPROACH

While a contracting vehicle like the National Coastal Mapping Program (NCMP) is not in place to meet Alaska's coastal mapping needs, a precedent for accomplishing this work through academia-government-industry partnerships does exist in the California Seafloor Mapping Project (CSMP). This program, first conceived in 2000, with field work commencing in 2008, was created to produce high resolution geologic and habitat base maps for all of California's state waters. The CSMP was sponsored by California's Ocean Protection Council, State Coastal Conservancy Department of Fish and Game, and NOAA with support from academia, industry, and government partners. Academia was represented by the Seafloor Mapping Lab and the Moss Landing Marine Laboratories; industry was represented by Fugro; and the federal government was represented by several branches of the National Oceanic and Atmospheric Administration (NOAA), the U.S. Geological Survey (USGS), USACE, the National Park Service (NPS), and the Bureau of Ocean Energy Management (BOEM). Accurate statewide mapping of the seafloor has contributed significantly to the following:

- Enabling more effective management and regulation of offshore development
- Establishment of a legal shoreline
- Provision of data for prudent infrastructure siting and management
- Improving maritime safety and navigability via a database of sediment distribution and thickness (regional sediment management)
- Identifying offshore active faults and submarine landslides, providing the basis for earthquake and tsunami hazard assessments and hazard mitigation
- Establishing baselines for long-term monitoring of coastal evolution related to large storms, anthropogenic influences, and erosion
- Providing a framework for scientific research

As of 2016, mapping has been completed in approximately 90% of California's state waters. Alaska can follow a similar framework, building on the state's past success with the topographic base mapping program. But doing so will require leadership from Congress to direct the appropriate federal agencies, including NOAA and the USACE to work with state-level stakeholders to initiate and be accountable for completion of this effort.

V. IV. CONCLUSION

To tie the concept of coastal zone mapping back to the topic of supporting energy and mineral projects in Alaska, I would like to point you to the 2016 Report prepared by the U.S. Committee on the Marine Transportation System – Arctic Marine Transportation Integrated Action Team - entitled, "A Ten-Year Prioritization of Infrastructure Needs in the U.S. Arctic." The goal of this Report is to set the nation on a path to address the lack of Arctic maritime transportation infrastructure to support the observed increase in maritime activity related to shipping, mining, oil and gas exploration, fishing, and tourism. Coastal zone mapping contributes to a number of the near-term goals identified in this report as they relate to navigable waterways (waterways planning and coordination), physical infrastructure (identifying infrastructure gaps and prioritizing port facilities' needs), information infrastructure (improving weather, water, and climate predictions; updating nautical charts), and Marine Transportation System (MTS) response services (improving search and rescue and emergency response). As you can see, comprehensive coastal zone mapping is an information infrastructure investment that will serve many users and provide a high return on investment. In fact, a 2012 socio-economic study performed by Leveson Consulting found a $35 benefit for every dollar spent on NOAA's Coastal Mapping Program. In Alaska, due to the lack of existing data and the potential for information infrastructure to support large energy and mineral projects and improve the standard of living for coastal residents, the benefits are likely to be even higher.

ALASKA LEGISLATURE

Representative Jonathan Kreiss-Tomkins

Angoon · Coffman Cove · Craig · Edna Bay · Elfin Cove · Game Creek · Hollis · Hoonah · Kake · Kasaan · Klawock · Kupreanof · Naukati Pelican · Petersburg · Point Baker · Port Alexander · Port Protection · Sitka · Tenakee Springs · Thorne Bay · Whale Pass

rep.jonathan.kreiss-tomkins@akleg.gov

Committees:
State Affairs, Chair
Fisheries
Judiciary

Juneau, Alaska 99801 (Jan. – April)
State Capitol, Room 411
907.465.3732

Sitka, Alaska 99835 (May – Dec.)
201 Katlian Street, Ste. 103
907.747.4665

Testimony of the Office of Alaska State Representative Jonathan Kreiss-Tomkins

United States Senate
Energy and Natural Resources Committee

Hearing to examine the potential for infrastructure improvements to create jobs and reduce the cost of living through all-of-the-above energy and mineral production in Alaska
March 30, 2017

Senator Lisa Murkowski, Chair
Senator Maria Cantwell, Ranking Member

Thank you for the opportunity to submit testimony regarding opportunities to improve and expand energy infrastructure in Alaska.

I represent 21 isolated island communities in rural Southeast Alaska in the Alaska House of Representatives. I care deeply for rural Alaska. My legislative priorities include growing Alaska's fishing economy, sustainable rural economic development, growing Alaska's knowledge economy, and celebrating and revitalizing Alaska Native culture and language.

Clean and affordable energy is vital to the future of Alaskan communities. Hundreds of remote Alaskan towns rely on isolated microgrids powered by expensive and unreliable shipments of diesel to generate electricity. Their dependence on diesel fuel, coupled with low income rates, makes these communities particularly vulnerable to the volatility of fuel prices.

For a more stable and sustainable foundation of our economy and electricity provision, Alaska needs to rapidly transition to clean energy. Renewable energy development and energy efficiency upgrades on existing facilities are worthwhile and cost-effective investments. The Renewable Energy Alaska Project estimates that 20% of energy consumed in Alaska is wasted through inefficiencies — a cumulative $1 billion-dollar loss each year that could be remedied with a relatively small capital investment.

Alaskan communities are particularly vulnerable to climate change and ocean acidification. Depending on burning fossil fuels dismisses the reality of thawing permafrost and changing marine ecosystems which threaten thousands of Alaskans. Local renewable energy offers a long-term,

affordable, and reliable solution for communities struggling with high and volatile fuel prices — but most worthwhile projects can't be accomplished without access to public research and financing.

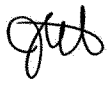
Given the large number of remote communities on isolated microgrids, Alaska is a natural laboratory for renewable energy innovation. Many of the 70 Alaskan communities currently employing local renewable energy are models for the rest of the nation — in part, because the high cost of power incentivizes testing new and emerging technologies. With adequate public assistance through research and funding, Alaska could be a world leader in the implementation of reliable microgrids and renewable energy technology.

I would encourage federal investment and support for renewable energy research and project financing through the programs below:

- Maintain funding for essential Department of Energy programs such as,
  - the **Advanced Research Projects Agency-Energy** (ARPA-E),
  - the **Energy Transition Initiative** (ETI),
  - The **Tribal Clean Energy Program.**
- Provide support for under-resourced communities through the USDA **Rural Energy for America Program.**
- Maintain phase-out agreements for **clean energy investment tax credits** to ensure continuity and reliability of regulatory frameworks for the energy industry. Maintain 26 U.S.C. §25D (Residential energy efficient property) and §48 (Energy credit).
- Encourage creation or investment in an Alaska state **green bank,** such as the **Community Energy Fund for Alaska,** to leverage limited public dollars to attract private capital investment in clean energy projects.

Thank you for your attention to the urgent need for more reliable and affordable energy for Alaska's communities.

Thanks for your consideration,



Representative Jonathan Kreiss-Tomkins

National Wildlife Refuge Association

March 30, 2017

The Honorable Lisa Murkowski
Chairman
Energy & Natural Resources
304 Dirksen Senate Office Building
Washington, D.C. 20510

The Honorable Maria Cantwell
Ranking Member
Energy & Natural Resources Committee
304 Dirksen Senate Office Building
Washington, D.C. 20510

Testimony submitted to the Senate Energy and Natural Resources Committee for the March 30, 2017 hearing on Alaska Infrastructure Needs by the National Wildlife Refuge Association

Dear Chairman Murkowski, Ranking Member Cantwell, and members of the Committee:

On behalf of the National Wildlife Refuge Association (Refuge Association) and its membership comprised of current and former refuge professionals, more than 200 refuge Friends organization affiliates and thousands of refuge supporters throughout the United States, please accept this letter as our official testimony to be added to the record for the March 30, 2017, hearing on the infrastructure needs of Alaska.

The National Wildlife Refuge Association is a national not for profit organization whose mission is to conserve America's wildlife heritage for future generations through strategic programs that protect and enhance the National Wildlife Refuge System and the landscapes beyond its boundaries.

Infrastructure Helps People Connect with their National Wildlife Refuge System

When Congress passed the National Wildlife Refuge System Improvement Act of 1997, a clear mandate was given to the U.S. Fish and Wildlife Service (Service) to provide wildlife-dependent recreational opportunities to the general public whenever such activities were deemed to be compatible on that refuge. These uses have since then become known as The Big Six: hunting, fishing, wildlife observation, photography, environmental education and interpretation.

The Service policy on Wildlife-dependent Recreation (605 FW 1) followed the Improvement Act and was designed to guide how the Service could enhance visitor experiences on refuges while conserving wildlife and habitats. While Alaskan refuges had historically recognized sport hunting and fishing as priority public uses (in addition to the legal purpose for refuges to continue to provide opportunities for subsistence uses), the Improvement Act gave equal priority to wildlife viewing, photography, environmental education and interpretation as priority public uses. While hunters and anglers are the original conservationists and continue to be a valued constituency of Alaskan refuges, other recreational pursuits are becoming more and more popular on refuges both in Alaska and the lower 48 and are contributing to the growing eco-tourism industry of Alaska. Nationally, in 2011, there were approximately 13.7 million hunters and 71.8 million wildlife watchers, and 65 percent of all refuge visits were to watch wildlife.

In order to meet the goal of providing meaningful and appropriate wildlife dependent recreation from the Improvement Act, often basic infrastructure is needed such as trails, parking lots, visitor centers, kiosks, paths and blinds that are handicap accessible, and restrooms. Nowhere is this more apparent than in Alaska, where many refuges are too remote to visit and those that can be visited more easily by the growing tourist population lack the ability to welcome and orient the visitor. These refuges often lack a visitor contact station, restrooms, and other basic infrastructure that could make their visitor experience more beneficial.

Below are a few examples of projects already approved or deemed appropriate by the U.S. Fish and Wildlife Service in Comprehensive Conservation Plans, by state plans with the Alaska Department of Transportation, or are mandated in the Alaska National Interest Lands Conservation Act. All that is needed are the funds to implement.

Improve Alaska Refuges' Ability to Serve Wildlife, Residents and Visitors: $76.5 million

1. Fairbanks FWS Office Complex and Visitor Contact Station $12 million

The U.S. Fish and Wildlife Service currently operates out of leased space by the Government Services Administration (GSA) in the Fairbanks Federal Building to serve the Arctic, Kanuti and Yukon Flats National Wildlife Refuges as well as Fisheries, Ecological Services and Science Applications programs. The GSA building meets basic space needs but is not cost effective and virtually eliminates public contact.

Approximately 85 Service employees occupy 37,397 ft² of GSA leased space for $1.033 million annually including $275,000 in annual security costs. The building includes the Federal Courthouse under jurisdiction of the Department of Homeland Security's Federal Protective Service whose security checkpoint is a deterrent to the visiting public as evidenced by Alaska's congressional offices, which moved from the building. A centrally located office building on seven acres suitable for environmental education activities is currently in foreclosure in Fairbanks for $3.5 million, well below its 2005 construction cost of $8 million. Additional costs would be incurred to build a storage facility for machinery such as boats, ATVs, etc., as well as the build out for the project.

The Service believes this vacant office building would better meet the needs of Service programs in Fairbanks while improving public access at a significant cost savings over current GSA leased space. Service cost savings would depend on future lease costs vs. purchase price of the new facility plus new operation and maintenance costs. Initial estimates suggest Service funds now paying the GSA lease could purchase the building in four years while also covering operational costs and utilities of $220,000 annually. Once the building is purchased, the Service would construct an adjacent storage facility for the numerous boats, motors, ATVs, and support equipment of the various Service programs.

2. Replace Alaska Maritime Refuge's Research Vessel $30 million

Launched in 1987, for 30 years the 120-foot *Tiglax* has sailed the world's most remote environments including the Aleutian and Pribilof Islands through the formidable seas of the Pacific

Ocean, the Gulf of Alaska, the Bering Sea, and the Chukchi Sea. Over three decades *Tiglax* and crew have earned international recognition for their expertise safely carrying FWS scientists, joined by those from other federal and state agencies and universities, doing research on fish, wildlife, botany, geology, and Native cultures. Charter fees for these researchers defray *Tiglax's* annual operating costs.

Unfortunately, the boat has outgrown its current needs and maintenance costs have increased to a point that acquiring a new vessel would reduce both operational and maintenance costs over the coming years. As a comparison, the capabilities of a 30-year old vessel vs. today's ships are like replacing a landline phone with a smartphone. Funding is needed for next generation marine electronics, radar, navigation systems, propulsion systems, as well as more efficient diesel engines and long-range fuel tanks to increase range and to operate in increasingly ice-free arctic waters of Alaska Maritime's northernmost Chukchi Sea Unit and Beaufort Sea.

3. Visitor Enhancements to Kenai NWR **$6.25 million**

The Kenai National Wildlife Refuge on the Kenai Peninsula is the easiest national wildlife refuge in Alaska for the visiting public to utilize. Just two hours south of Anchorage, the refuge is one of only four national wildlife refuges accessible via the Alaskan road network. In order for the U.S. Fish and Wildlife Service to meet the needs of a growing visiting public, we recommend several public use enhancements such as restoring public recreation cabins, creating or enhancing hiking and canoe trails, and improving signage throughout the Kenai Refuge.

- Restore 15 cabins to continue their availability for public rental via *Recreation.gov*.
- Restore 200 miles of Kenai Refuge's hiking trails and bridges.
- Restore 200 miles of National Recreation Canoe Trails, portages, and deteriorated boardwalks used by anglers on the popular Kenai River.
- Install comprehensive signage to improve public access to trails, campgrounds and other visitor opportunities throughout the two million acre refuge.

4. Kaktovik Community Visitor Contact Station **$5 million**

In partnership between the U.S. Fish and Wildlife Service and the Native Village of Kaktovik of the North Slope Borough, we recommend building a Community Visitor Contact Station in Kaktovik to be staffed by local residents with exhibits interpreting the cultural and natural history of the Inupiat people, wildlife such as polar bears and marine mammals, and the impacts of a changing climate.

5. Alaska Public Lands Information Center (APLIC), Tok, Alaska **$8 million**

In partnership with the Alaska Department of Transportation, we recommend building an Alaska Public Lands Information Center on Alaska Highway #1. The Center would be located on lands purchased in 2008 by the Tetlin National Wildlife Refuge. This Visitor Contact Station would welcome and orient visitors entering from Canada with information on recreation opportunities on surrounding public lands such as the Tetlin National Wildlife Refuge and Wrangell-St. Elias National Park, along with numerous lands of the Bureau of Land Management and Alaska state parks. Importantly, this APLIC is specifically *mandated* for Tetlin Refuge in the 1980 Alaska National Interest Lands Conservation Act (ANILCA) and would join existing APLICs in Anchorage, Fairbanks, Coldfoot and Katchikan.

6. Visitor Enhancements at Kodiak NWR **$250,000**
Kodiak NWR visitation is increasing every year with hunters, anglers, and wildlife watchers flocking to the refuge for sitka blacktail deer hunts, bear hunts, salmon fishing and bear watching. From mid-July to mid-September, visitors travel across the globe to see bears congregate and feast in any of the 117 salmon-spawning streams. Upgrades to the eight public recreation cabins on Kodiak Refuge available to rent via *Recreation.gov* are needed to enhance visitor's stays. The cabins on Kodiak Refuge are extremely popular as they provide safe, welcoming, multi-day accommodations for visitors on a remote island renowned for bad weather and abundance of giant brown bears.

7. Airplane Hangar, Kaktovik **$5 million**
Service planes operate out of the remote field headquarters of the Arctic National Wildlife Refuge in the Native village of Kaktovik. An airplane hangar will provide essential protection from the inclement weather and sub-zero temperatures that challenge Service airplanes from operating. Kaktovik is not on the road system and airplanes are essential for wildlife surveys and law enforcement patrols. The sun sets in Kaktovik in November and doesn't return until February. Further, temperatures commonly reach degrees of 40 below zero (-40 F) or more degrees so a hangar is critical to keep airplanes flying safely.

8. Construct Essential Storage Facilities at Three Remote Refuges **$10 million**
Remote national wildlife refuges need facilities to store their equipment from the harsh elements. Yukon Delta NWR in Bethel, Selawik NWR in Kotzebue, and Kodiak NWR each has a large supply of boats, motors, snowmachines, ATVs and other expensive, specialized equipment that must be protected from the Alaska's extreme weather and winter temperatures. Costs to construct such facilities in remote locations are high, but the cost to have the machinery open to the elements is more expensive with increased repair costs and replacement costs.

These are just some of the top priority infrastructure needs in Alaska to restore capacity and improve the relevancy of Alaskan national wildlife refuges for Alaskans and a growing tourist constituency. If you have any questions or concerns, please contact our Vice President of Government Affairs, Desiree Sorenson-Groves, at dgroves@refugeassociation.org or 202-290-5593. We hope to work with you in the future to ensure these and other infrastructure projects on Alaskan national wildlife refuges can be implemented.

February 3, 2017

State of Alaska Congressional Delegation:

The Honorable Lisa Murkowski, United States Senate
The Honorable Dan Sullivan, United States Senate
The Honorable Don Young, United States House of Representatives

Bruce Sexauer
Alaska District Corps of Engineers
Civil Works Project Management Branch
CEPOA-PM-C
P.O. Box 6898
JBER, AK 99506-0898

RE: PORT OF NOME – SUPPORT & REQUEST RESTART OF STUDIES & DESIGN

Dear Senator Murkowski, Senator Sullivan, Congressman Young and Mr. Sexauer:

On behalf of Sitnasuak Native Corporation, I want to express our strong support for the future development and expansion of the Port of Nome. Sitnasuak Native Corporation also strongly supports and requests federal action to restart and complete the US/Alaska Deep-Draft Arctic Port System feasibility study by the US Army Corps of Engineers – Alaska District.

As an introduction, Sitnasuak Native Corporation (SNC) is one of the Alaska Native corporations created in 1971 under the Alaska Native Claims Settlement Act (ANCSA). SNC is proudly headquartered in Nome, Alaska, with operations in Anchorage, California, Virginia Beach and Puerto Rico. Today, SNC is the largest of 16 village corporations in the Bering Straits region with over $130 million in annual revenues. SNC is owned by approximately 2,900 Alaska Native shareholders.

As you may know, the Port of Nome is a strategically situated and existing Arctic port with the ability to be cost effectively expanded to serve private, state, national and international needs. In addition, there is already developed and available shore-based infrastructure with proven capacity and services which include the following: fuel storage, marine refueling via a shore based header, United States Customs office, comprehensive utilities (water, sewer and electricity), and telecommunications with a future upgrade to fiber connectivity expected to be completed in 2017-18. There is also publicly maintained road access to the community of Nome where infrastructure and services include the following: State of Alaska maintained airport with TSA staffing, surgical care hospital facilities, retail grocery and supply stores, hotels and lodging, restaurants, meeting space rentals, banking, library-museum-culture center, National Park Service visitor center, and Nome Convention and Visitors Bureau. Furthermore, the

community provides extensive public safety infrastructure with courthouse, regional correctional center, State of Alaska Troopers, and local police.

The Port of Nome is a publicly maintained facility with a current depth of -22.5 feet (MLLW) accommodating multiple users while directly benefitting the community including the 16 villages in the Bering Strait Region, our neighboring Arctic regions of Southwest/Calista, Northwest Arctic/NANA, and North Slope/Arctic Slope Regions. The inter-regional support includes the shipment or export of gravel and rock from quality Nome resources that facilitates community infrastructure and housing development in the above listed regions. The Port of Nome has a strong history of community engagement including the City of Nome Port Commission with seven commissioners that is staffed by a City Port Director and Harbor Master.

The Port of Nome facilities and operations serve various maritime users and represent significant economic and quality of life value to the people and communities as well as the private industry users. Maritime users include fisheries, marine transport of commercial barge services for transshipment of goods and fuel, research vessels, tourism and cruise ships, subsistence users, and resource development including mining and oil/gas industries. It should also be noted that the Port of Nome currently represents one of the few publicly available U.S. ports north of Dutch Harbor and supports critical access to the Arctic.

SNC is one of the many users of the Nome Port. SNC operates Bonanza Fuel, LLC (Bonanza), as a wholly owned subsidiary that manages the largest bulk fuel storage facility in Nome and is located at the Port of Nome for over 20 years. Bonanza offers shore-based fueling services to maritime customers, commercial operations, and community residents. The marine fueling services utilize the Port of Nome fuel header for transfers of 41,000 gallons in approximately 2 hours. This also allows the simultaneous delivery of potable water, sewage pump-out, refuse removal, resupply of stores, and crew changes. This is a long-term private investment of SNC and an important service to the community and Port of Nome as an existing Arctic port. As an existing user of the Port of Nome, SNC supports the ongoing port infrastructure improvements to best serve the community and greater Arctic community and transportation network. Bonanza also has built capacity in oil spill response that is an important benefit to the Port – particularly as a rural community that networks closely together.

In regards to the federal support for the Port of Nome's future development, SNC supports and requests immediate action be taken by the US Army Corps of Engineers to restart and complete the *Alaska Deep Draft Arctic Port Study*, which was started in 2011 and was paused on October, 23, 2015, for a strategic interval of 12-months. This resuming of the project is supported with the passage of additional federal provisions contained within the Water Infrastructure Improvements for the Nation (WIIN) Act of 2016, and the National Defense Authorization Act (NDAA) of 2016.

According to Section 2006 of the WIIN 2016, there are specific and important provisions for updating project factors regarding the long-term viability and welfare of the communities in a region, as well as a project's social and cultural value to those regional communities. This is a new and major consideration that supports justification for an Arctic Deep Draft Port in Nome, in that there are numerous communities in Norton Sound and the Bering Strait region that rely heavily upon the Port of Nome as a transshipment point for fuel, equipment and supplies. Many

of these communities are legitimately threatened by the high price of fuel, construction and goods/equipment in the region, and would greatly benefit by lower cost commodities to be realized as a result of larger vessels ability to call at Nome.

According to Section 1095 of the NDAA 2016, there are specific provisions related to the strategic importance of Arctic infrastructure, such as the Port of Nome, into the discussion by requiring an assessment of the future security requirements for one or more strategic ports in the Arctic be compiled by the Secretary of Defense in a report delivered to Congress within 180 days after becoming law. The results of this effort will clearly highlight the existing and growing capabilities in Nome and further justify federal investment into the development as critically needed to protect the Alaska coastline and U.S. national security.

The exponential growth in vessel traffic transiting the Bering Strait and calling at the Nome Port is clearly discernible. The following presents historical maritime transits and Port of Nome vessel statistics provided by the Marine Exchange of Alaska and City of Nome, respectively:

	2010	2011	2012	2013	2014	2015	2016
Bering Strait Transits	242	239	316	344	255	452	369
Port of Nome Vessel Calls	296	271	444	496	498	635	751

These figures make it clear that maritime activity has significantly increased with future trends and indications of ongoing growth. The Port of Nome expansion is needed preparation in the Alaskan and US Arctic for safety, infrastructure and economic development, and national security.

In regards to the expansion needs at the Port of Nome, SNC fully supports the evolving scope of design concepts that deepen the existing basin to -28 feet, and extend the Causeway out to a depth of -36 feet for constructing a much-needed deep draft dock. These enhancements to the existing port infrastructure are cost effective and timely to allow for safe resupply and shore access for the deeper draft ships, working in, and transiting through, Arctic waters. The expanded facility would provide more efficient resupply of the larger vessels, and significantly reduces the risk of moving people and supplies via lightering or on small boats to ships anchored offshore of Nome. This would significantly increase safety and reduce schedule delays experienced even in the mildest, yet typical 2-3 foot swells in Nome.

In closing, SNC strongly supports the expansion of the Port of Nome as a deep-water Arctic port in the United States. As maritime commerce in the Arctic continues to grow, the need for a deep-water port in the Arctic is becoming critically important to ensure operational safety and efficiency of the vessels and souls traversing the waters, as well as the strategic placement of military assets and other resources necessary to the nation. If you have any questions, please feel free to contact myself or Ukallaysaaq T. Oklcasik, Vice-President of Corporate Affairs at (907) 387-1200 or via e-mail at ukallaysaaq@snc.org. We look forward to your support for the development of the Port of Nome.

Respectfully,

Richard Strutz
CEO
Sitnasuak Native Corporation

Cc: Robert "Bobby" Evans, Chairman, Sitnasuak Native Corporation
Mike Orr, Senior Vice President, Alaska Operations
Ukallaysaaq Okleasik, Vice President, Corporate Affairs
Scot Henderson, CEO Bonanza Fuel, LLC
Joy Baker, Port Director at the Port of Nome
The Honorable Bill Walker, Governor of the State of Alaska
The Honorable Marc Luiken, C.M., Commissioner of the State of Alaska Department of Transportation and Public Facilities
The Honorable Richard Benneville, Mayor of the City of Nome

St. Mary's Native Corporation

St. Mary's
P.O. Box 149 • St. Mary's, AK 99658
Phone 907-438-2315 • Fax 907-438-2961

Anchorage
203 W. 15th Ave., Ste. 207 • Anchorage, AK 99501
Phone 907-793-3140

March 3, 2017

Sitnasuak Native Corporation
PO Box 905
Nome, Alaska 99762

RE: Letter of Support for the Port of Nome Project

To Whom It May Concern:

St. Mary's Native Corporation (SMNC) is in support of Sitnasuak's Native Corportion efforts in expanding the Port of Nome's Project.

The Lower Yukon region is accessible by airplane and summer barge like much of rural Alaska which makes the cost-of-living very high. A gallon of gasoline in St. Mary's cost $5.91 with a gallon of milk at $14.90 is up from $7.45 per gallon last May. St. Mary's has 550 people living in the village. The few federal, state, city or corporate jobs are supplemented with subsistence activities.

Like many Alaska Native Corporations, our mission statement is holistic and captures profit, people, land, and culture. In today's fiscal environment, it prudent to work together for the benefit of all and that would include Alaska Native Corporations, tribal entities, non-profits, city, federal, and state governments.

Expanding the Port of Nome would be definitely being a strategic transportation hub for the State of Alaska and the United states.

SMNC looks forward to collaboration, innovation, and strengthened infrastructure for the State of Alaska and the United States. If you have any questions, please call or email me at 907-793-3140 or nandrew@stmnc.net.

ST. MARY'S NATIVE CORPORATION
Sincerely,

Nancy Andrew, CEO

CC file