To Build a Fire

The Alaska Science and Technology Plan

The Alaska State Committee on Research

2012

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Executive Summary

Alaska's economy is based on knowledge. Research – the expansion of knowledge – can improve the state's resilience and competitiveness while contributing to human progress. While the state's vast size, extreme climate, and scattered population present a unique set of challenges for science and technology development, Alaska also offers a number of advantages: a rich resource base, an educated population and increasingly well-regarded university system, and a landscape ideally suited for the study of human and natural systems undergoing climatic and social change.

This report presents a road map for the future of Alaskan science and technology (S&T) development. Improving Alaskan S&T requires a collaborative effort between the state, the University of Alaska (UA), federal agencies, communities, and the private sector. The state's role is to help provide education and training for future innovators; incentives for industrial development; infrastructure; cost matching and focused funding; and oversight and coordination of research efforts. By adopting in-state innovations, the state can also leverage and validate Alaskan research.

To offer up an analogy, the state seeks to build a fire under research. The "spark" is education and incentives for innovation. The "tinder" is infrastructure and capacity. The "fuel" is match funding and other support, and the "bellows" represents long-term planning and coordination by the State Committee on Research (SCoR) and other bodies.

Alaska's unique characteristics lend themselves to seven specific S&T research arenas, as detailed in this report. These arenas take advantage of Alaska's natural and human assets and tackle research questions crucial to the state's economy, ecology and society:

1. *Community Resilience and Sustainability*. The capacity of communities to adapt to change; food security; and preservation of Alaska Native culture and traditional knowledge.
2. *Resource Extraction*. Technology and processes for safe and efficient extraction, transportation and use of oil, gas, minerals, and timber, as well as innovations in northern agriculture.
3. *Energy Solutions*. Alternative energy sources for northern communities - especially remote communities - and cold climate housing and technology.
4. *Terrestrial Monitoring and Management*. Monitoring and mitigation of environmental change, mapping and remote sensing, geophysical research, and hazard prediction and mitigation.
5. *Aquatic Monitoring and Management*. Ocean and freshwater monitoring and fisheries management, particularly in relation to environmental change.
6. *Human Health*. Delivering effective physical and behavioral health care in arctic and subarctic environments.
7. *Transport and Communications*. Land transport, shipping, aviation, aerospace, and telecommunications technology in northern environments.

An additional section of this report addresses the *Education* of future innovators at both the K-12 and university levels. A final section offers *Policy Proposals* for state leaders.

A Note on Direct Business Engagement

In addition to the specific research arenas detailed, it is important to mention several broad programs charged with engaging with Alaskan commercial S&T:

- The UAA Technology Research and Development Center (TREND) provides proposal preparation and review, as well as grant assistance, to Alaskan tech businesses competing for federal research and development dollars.
- The UAF Office of Intellectual Property and Commercialization (OIPC) works with UAF employees to facilitate innovative activities and to bring the results to private business use.
- The Alaska Forward Initiative is a project by a consortium of economic development entities to identify and bolster industry clusters in the state.
- The UAA Office of Research and Graduate Studies (ORGS) recently created a commercialization infrastructure that includes the Seawolf Venture Fund, LP, a for-profit private equity fund which provides early-stage funding for start-up companies based on research from UAA and the community. ORGS also maintains a "UAA Patent Hall of Fame."
- The Municipality of Anchorage's new $13.2 million 49th State Angel Fund makes equity investments in local startups, and in other equity funds, to encourage local growth.

Introduction

Developing Alaska's science and technology capabilities is of critical importance to the state. Research is widely recognized as the most significant engine of economic growth, and also constitutes an economically significant "industry" in its own right: the University of Alaska, for example, conducted some $138 million worth of sponsored research in 2010-11. This research activity generates over 2,000 jobs, attracts talent from around the nation and world, and improves our ability to "grow our own" and to keep our best and brightest in Alaska.
The other reason S&T is important in Alaska is the state's unparalleled richness and diversity of human and natural resources. A common saying is, "If we can solve it in Alaska, we can solve it anywhere." Our goal is S&T that enables us to affordably and sustainably meet socioeconomic needs while preserving the health of our environment and improving our quality of life. These results are likely to be exportable as well: better solutions for basics such as clean water, green energy, quality education and improved health care for remote areas are needed by people around the world.

Challenges. Alaska offers unique challenges to S&T development. The state's vast size, scattered population, extreme climate and limited transport infrastructure all complicate logistics and increase costs. Another hurdle stems from land ownership: Research questions don't respect the jurisdictional boundaries of the various federal, state, and Native organizations which own 99% of land in Alaska, complicating the process of obtaining permits and approvals. A further consideration is the significant amount of research conducted on Alaska Native-owned lands, or involving Native communities or populations; such work requires special attention to ethics and to intellectual property issues concerning the use of traditional local knowledge.

Opportunities. At the same time, the Great Land has abundant potential for S&T development. The state's wilderness and coastline, and its position at the forefront of global climate change, make it a natural laboratory for innovations in environmental monitoring and management. Its isolated rural communities are ideal sites for social and economic research addressing cultural preservation, migration, and community sustainability, and for testing alternative energy technologies.

Most of all, perhaps, Alaska offers motivation: nowhere else in the U.S. is there a more pressing need for innovation in areas like energy production and adaptation to climate change. And never before has there been such intense interest in the North, as factors such as climate change, resource potential, and new shipping lanes focus attention on the eight Arctic nations. As America's only Arctic state, Alaska is at the forefront of the nation's opportunities for national and international research, stakeholder collaboration, energy development, and governance initiatives.

The Role of the State. Alaska's unique economic structure and research and needs have led to a climate dominated by state and federal agencies and the University of Alaska: in 2010, only 19% of Alaskan R&D came from industry, versus a national average of 72%. The function of the state is thus to conduct appropriate research through the UA and agencies; to bolster research taking place at the federal and local levels, and to identify ways to facilitate increased research by private industry. There are five roles the State of Alaska can play in the development of science and technology:

5 roles for state of Alaska in development of science and technology

1. ***Education and Training.*** Through the Department of Education and the UA, the state takes a lead role in educating tomorrow's innovators. Tax credits and other support promote private education and research programs.

2. ***Incentives for commercial S&T development.*** Alaska seeks to expand private-sector participation in S&T to spur sustainable economic growth. Tax incentives, direct financial support, purchasing and early adoption of innovations contribute to this end. Additionally, industry and government can often share the costs of research and exploration that identifies opportunities and improves feasibility.

3. ***Infrastructure.*** Adequate laboratory space at the University of Alaska is critical to science and technology development, as are cyberinfrastructure, faculty retention and recruitment, and independent research by state entities.

4. ***Cost matching.*** Many federal programs require a cost match; to the degree that the state seeks to attract such funds, it must provide the needed resources. Similarly, the state should bear the burden for building capacity and maintaining excellence in areas where it wishes to attract additional long-term federal support and private investment.

5. ***Oversight and coordination.*** It is incumbent on the state to pull together the various elements of S&T by developing a thorough understanding of what is already occurring and the mechanisms by which it occurs, and then suggesting priorities, encouraging partnerships, identifying gaps, providing incentives, improving the S&T climate, and supplying resources.

To Build a Fire.

"Building a fire" under research is critical if the state is to diversify and grow its economy.

Education and incentives are the **spark**.

Infrastructure and capacity-building provide **tinder**.

The **fuel** is state support of external grants, as well as other financial support and guidance to help new technology to leave the laboratory.

The **bellows** is perhaps the most important part: it represents coordination and long-term planning by the State Committee on Research and other state bodies to foster continued development.

Once the state has lit a fire under S&T, it will take the continued development and application of sound policy to **keep the blaze alight**.

Research Arena 1: Community Resilience and Sustainability

Introduction. While more than 500,000 of Alaska's 723,000 residents live in or near the principal cities of Anchorage, Fairbanks and Juneau, many of the remainder occupy remote "mixed-subsistence" villages, in which residents obtain food from the land but also participate in the cash economy. In recent years there has been a slow migration of village residents toward population centers, driven by jobs, schooling, health facilities, and increasing reliance upon modern technology. The continued viability of these small, isolated communities is dependent on numerous variables both local and global, from caribou migration patterns to the price of gasoline. Understanding these variables and ways to respond to them is thus critical to preserving the rural Alaskan way of life.

Research Initiatives. **Adaptive Capacity**. A primary focus of Alaskan research is the study of *adaptive capacity*: the ability of communities to effectively respond to environmental and social changes. The key mover in this research is Alaska NSF EPSCoR (the Experimental Program to Stimulate Competitive Research), which is implementing a 5-year, $20 million NSF award to study adaptive capacity in Alaska. The award funds an interdisciplinary effort to create and refine an adaptive capacity index, which will pinpoint the specific elements of communities – such as economic drivers, social organizations, and mores and attitudes – that enable them to weather change. The ultimate goal of the Alaska NSF EPSCoR project is to lay the foundation for a permanent entity to study adaptation in northern social-ecological systems.

Another important Alaskan initiative for adaptation research is the Resilience and Adaptation Program (RAP), an interdisciplinary graduate-level sustainability science program at UAF. RAP students engage in coursework, internships and other training in resilience and vulnerability to prepare them for leadership positions in academia, government, non-government organizations, education, Native organizations and agency management. At UAA, the Resilience and Adaptive Management (RAM) Group conducts research into linked changes in Alaskan environmental and social systems and local sustainability issues. The Institute of Social and Economic Research (ISER) at UAA conducts research into subsistence, rural-urban migration, sustainable communities, and other aspects of social, economic and cultural change, and helped produce the NSF-sponsored Survey of Living Conditions in the Arctic, a cross-cultural comparison of circumpolar indigenous people. The UA Justice Center also conducts basic and applied research into pressing issues of crime, justice and law that impact community resilience.

Community-Based Participatory Research. The Alaska NSF EPSCoR research project will encompass a cross-section of communities, from urban Juneau to rural Arctic villages. One goal of the project is to refine principles of community-based participatory research (CBPR), enabling researchers to better interact with local residents in a mutually beneficial manner. All NSF EPSCoR test case leaders have experience in directly engaging target populations in the development, application and execution of scientific inquiry, and the project will present an opportunity to test and apply new methods of CBPR to improve scientific interaction with communities.

Food Security. Alaska's isolation and climate make it extremely "food-insecure:" it is estimated that less than five percent of food eaten in Alaska is produced in the state. Research at the university and state levels into bolstering local food production and improving food security is thus critical not just to Alaska's remote communities but to the state as a whole.

Cultural Preservation. There is a growing global awareness of the importance of traditional local knowledge, especially in regards to a changing climate – but as Alaskan elders age, important knowledge is threatening to fade into history.

Strategies

The State Committee on Research was actively involved in crafting the Alaska NSF EPSCoR proposal, and will continue to provide oversight and coordination to the program's various elements (including collaborations with local organizations, federal and state agencies and industry groups.) The state is also providing an award match. A significant portion of the award will go toward new infrastructure, faculty hires, and education and workforce development initiatives, including some support for the RAP and RAM programs. Substantial direct state funding was also appropriated in 2012 to support RAP, which had been funded by an expiring NSF IGERT grant.

A state organization, the Alaska Food Policy Council, has crafted a 3-year (2012-15) strategic plan for impro ving Alaska's food systems. The Council's priority strategies over that period are to expand school-based programs to provide healthy, local foods; to strengthen enforcement of a statute requiring state agencies and school districts to purchase Alaskan food products under certain conditions; to advocate for and participate in the development of community and statewide emergency food awareness plans; and to support local food security initiatives. The UA Cooperative Extension Service has taken the lead at the university level in championing local food production.

The state increased its role in language preservation in 2012 by establishing the Alaska Native Language Preservation and Advisory Council, which will advise the governor and legislators on language projects and policy. The council's first report is due in 2014. Other organizations and initiatives that promote language and cultural preservation are listed in the box. Another ongoing contribution to historic preservation by the state is funding for a new $127 million facility to house the state museum, library and archives, with construction set to begin in 2013. This follows on the heels of a giant expansion of the UA Museum of the North in Fairbanks.

Images of Alaska Native Medical Center art displays

Examples of Alaska Native Language and Culture Preservation Efforts

- The UAF Oral History Program preserves more than 10,000 audio and video recordings about Alaska's history and people, many of which are available online.
- The UAF Alaska Native Language Center researches and documents Alaska's 20 Native languages and raises public awareness of language loss.
- UAF is partnering with Google in the Endangered Languages Project, which will allow people worldwide to find and share information about endangered languages online.
- UAA's Kenai Peninsula College has developed a major grant-funded research center for language documentation.
- The Alaska Native Science Commission, formed by the Alaska Federation of Natives, works to integrate Native knowledge into research.
- The First Alaskans Institute is a non-profit organization that helps develop the capacities of Alaska Native people; its efforts include a Native policy think tank and leadership development programs.
- The Sealaska Heritage Institute is a non-profit organization that works to preserve and enhance Southeast Alaska Native cultures.

Introduction. Oil has been the linchpin of Alaska's economy for four decades, but Alaskan oil production has declined by more than two-thirds from its 1988 peak. It is estimated that more than 5 billion barrels of accessible oil remain in Alaska's North Slope and billions more are present on the North Slope, in Cook Inlet, and beneath the Chukchi and Beaufort seas. The North Slope also contains significant heavy oil reserves and shale oil deposits. The state contains an estimated 35 trillion (and potentially upwards of 240 trillion) cubic feet of proven recoverable natural gas, but these supplies are largely stranded far from major markets. It is incumbent upon the state to foster and support efforts to assess and utilize these crucial resources, as well as other resources such as coal, minerals and timber, and agriculture.

Research Initiatives. **Oil and Gas**. One state research goal is to use technology and improved research data to refine oil permitting to be more efficient and scientifically sound. This includes improving understanding of the impacts of development on wildlife and the potential effects of climate change on infrastructure, vegetation and wildlife. Alaska also facilitates oil development by gathering geologic and engineering information for potential oil and gas basins (see Arena 4.) ISER and other entities can also offer insights into economies of oil production, including appropriate levels of public versus private investment.

In addition, the state seeks to collaborate with oil and gas multinationals to help develop and implement advanced exploration and production technology, such as directional drilling techniques, 3-D seismic surveys, and methods of reinjecting water, polymers or carbon dioxide to improve recovery. One key area is production techniques for heavy oil - which constitutes a huge (an estimated 20 billion barrels), largely untapped reserve - and for oil shale. Increased exploration and drilling in the Arctic Ocean means the state must develop and implement better offshore oil spill prevention, monitoring, modeling and response methods.

Alaska can also facilitate natural gas research. High priorities include arctic engineering research; resource and reservoir identification studies focused on coal bed methane, natural gas hydrates, and conventional natural gas; gas-to-liquids engineering; and public policy issues.

Minerals. Alaska has potentially commercial quantities of 13 strategic minerals, including abundant rare earths and deposits of gold, silver, lead and zinc already mined at an industrial scale. A major goal of the state is to make informed permitting decisions that minimize harmful effects on the environment. Other goals are to assess public lands for mineral potential, to construct ore deposit models and to develop new techniques to explore for ore through environmental samples.

It is estimated Alaska contains half of total U.S. coal reserves, but little is currently economically recoverable. Although most known deposits are not of the scale to merit development for export, many regions contain the potential for development for local use. For example, natural gas generated from coal in Tertiary basins as well as coal suitable for surface mining have been identified in regions which rely primarily on imported diesel for heat and electricity. Clean coal, coal gasification, tight reservoir gas production and other emerging technologies could be developed for application in these regions. Further delineation of deposits, in combination with development of technologies for extraction and generation, is needed in these areas.

Timber and Forestry. Alaska's timber industry is constrained by changing market conditions and by the small amount of commercial-quality old-growth hardwoods available for harvest. The state can contribute to the industry through innovations: for example, the Ketchikan Wood Technology Center, a government-industry collaboration, has developed new strength values for Alaska softwood species, enabling them to gain recognition for their aesthetic and structural properties. Market and business planning research can also help in the development of value-added products. The state is also facilitating the expansion of wood energy, including the use of low-grade timber, wood waste and sawdust, and wood pellets for biomass projects.

Agriculture. Alaska's short but highly productive growing season has strong potential for large-scale agriculture, but less than 1 million acres statewide are used for farming. There are also economic opportunities in certain high-value agricultural products for which Alaska's high latitude is an advantage, such as reindeer antlers, peonies, and golden root (Rhodiola rosea.)

Strategies

The Institute of Northern Engineering at UAF hosts a Petroleum Development Lab and a Mineral Industry Research Lab. Other analytical labs at the UA are listed in the box. The state's greatest recent contribution to improving resources research is the partial funding of a pair of $100-million-plus engineering buildings at UAA and UAF, concurrent with a highly successful push to increase UA engineering student numbers. The Alaska Native Science and Engineering Program (ANSEP) at UAA works to diversify the engineering workforce.

In 2012 the state funded a number of resource initiatives. One project is providing critical data to developers on the natural gas potential of several unexplored basins. Another provides new geologic and environmental data on the potential for shale oil, and a third supplies geologic data for deposits of strategic minerals, such as rare earths. Through initiatives such as an Alaska Wood Energy Development Task Group, the state is also supporting new timber and resource roads and working to coordinate timber sales with biomass power projects.

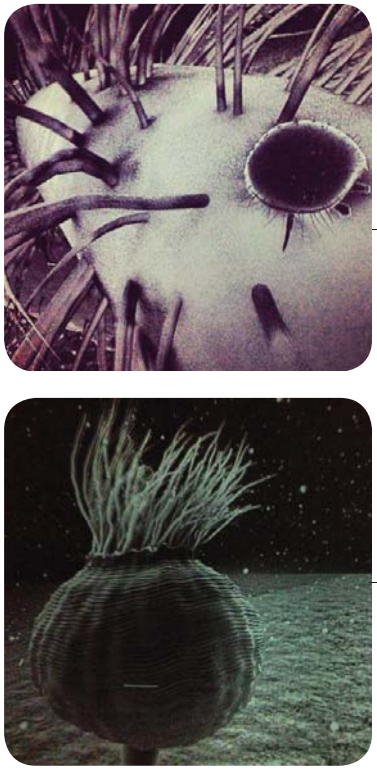
The state Division of Agriculture encourages food production through activities such as a pair of agricultural revolving loan funds and support for the Food Policy Council (see Arena 1), while UAF hosts multiple agricultural sites, including experimental farms in Fairbanks and Palmer.

The UA is also preparing a proposal for an NSF-supported Science and Technology Center, which would work directly with industry and agency partners to conduct research into Arctic oil spill prevention and preparedness and numerous other oil spill-related topics. This will supplement work being done by the Oil Spill Recovery Institute, a federally-funded research facility in Cordova.

Examples of UA Laboratory Facilities

UA has more than 450,000 square feet of space assigned to organized research, including (as of 2009-10) more than 400,000 at UAF and 32,000 at UAA. Facilities include:

- The UAF Advanced Instrumentation Laboratory specializes in surface and elemental analysis and electron microscopy, and also houses sample preparation facilities.
- The Alaska Stable Isotope Facility at UAF and the Stable Isotope Laboratory at UAA conduct isotope analyses of a wide range of sample types.
- The UAA Applied Science, Engineering and Technology (ASET) Laboratory serves researchers studying health, safety, welfare and climate change issues, including toxic substances and chemical environmental changes resulting from glacier and permafrost thaw.
- The Arctic Region Supercomputing Center (ARSC) at UAF is a high-performance computing research unit which operates "Fish," a 1152 CPU processor Cray XK6m; "Pacman," a 816-processor Penguin Computing Cluster; "Bigdipper," a Sun SPARC Enterprise T5440 storage server, and a StorageTek robotic tape library.
- The Southeast Alaska Geospatial Environmental Analysis Lab at UAS provides educational and analytical research capacity in the geospatial sciences, while the UAS Spatial Ecosystem Analysis Lab enables the analysis of inorganic and organic samples that are harbingers of socio-ecological and biophysical change.



Images from University of Alaska Anchorage Planetarium and Data Visualization Center showing of "Nanocam"

Research Arena 3: Energy Solutions

Introduction. Energy prices in parts of Alaska, especially rural Alaska, are astronomical, and developing cost-effective ways to produce and distribute energy is crucial to ensuring the future of the rural Alaskan way of life. In addition to conventional energy resources (see Arena 2), the state's landscape holds significant potential for alternative energy; the challenge lies in making its use affordable, efficient, and dependable in extreme weather. Alaskan research into cold climate technology will also assist in energy conservation.

Research Initiatives. **Renewable Energy**. Alaska contains abundant energy alternatives – including more than 50% of the nation's wave energy resources and over 90% of its river current and tidal energy resources - and lawmakers have set a goal of producing half of the state's energy from renewables by 2025. Renewable energy possibilities for Alaska include the use of shrubs and trees or waste to power small biomass generators; wind turbines at a number of possible locations; seasonal solar power; geothermal power generation (including low-temperature geothermal) in the Aleutians and in other areas; and hydropower from dams, riverine, wave and tidal generators.

Many options for renewable generation in Alaska have been identified and mapped, but further identification of resources and optimal sites for power generation is needed. Even more important will be continued research into power transmission, in order to bridge the long distances between resources and communities. Improvements in energy storage are needed to increase the feasibility of renewables and lower their cost. One innovation being studied in Alaska is the use of ammonia as an energy storage medium: alternative energy, water, and atmospheric nitrogen could be used to produce ammonia, which could then be stored and later used to fuel combined heat-and-power electricity generation.

Another major challenge for renewables lies in Alaska's climate, which can devastate equipment built for milder weather. Alaskan scientists are continuing research into materials and their performance under arctic conditions, including windpower systems backed up by diesel generators.

Renewables are envisioned as potential power sources for remote villages as well as for industry sites such as mines and fish processors. Research is also needed into the potential for using abundant renewable resources as a carrot to attract energy-intensive industries to the state. On a much larger scale, Alaska continues to research the feasibility and cost of a hydroelectric dam on the Susitna River, which would have the potential to supply 600 megawatts of power, almost half of the power needs of the Fairbanks-Anchorage rail belt.

Economics. A significant dimension of alternative energy is its affordability and its acceptance by the public. State research into developing and implementing alternative energy must take into account the socioeconomic factors involved in developing and delivering alternative energy sources.

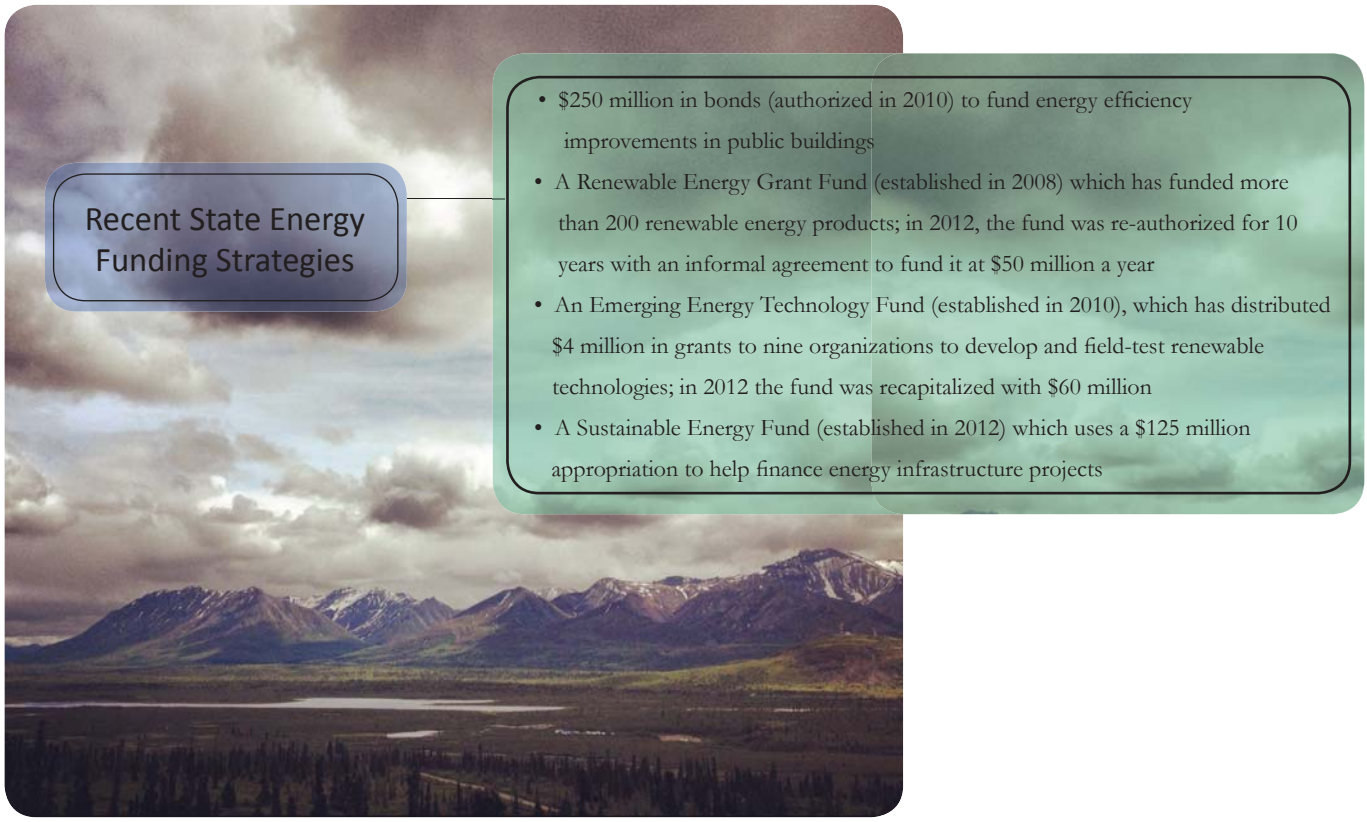
Cold Climate Housing and Technology. The other side to the Alaskan energy challenge is conservation, and the state has set goals of reducing Alaskan per capita electricity use by 15%, and retrofitting 25% of public buildings for efficiency, by 2020. The state leader in energy-efficiency research is the Cold Climate Housing Research Center (CCHRC), a university-industry partnership which develops facility designs, materials, and construction techniques for the subarctic and Arctic. One aspect of housing technology being explored in Alaska is the use of nanofluids to enhance convective heat transfer and thus improve home heating methods.

Strategies

In 2010 the Alaska Energy Authority - a state organization charged with promoting energy alternatives and coordinating state energy priorities - produced Energy Pathway, a master document for use in planning and developing local and regional energy projects. In recent years, various state funds (see box) have been used on numerous biomass, geothermal, wind, hydropower, waste heat recovery and energy efficiency projects. Additionally, the state Department of Labor has established the Alaska State Energy Sector Partnership, which funds job skills training aimed at renewables, specifically focused on remote communities where energy projects will be located.

The focal point of Alaskan energy S&T is the UA. CCHRC was founded in 2006 and has completed dozens of research projects to improve energy efficiency and to incorporate alternative energy into home designs. The CCHRC has worked closely with other agencies like the Alaska Energy Authority and the Alaska Housing Finance Corporation, including jointly producing a comprehensive review of state energy efficiency policies and programs in 2008 (which led to a number of new initiatives, including some of the new funding detailed in the box.)

The Alaska Center for Energy and Power (ACEP) was founded in 2008 to conduct a wide variety of energy research, and operates under an innovative private sector business model within the UA system. ACEP is in the middle of a $3 million Department of Energy (DOE) EPSCoR grant to develop and test wind-diesel technology in remote villages, and also recently published a comprehensive report on Alaska's stranded renewable resources. ANSEP is also developing energy solutions for rural Alaskan communities, and ISER is regularly tasked with analyzing energy issues, including contributing socioeconomic research to ACEP's DOE EPSCoR award. Alaska NSF EPSCoR research into community sustainability also encompasses local energy concerns.



Research Arena 4: Terrestrial Monitoring and Management

Introduction. Alaska's 586,412 square miles encompass a huge array of ecosystems, from temperate rainforest to boreal forest to arctic tundra. These lands are home to a rich diversity of wildlife and provide commercial, recreational, and subsistence resources to many of Alaska's peoples, as well as to the rest of the nation and the world. It is not a stretch to say that the Alaska environment, to a large extent, defines the people of Alaska. For that reason, ensuring the long-term health and sustainability of this environment is crucial to the state as a whole.

Research Initiatives. **Monitoring Environmental Change**. The research and resource management communities recognize the value of high-quality observations over a sufficiently long period to measure the variations associated with important natural cycles. This is the only way researchers can hope to tease out the impacts of natural versus human-induced change, a necessary element of understanding and predicting climate patterns. The state's primary goal is to facilitate this effort by coordinating an environmental land monitoring network (integrated with an ocean network) consisting of linked in-situ and remote sensing nodes with a common data portal. Such a network would build on and coordinate existing monitoring by an array of state and federal agencies.

This improved information stream would create enhanced environmental models and forecasts for use in adaptive resource management. These would serve as the basis for refined decision-support tools for societal adaptation, which can be used to identify effective climate change mitigation strategies. Developing these tools is a primary goal of Alaska NSF EPSCoR (see Arena 1).

Wildlife Management. The state manages wildlife for abundance to support diverse populations and to enable hunting and wildlife viewing. Research into basic biology and ecology, population monitoring and modeling (see box, next page) is important in order to track wildlife information and to understand the ways climate change affects fauna. Another goal is to identify appropriate means to incorporate local and traditional knowledge into fish and wildlife management. The state must also take a lead role in preventing and, when practicable, eradicating invasive species.

Mapping and Remote Sensing. Alaska is the least mapped state: only a few areas have been mapped to the high resolutions of 1-5 meters needed for land use planning and many resource applications. A recent effort, the Statewide Digital Mapping Initiative, has brought together the UA, state agencies and numerous stakeholders in an effort to acquire new and better maps for the state.

A major focus of research at the UA is in remote sensing; agencies like the Alaska Satellite Facility are ideally located to process, archive and distribute remote sensing data from NASA, NOAA, the USGS, and other agencies. Many of the engineering challenges presented by remote sensing open the door for new Alaska industries in sensor development and space-based engineering. One innovation under continued development at the UA is unmanned aerial vehicles (UAVs), including helicopters, planes and gliders. UAV's are especially useful for research in Alaska's harsh conditions, and have been used for a variety of applications, including low-altitude ice observations, marine surveys, and wildfire monitoring.

Hazard and Disaster Prediction, Mitigation and Management. Alaska is subject to numerous environmental hazards, including earthquakes, volcanoes, fire, storm surges and tsunamis, floods and solar storms. Alaskan researchers work to enable more accurate prediction of changing environmental conditions such as permafrost thaw, flooding, wildfires, and coastal erosion. This will enable enhanced assessment, monitoring, warning, response and resiliency to emergency situations. One area of focus is improving projections of ice cover and its direct effects on evaporation and albedo, which will lead to improved projections of storm events.

Strategies

The state can play a key role in coordinating a terrestrial sensor network, collaborating with existing initiatives like the National Ecological Observatory Network and the Arctic Observing Network. The Barrow-based interagency North Slope Science Initiative (NSSI) also collects and disseminates ecosystem information in Alaska's Arctic. The Alaska NSF EPSCoR project will install a number of integrated sensors. A new data portal being implemented by the Arctic Region Supercomputing Center (ARSC) at UA in connection with Alaska NSF EPSCoR will provide access to this sensor information and facilitate modeling and scenario development. Existing UA organizations are already engaged in scenario development, including the Scenarios Network for Alaska and Arctic Planning (SNAP) and the RAM Group. ARSC can supply the supercomputing support needed for such efforts, thanks in part to upgrades from a pair of NSF EPSCoR grants. A substantial state and federal appropriation in 2012 will allow the Digital Mapping Initiative to develop a statewide digital elevation model.

The UAF Geophysical Institute (GI) studies earth science phenomena, including atmospheric science; remote sensing; seismology, tectonics, sedimentation and volcanology; space physics and aeronomy; and snow, ice and permafrost. The State Division of Geological and Geophysical Surveys partners with the GI, the USGS and NOAA in earthquake, tsunami and volcano research, monitoring and warning. It is important to expand and upgrade as well as maintain those networks. Additionally, Alaska is a pioneer in developing means of relocating communities in hazard zones: the Newtok Planning Group, a partnership of 26 different agencies and organizations, is spearheading an ongoing effort to move the Native village of Newtok from its current untenable location.Space technology research is organized and sponsored by a NASA EPSCoR program in Alaska and by the Alaska Space Grant Program. UAV research is being conducted at UAF's Poker Flat Research Range and is being facilitated by a recent $5 million state grant to support joint development of UAVs by Poker Flat and the U.S. Air Force.

Examples of UA Biology Research Units

- The UAF Institute of Arctic Biology (IAB), with a roughly $21 million annual budget, advances basic and applied knowledge of high-latitude biological systems. A new $109 million Life Sciences facility at UAF will house IAB beginning in 2013.
- The Alaska Cooperative Fish and Wildlife Research Unit at UAF (a subsection of IAB) is part of a nationwide cooperative university-state-federal program to promote research and graduate student training in the ecology and management of fish, wildlife and their habitats.
- The UAA Environment and Natural Resources Institute conducts terrestrial research into arctic tundra, boreal forest and coastal rainforest regions, including environmental contaminants, geochemical resources, and terrestrial-marine ecosystem linkages.
- The UAF-affiliated Arctic and Bonanza Creek Long-Term Ecological Research stations support research into the long term onsequences of changing climate and disturbance regimes on tundra and boreal forest ecosystems, respectively.
- The UAF Agricultural and Forestry Experiment Station focuses on natural and manipulated ecosystems, sustainable soil productivity, food safety, plant genetics, enhanced livestock production, economic and legal aspects of resource use, silviculture and forest management.
- The Alaska Coastal Rainforest Center at UAS is a new university-interagency effort to facilitate research into coastal temperate rainforests.

Research Arena 5: Aquatic Monitoring and Management

Introduction. Alaska encompasses almost 47,000 miles of coastline and about 55 million acres of inland waters, and Alaskan fisheries are the largest and most productive in the country. Monitoring and management of the state's maritime and inland waters is crucial, as climate change and increased human use influence ocean circulation and ecosystem dynamics, impacting biological productivity, marine mammals and fish stocks.

Research Initiatives. **Ocean and freshwater monitoring**. The primary goal of the state is to build an ocean monitoring network (integrated with a land network) consisting of linked in-situ and remote sensing nodes with a common data portal. This will include equipment to assess freshwater quality, quantity and availability, and quality and productivity of ocean water. Scenarios and models constructed in conjunction with terrestrial models (see Arena 4) will enable researchers to predict future water needs and sources and to assess effects on water systems of permafrost thaw, glacial runoff, ocean acidification, and land cover, snowpack, and precipitation change. It is also critically important to develop accurate methods of monitoring and predicting ice extent.

Habitat and Wildlife. Long-term monitoring, process studies, and numerical models of fish and their habitats are a high priority for research in Alaska. Researchers will continue to study the effects of water system changes on aquatic communities, and will also improve monitoring and management methods for marine mammals. Other priority areas of research include marine ecosystem structure and processes; endangered and stressed species; and contaminants. One specific area to be addressed is the cause of major changes in Chinook salmon returns on the Yukon and Kuskokwim rivers. The state must also take a lead role in preventing and, when practicable, eradicating invasive species in Alaskan waters, including dealing with recent incursions of the didemnum vexillum sea squirt ("sea vomit") and didymospheria geminata ("rock snot").

Potable Water. Engineering is also an important part of Alaskan water research. Researchers will be tasked with improving identification of water sources and engineering design of affordable and sustainable potable water systems for remote communities. The state Department of Environmental Conservation conducts a Village Safe Water program to address rural sanitation. Identifying and modeling potable water trends is a focus of the Alaska NSF EPSCoR-supported RAM Group, as well as UA health and engineering departments.

Fisheries. Fisheries employ more workers than any other Alaskan industry. Precise regulation of commercial fisheries is necessary to assure sustainable harvests, and it is imperative that the state develop better science-based management of fish and shellfish stocks. In addition to habitat issues cited above - which also pertain to commercial fisheries - research priorities include bycatch and stock assessment and recruitment processes. Additionally, the state seeks to study the potential role of expanded mariculture and aquaculture in the state economy, to maintain sustainable wildlife fisheries, and to research opportunities for value-added fisheries products. ISER has been a center for research on the economic impact and future of fisheries and other natural resource extraction.

Strategies

As on land, the chief function of the state in building an aquatic monitoring network will be in coordinating existing nodes. Fisheries expertise is spread across a huge number of areas in Alaska (see box.)

It is incumbent on the state to coordinate these geographically and scientifically disparate efforts into an integrated network. This would be linked to the Alaska Ocean Observing System (AOOS), part of the national Integrated Ocean Observation System, which consolidates regional networks in the Gulf of Alaska, the Bering Sea and the Arctic Ocean. AOOS recently drafted a 10-year Build-out Plan which identifies future observing needs.

In 2013, the UA School of Fisheries and Ocean Sciences (SFOS) takes delivery of the R/V Sikuliaq, a global-class ice-capable research vessel that replaces its more than 40-year-old predecessor. The technologically advanced platform will allow up to 26 scientists and students per cruise to conduct multi-disciplinary ocean research, and will facilitate broadband real-time virtual participation of classroom students in expeditions, including remotely operated underwater vehicles. Other centers of marine science research are noted in the sidebar. Sikuliaq fits into a recent pattern of infrastructure improvement in the state, including a new NOAA lab and SFOS facility in Juneau. In 2012, the state appropriated $2.7 million to expand oceanic sensors networks in order to track ocean acidification and study its potential effects on fisheries.

The UA has taken several steps to coordinate fisheries S&T and seafood industry development. A new Fisheries Seafood Maritime Initiative has been instituted in collaboration with industry to better coordinate research into sustainable fisheries and to develop a skilled workforce in fisheries, seafood processing and maritime fields. The initiative is led by an 18-member panel of UA program heads and faculty. Additionally, the UAF Cooperative Extension Service has organized a statewide interagency Invasive Species Working Group to foster collaboration and to formulate state strategy to tackle both terrestrial and aquatic invasive species. This includes a statewide ban on felt-soled wading shoes to combat marine invasive species.

Examples of Alaskan Aquatic Research Facilities and Efforts

- The Alaska Sealife Center in Seward generates and shares scientific knowledge to promote understanding and stewardship of Alaska's marine ecosystems.
- The UAF School of Fisheries and Ocean Sciences (SFOS) creates and shares knowledge about marine and freshwater ecosystems, and their responses to global change.
- The Kachemak Bay National Estuarine Research Reserve in Homer researches ecological processes in the Gulf of Alaska.
- The interagency Kodiak Fisheries Research Center studies, shellfish, groundfish, ocean acidification, and other topics.
- The Alaska Sea Grant College Program, a joint effort of UAF and NOAA, supports marine and coastal research, provides education and extension services, and distributes information about Alaska's seas and coasts.
- The Prince William Sound Science Center in Cordova conducts research and education programs focused on the Prince William Sound and Copper River Delta ecosystems.
- The Barrow Arctic Science Consortium encourages research and educational activities pertaining to Alaska's North Slope, the Arctic Ocean, and Chukotka, Russia.
- The Gulf of Alaska Ecosystem Monitoring Program ("Gulfwatch") is a 5-year, $12 million program to monitor the region affected by the Exxon Valdez oil spill.
- The NOAA Alaska Fisheries Science Center conducts statewide scientific research on fish stocks, fish habitats, and the chemistry of marine environments.
- The Alaska Department of Environmental Conservation functions statewide and recently conducted marine water quality monitoring surveys in the Chukchi Sea.

Research Arena 6: Human Health

Introduction. Alaska holds multiple healthcare challenges as well as opportunities for research and innovation. Environmental contaminants and infectious diseases are health issues, as are chronic diseases like heart disease, cancer and diabetes and preventable conditions like obesity and substance abuse. Other health issues include behavioral and mental health-related problems (e.g. suicide, fetal alcohol syndrome, and violence) and the challenge of providing services to a dispersed population. Further, there are glaring health disparities between Alaska Natives and other Alaskans.

Research Initiatives. **Basic, Translational, and Clinical Research**. UA has growing expertise in biomedical and population health fields, including cell biology, neuroscience, physiology, immunology, genetics and computational bioinformatics.

Environmental Health. Hepatitis and other STDs, tuberculosis, pneumonia, and Heliobacter pylori are public health concerns in Alaska. Unusual epizootic diseases erupt in rural villages where people are exposed to feral animals. Severe and catastrophic weather events can render animals and people susceptible to opportunistic infections. Climate change causes new animal migration patterns and human-animal interactions that may increase the incidence of zoonotic diseases such as West Nile virus. Bioterrorism threats present unique challenges in Alaska because of the great distances and isolation. Melting and receding glaciers have the potential to unleash new types of pathogens.

Other important environmental health-related topics in Alaska include the impact of contaminants on food safety and security; improved infrastructure for water supplies, sewage and waste disposal; air quality, particularly as it affects asthma and other respiratory problems; maternal and child health; and occupational health and safety. Alaska will examine ecosystem and human health ties including toxicology, zoonotic diseases and other infectious agents. The state will also improve methods for monitoring food and water safety in both rural and urban environments.

Rural Health Delivery. A few examples where S&T research can make significant contributions to rural health care include the study of epidemiology in sparse populations and in harsh winter conditions; emergency treatment in the wilderness; seasonal syndromes and cold-induced injuries; health and social-care delivery to remote regions with a very low number of health care providers; and advances and innovations in telemedicine (including telepsychology).

Behavioral Health. Alaska has staggering rates of suicide, child maltreatment, substance abuse and violence. Yet some communities in Alaska are virtually free of these problems. Alaska researchers must parse out what makes these communities resilient compared to their neighbors, and determine effective methods blending cultural values and traditional western concepts. Since many significant disparities among segments of Alaska's population are in the areas of behavioral health, the intersection of indigenous and Western beliefs and practices are important issues. The Alaska Native health community continues to make essential contributions to these issues, and the people themselves must partner with researchers in their efforts.

Alaska Native Health. Alaska Natives, who make up 14.8% of the state population, have a unique set of health needs. In addition to behavioral health challenges, Natives are subject to heightened levels of chronic disease, due to rapid environmental, social, and economic change. Trends in rural-urban migration, in particular, can have profound health ramifications for Natives. The unique tribal health system, with its university and community partners, serves as a laboratory for testing innovative solutions to these health challenges, and is well-situated for collaborative, translational health research projects. UA also focuses on public health and social services, including studies on health disparities between rural and urban areas.

Veterans. Alaska must further research the needs of veterans, including both physical and psychological therapy for traumas and stresses associated with military service. This includes the development and refinement of prosthetic devices for veterans. These research goals are perhaps best met through university partnerships with military agencies.

Strategies

Biomedical research and capacity-building in Alaska is spearheaded by the statewide NIH INBRE program, focused on the impacts of climate change on contaminant transport and movements of infectious pathogens at high latitudes.

UAA (see box) is a focal point for health education and research. Nursing enrollment at the school has skyrocketed, and in 2011 UAA both expanded the College of Health and dedicated a 66,000-foot health sciences building, the first phase of a new health complex. Beginning in 2013, an additional year of medical instruction will take place in the UAA WWAMI School of Medical Education, allowing half of a physician's training to take place within Alaska. The expanded program will build capacity for further health initiatives in the state, such as a full medical school, a pharmacy school and a graduate program in biomedical research.

Major players in Native and rural health are the Alaska Center for Rural Health at UAA and the Center for Alaska Native Health Research (CANHR) at UAF. CANHR research includes Native nutrition and obesity, genetics, environmental contaminants in rural areas, behavioral issues, and other topics. The UAA Justice Center engages in research on violence and substance abuse, including the Alaska Victimization Survey, designed to provide valid estimates of sexual violence. On the state level, the Alaska Network on Domestic Violence and Sexual Assault evaluates and tests innovative practices, and suicide prevention efforts are stewarded by a state panel, the Alaska Suicide Prevention Council, which recently drafted a 2012-17 strategic plan. A state virology lab constructed in 2009 at UAF has greatly increased the state's virological capabilities. A joint UAA-UAF Ph.D. program in Clinical-Community Psychology was recently accredited by the American Psychological Association. A major initiative at UAF will partner the institution with several North Pacific universities in a joint study of childhood obesity.

Examples of UAA Health Research Efforts

- The Biomedical Interdisciplinary Group in the Office of Research and Graduate Studies works to increase interdisciplinary research in biomedical sciences.
- The Institute for Circumpolar Health Studies conducts research into health problems throughout Alaska and the world's northern regions, including current studies of inhalant abuse prevention, HIV interventions, and mitigation of health impacts of climate change.
- The Center for Behavioral Health Research and Services is undertaking several studies, including examining aspects of fetal alcohol syndrome, diabetes, and sex offender treatment.
- The Alaska Center for Rural Health helps to strengthen systems to deliver comprehensive and culturally relevant health care to rural Alaskans.
- The Center for Addressing Health Disparities through Research and Education uses a $1.2 million NIH grant to inform students and faculty about health disparities in Alaska and to encourage students, especially those from underrepresented groups, to pursue health careers.
- The Center for Human Development conducts research, education and service in the field of developmental disabilities.

Research Arena 7: Transport and Communications

Introduction. Alaska has less transport and communication infrastructure than any other state, a fact that presents both challenge and opportunity. The state has great potential for pioneering approaches to land and sea transport, aviation, and aerospace, while the distances between population centers necessitate the continued improvement of telecommunications technology. Alaska's strong military presence can both contribute to and benefit from this research.

Research Initiatives. **Shipping**. As America's only Arctic state, Alaska will be heavily involved in addressing the myriad safety, environmental and security concerns engendered by increased national and international use of the Arctic Ocean. One major thrust of marine research will be feasibility studies of Arctic shipping and the construction of ports and other infrastructure to capitalize on expanded Arctic shipping lanes. Other areas of shipping S&T include engineering studies to improve the design and operations of ports in Alaskan waters; integration of marine transportation into intermodal systems; and analysis of marine policies to promote commerce and economic growth.

Land Transport. Areas for development include inter-modal operations; maintenance methods, construction techniques, engines and fuels for extreme weather; improvement of road traction in snow and ice; engineering practices to reduce rural road maintenance; construction techniques to minimize impact and simplify permitting; intelligent transportation systems that employ real-time data acquisition and analysis; and transportation safety.

Aviation. Alaska's remote areas with minimal surface infrastructure, varied terrain, severe weather, mix of small and large private, commercial, and military aircraft, low density of air traffic, contained airspace, and areas of minimal flight restrictions make the state ideal for both civilian and military aviation S&T development. Research will support Alaska's domestic aviation needs with safer and more efficient technologies, and can also identify ways to help Alaskans export goods and services to global space, aviation, avionics, and airframe customers.

Aerospace. Aerospace S&T initiatives in Alaska include the launch of sounding rockets for auroral and atmospheric research by UAF's Poker Flat Research Range; a low earth-orbit launch complex at Kodiak operated by the Alaska Aerospace Development Corporation, and study of the physical and electrical properties of the ionosphere by the High Frequency Active Auroral Research Program observatory. The state recently committed $25 million toward a new launch pad at the Kodiak complex in anticipation of $100 million in support by Lockheed-Martin. Alaska's sophisticated radars and other ground- and satellite-support instrumentation, the research capabilities of UAF's Geophysical Institute, and the state's geographic advantage for accessing polar orbiting satellites mean it has considerable unrealized potential for significantly expanded aerospace S&T research, for both civilian and defense purposes.

Telecommunications. Alaska's dispersed population and lack of infrastructure necessitate extensive communications networks. State priorities include increasing wide-bandwidth connectivity, to support data and computer operations of NASA, the Department of Defense, NOAA, and the university, as well as other state and federal agency users. Another need is to improve the state's ability to serve rural communities through the remote delivery of healthcare, education, instructions for utility maintenance, and other information, as well as to enable universal personal use in rural areas to combat the "digital divide." Another need arises from the establishment of integrated long-term monitoring networks across the state (see Arenas 4 and 5); each group that currently takes remote observations is on its own for communications, resulting in extreme inefficiency, low productivity, high costs, and considerable interference. Scalable wireless networks taking advantage of satellite connectivity and technologies offer opportunities for statewide monitoring.

Also key are upgrades to low-earth orbiting satellite services such as Iridium to enable realistic data service speeds in unpopulated areas. Incremental improvements in remote satellite communications would benefit multiple user groups, from fire crews to field researchers. The state must also research improved techniques for laying fiber-optic cable in hostile Alaskan environments, such as river crossings and permafrost soil. Also key is the improvement of microwave technology so that the backbone network used in rural Alaska can provide needed high-speed service.

Strategies

In 2012, the state legislature established the Alaska Arctic Policy Commission, a 20-member panel charged with writing a comprehensive plan to address future Arctic developments. Their final report is due in January 2015. Alaska is also contributing to Arctic safety concerns by funding vessel tracking system upgrades, digital mapping, and an Arctic deep-water port study.

The Alaska University Transportation Center at UAF hosts about $7 million in funded research annually. Anchorage-based Peak Civil Technologies is pioneering a new soil stabilizer that could vastly improve foundations for transport infrastructure. The UA was central to developing the revolutionary NextGen air traffic control system and is one of four founding universities of the FAA Center of Excellence for General Aviation; particularly through UAA's Aviation Technology Division, this center can play a significantly enhanced role in coordinating and conducting aviation S&T. Through a NASA agreement, Alaska is also serving as a testing ground for airship technology.

Connectivity efforts are led by the Alaska Broadband Task Force, a government-industry panel charged with increasing penetration of broadband in both urban and rural Alaska. In early 2012 a new broadband network was extended to 9,000 homes and 750 businesses in Southwest Alaska, with plans to expand into Northwest Alaska later in the year. The Arctic Slope Regional Corporation has received partial funding for a terrestrial fiber-optic link to Barrow and the Tlingit & Haida Central Council has developed a broadband strategic plan for Southeast Alaska. Alaska stands to benefit substantially from a pair of planned London-Tokyo fiber-optic cables, which may be routed through the Northwest Passage and include links to Arctic communities.

The Alaska NSF EPSCoR award includes provisions to procure software with the potential to improve tele-delivery of resources statewide. The ramifications of local transport access options (or lack of same) will also figure into the program's community resiliency studies.

Education

Introduction. The most significant way for the state of Alaska to contribute to S&T innovation is through ensuring a quality education in science, technology, engineering and math (STEM) fields, both at the K-12 and university levels.

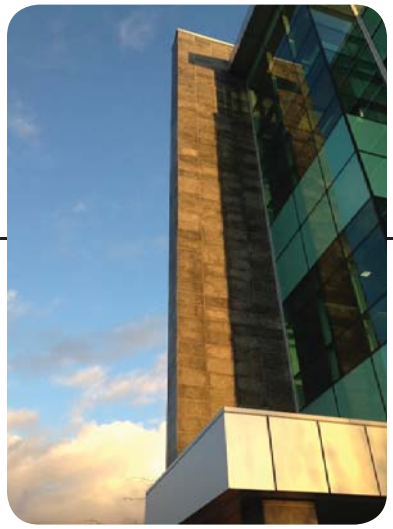
Research Initiatives. **K-12 Education**. One challenge confronting the Alaska K-12 system is teacher recruitment and retention, which is especially problematic in rural areas. Teacher retention appears to be closely associated with student achievement; at issue is not just retention in general, but the need for teachers with expertise in given areas, such as math, science and (most particularly) special education. A closely related issue is professional certification for teacher aides, and methods to transition these aides - often the most stable element in the school system - into teaching.

Other key goals of the state Department of Education are to determine what incentives are needed to make schooling more successful; to better align the programs of Alaska's K-12 school districts with the University of Alaska; and to ensure that adequate resources are available in-state. The state will also work to optimize the offerings of successful programs on the K-12 level, such as Best Beginnings and Parents as Teachers, and will also research the impact of the Head Start program on K-12 and university student performance. Another major goal of the state for STEM education in particular is to find ways to incorporate research into K-12 classroom settings.

Distance Delivery. Distance delivery of education at both the K-12 and university levels is essential in Alaska, both because of its size and dispersed population, and because of the need for many students to accommodate other activities - from subsistence to paying jobs - while learning. Challenges for distance delivery include communications systems, teaching methods, faculty proficiency, integration of distance and traditional programs, and cultural relevance and acceptability.

University of Alaska. The UA, with almost 35,000 students statewide, is of crucial importance to the state as a teaching institution. The UA has in recent years concentrated on training Alaskans for high-demand jobs, most of which strongly correlate to the research arenas in this report: engineering, health, biomedicine, teaching and workforce development. As noted elsewhere in this report, the university has concentrated resources in its engineering and health departments, with strong results: enrollment in the UAF College of Engineering and Mines, for example, has increased by 70% since 2006.

One important goal for the state is to gauge the success of specific programs at the UA, such as ANSEP, the Rural Alaska Honors Institute, the Della Keats Health Sciences Summer Program, and the TRIO program, and work to optimize their impact on Alaskan students.



UAA Health Sciences Building

Strategies

In 2010, the state formed an Alaska Advisory Task Force on Higher Education and Career Readiness to address improvements to K-12 education to better prepare students for college or careers. The Legislature has since taken steps to implement their recommendations, which include suggestions to create or expand a number of training and education programs; to improve academic advising and teacher mentoring; to improve testing; and to provide predictable and sustainable education funding. In 2012 the UAA Center for Alaska Education Policy Research was established within ISER; the center will partner researchers with an advisory board to identify and address the most important educational policy issues facing Alaska.

The UA and state partner on Alaska Teacher Placement, an online clearinghouse linking interested teachers and administrators with Alaska jobs. The state also partners with the federal Department of Education to administer Future Educators of Alaska, a program to inspire and support Alaska Native students to enter the teaching profession. The Alaska Statewide Mentor Project, a state-university collaboration, provides career support for early-career teachers with the goals of improving teacher retention and student achievement. The Alaska NSF EPSCoR award includes provisions for K-12 education initiatives, including support for multiple activities aimed at Alaska Natives and rural educators as well as experiential classroom learning activities. These include a program to provide internships at Alaska Native Corporations as well as support for IPY GLOBE, a classroom research program.

Alaska ranks 8th nationwide in per-capita state spending on higher education. The 2012 state budget included more than $500,000 dedicated specifically to preparing UA students for the state's key industry sectors, all of which relate to critical areas of S&T development: health, oil-gas & mining, engineering, education and fishing/seafood processing/maritime. This bolsters UA efforts to improve numbers in these fields: UA vocational education funding has increased 180% since 2001. A new statewide program of Alaska Performance Scholarships is also providing tuition funding for Alaskan high school students to pursue in-state higher education and training.

The state has invested heavily in UA infrastructure projects in recent years. These include the aforementioned engineering buildings at UAA and UAF, health sciences building at UAA, Museum of the North and Life Sciences Facility at UAF, and NOAA-UAF fisheries facility in Juneau. In addition, a new UAA integrated science building opened in 2009, centered around a state-of-the-art Planetarium and Visualization Theatre that serves both research and education purposes (including use by the NSF EPSCoR program for interactive "decision theatre" events for resource managers.)

UA is currently engaged in a public input process called "Shaping Alaska's Future 2017," which will produce a set of recommendations for the near-future direction of the university. The project is centered on improving student achievement and attainment, productive partnerships with Alaska's schools, agencies and industries, and fostering research and development for economic growth.

The UA is addressing university-level distance education by following the recommendations of a Distance Education Plan approved in 2009. UAF recently opened an eLearning and Distance Education Office designed to streamline and improve distance education offerings. The UAA School of Nursing now offers all required nursing courses through distance delivery, making it possible to complete a nursing program from 13 different communities across the state.

The UA has also pursued human infrastructure improvements through partnering with federal programs. The Alaska NSF EPSCoR award includes funding for eight new faculty hires, whose contracts will be picked up by the university after the award expires. The current NIH INBRE award includes six faculty hires.

Policy Proposals

A. Government

1. Create a state entity to stimulate S&T by identifying gaps in seed funding, providing capital and/or tax incentives, and supporting next steps such as patenting Alaskan products.
2. Appoint a science advisor in the executive branch to coordinate and represent Alaska leadership on boards and committees, such as the North Pacific Research Board (NPRB) and the U.S. Arctic Research Commission.
3. Create a joint Science and Technology committee in the state Legislature.
4. Establish a "scientific SWAT team," a state brain trust that could quickly formulate scientifically appropriate responses to emergent problems.
5. Use the state as a vehicle to encourage the dissemination of traditional knowledge through support for groups such as the Alaska Native Science Commission.
6. Pioneer methods of supporting K-12 STEM education, including adding STEM elements to Alaska Performance Scholarships.
7. Partner with the UAF and UAA offices of Intellectual Property and Commercialization to identify innovations based on university research, and modify state procurement policies to encourage early adoption of new software and other innovations developed in-state.

B. Academia and Research Groups

8. Use research directors from the three UA campuses as "scouts" to seek out funding opportunities such as those offered by the NSSI and the NPRB
9. Systematically examine state needs for research space and cyberinfrastructure (especially improved broadband access) and adjust the long-term development agenda accordingly.
10. Coordinate and sustain established environmental monitoring networks, such as the Arctic Observing Networks and Global Earth Observation System of Systems.
11. Explore ways to provide support and incentives for UA faculty to partner with the private sector on research projects.

C. Business

12. Continue economic development efforts such as the Alaska Forward Initiative, which applies cluster theory to identify Alaska's unique business and development opportunities.

D. Non-Governmental Organizations

13. Establish and publicize an Alaska Innovators Hall of Fame, tied to the Alaska Workforce Investment Board.

SCoR Next Steps

- Hold three public workshops across the state to identify research gaps and policy directions
- Incorporate workshop recommendations into living S&T plan
- Work with Alaska Workforce Investment Board to facilitate investment in S&T
- Work with key stakeholders to bolster data portals and networks
- Use SCoR as a vehicle to support UA commercialization efforts

Appendix 1: Drafting Process and SCoR Membership

1. **Mark Myers, Acting Committee Co-Chair**
   UAF Vice-Chancellor for Research
2. **Mead Treadwell, Committee Co-Chair**
   Lieutenant Governor, State of Alaska
3. **Lilian Alessa**
   UAA Associate Professor of Biology
4. **Sarah Barton**
   Senior Vice-President, Rise Alaska LLC
5. **Rick Caulfield**
   UAS Provost
6. **Elisha "Bear" Baker**
   UAA Interim Vice-Chancellor and Provost
7. **Jim Hemsath**
   Deputy Director, Alaska Industrial Development and Export Authority
8. **Susan Henrichs**
   UAF Provost
9. **Alex Hills**
   Distinguished Service Professor, Carnegie Mellon University
10. **Jim Johnsen**
    Senior Vice-President, Alaska Communications System
11. **Karl Kowalski**
    UA Chief Information Technology Officer
12. **Dale Nash**
    Chief Executive Officer, Alaska Aerospace Corporation
13. **Peter Schweitzer**
    Principal Investigator, Alaska NSF EPSCoR
14. **Robert F. Swenson**
    State Geologist, Alaska Department of Natural Resources
15. **Dana Thomas**
    UAF Vice-Provost for Academic Affairs
16. **Dan White**
    Director, UAF Institute of Northern Engineering
17. **Helena Wisniewski**
    UAA Vice-Provost for Research and Graduate Studies
18. **Fran Ulmer (ex officio member)**
    Chair, U.S. Arctic Research Commission

Appendix 2: Acronyms

ACEP	Alaska Center for Energy and Power
ANSEP	Alaska Native Science and Engineering Program
AOOS	Alaska Ocean Observing System
ARSC	Arctic Region Supercomputing Center
ASET	Applied Science, Engineering, and Technology
CANHR	Center for Alaska Native Health Research
CBPR	Community-Based Participatory Research
CCHRC	Cold Climate Housing Research Center
DOE	Department of Energy
EPSCoR	Experimental Program to Stimulate Competitive Research
FAA	Federal Aviation Administration
GI	Geophysical Institute
IGERT	Integrative Graduate Education and Research Traineeship
IPY GLOBE	International Polar Year Global Learning and Observations to Benefit the Environment
ISER	Institute for Social and Economic Research
NASA	National Aeronatics and Space Administration
NGO	Non-Governmental Organization
NIH INBRE	National Institutes of Health IDeA Network of Biomedical Research Excellence
NOAA	National Oceanic and Atmospheric Administration
NPRB	North Pacific Research Board
NSSI	North Slope Science Initiative
ORGS	Office of Research and Graduate Studies
RAM	Resilience and Adaptive Management
RAP	Resilience and Adaptation Program
S&T	Science and Technology
SCoR	Alaska State Committee on Research
SFOS	School of Fisheries and Ocean Sciences
SNAP	Scenarios Network for Alaska and Arctic Planning
STEM	Science, Technology, Engineering and Math
TREND	Technology Research and Development Center
UAA	University of Alaska Anchorage
UAF	University of Alaska Fairbanks
UAS	University of Alaska Southeast
UAV	Unmanned Aerial Vehicle
USGS	United States Geological Survey
WWAMI	Washington, Wyoming, Alaska, Montana and Idaho