To Build a Fire

The Alaska Science and Technology Plan

The Alaska State Committee on Research

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conduct appropriate research through the UA and state 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:

1. *Education and training.* Through the Department of Education and the UA, the state takes a lead role in educating tomorrow's innovators. In addition to state efforts, tax credits and other support mechanisms can promote private education programs.

2. *Incentives for commercial S&T development.* Alaska seeks to expand private-sector participation in S&T to spur economic growth. Tax incentives, direct financial support, and purchasing and early adoption of innovations contribute to this goal. Industry and government can also share the costs of research and exploration that identifies opportunities and improves feasibility. (This topic is discussed in more detail on page 21.)

3. *Infrastructure and basic research.* 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. The state can also support and conduct the basic research that undergirds all applied science efforts, but that is unlikely to attract private funds.

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 bears the burden of building capacity and maintaining excellence in areas where it wishes to attract federal support and private investment.

5. *Oversight and coordination.* It is incumbent upon the state to pull together various elements of S&T by developing a thorough understanding of what is already occurring and the mechanisms by which it occurs, including economic factors. The state can then suggest priorities, encourage partnerships, provide incentives, and improve the S&T climate.

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, basic research and capacity-building provide "tinder."

sustainability. A significant portion of the NSF EPSCoR award goes toward infrastructure, faculty hires, and education and workforce development, including 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. This funding has been picked up by the state as an annual expenditure.

The state increased its role in language preservation and revitalization 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. Another ongoing contribution to historic preservation is a new $127 million facility to house the state museum, library and archives, which is slated to be completed in 2016. This follows a major expansion of the UA Museum of the North in Fairbanks.

The Alaska State Council on the Arts is the state's primary organization providing assistance and services to artists, art organizations and arts supporters across the state. Since its inception, the council has provided over 4,000 grants totaling more than $42 million, including direct support for artists and a variety of programs to bring artists and art curricula to schools. The council is operating under a 2012-16 strategic plan, which calls for the organization to cultivate awareness of arts and culture; to promote equitable, accessible high-quality arts education; to expand Alaska's artistic vitality; to build vibrant communities through the arts; and to strengthen the council's governance and administrative capacity. The nonprofit Rasmuson Foundation also provides major funding and support to Alaskan artists.

Introduction. Alaska's fisheries are among the most productive in the country, and fishing employs more people in Alaskan than any other industry. Monitoring and managing the state's waters and fisheries is crucial, as climate change and increased human use influence ocean circulation and ecosystem dynamics, impacting biological productivity, marine mammals and fish stocks. Timber and agriculture are other areas where S&T can help increase renewable resource use.

Research Initiatives.Fisheries and Marine Life Alaska contains commercial, subsistence, and sport fisheries. Precise regulation of commercial fisheries is necessary to assure sustainable harvests, and it is imperative that the state collaborate with industry to develop better science-based management of fish and shellfish stocks. There is great potential within the seafood industry for product use and processing to increase the share of seafood processed locally and in-state.

Research priorities include species-specific assessment and modeling for salmon, sablefish, pollock, halibut and other species. Challenges include in situ data collection, data management, spatial data collection and habitat mapping. One key research area is the decline of Bering Sea pollock fisheries, which have been linked to higher water temperatures, and of Chinook salmon populations, which have been declining statewide. Ocean acidification is another major cause for concern in Alaska; habitat studies (see Arena 5) are key to charting the effects of acidification and climate change on fisheries and marine mammals.

New technology could have major application in fisheries. Areas of interest include advances in processing, refrigeration, dehydration, genetics and acoustics, spatial information software, and value-added processes, as well as ways to minimize or mitigate bycatch and to use fish waste.

Another key area for research is the potential for increased mariculture and aquaculture, including the production of oysters, mussels, clams and kelp, and salmon ranching. The state Legislature has passed several acts designed to help the industry, and research could help pinpoint other ways to encourage growth. This includes ways to reduce shellfish maturation times and up-front investments, improved sources of oyster seed, ways to decrease otter predation of mussels, and methods for commercializing abalone and other underutilized species.

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, developed new strength values for Alaska softwoods, earning them recognition for their aesthetic and structural properties. Market research can also help in the development of value-added products. The state also works to facilitate wood energy, including the use of low-grade timber, wood waste and wood pellets for biomass projects.

Introduction. Alaska's 586,412 square miles encompass a wide array of terrestrial and marine ecosystems, which house

urban migration, in particular, can have profound health ramifications for Natives. Alaska's unique tribal health system, with its university and community partners, serves as

Introduction. Alaska has less transport and communication infrastructure than any other state. The state has potential for pioneering approaches to land and sea transport, aviation, aerospace, and information technology (IT). In addition, improved telecommunications through the Arctic would place Alaska at the crossroads of global telecommunications, data, and financial networks and position the state for economic growth and new technology industries.

The effective and efficient coordination of this infrastructure is key to the economic and social development throughout the State. While the five research initiatives described below detail specific functional issues, it is also recommended that an overarching program on statewide logistics and systems analysis be developed.

Research Initiatives Shipping. Alaska will be heavily involved in addressing safety, environmental and security concerns engendered by increased Arctic shipping. One research thrust is feasibility studies of expanded shipping and related construction of ports and infrastructure. Other shipping S&T includes engineering studies to improve port design and operations and integration of marine transportation into intermodal systems. Research is also needed into global supply chain logistics to decrease the amount of perishables spoiled or damaged en route to Alaskan communities.

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; and engineering practices to reduce road maintenance and improve longevity.

Aviation. Alaska's remote areas with minimal surface infrastructure, varied terrain, severe weather, mix of 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 by providing safer and more efficient technology, and can also identify ways to better export goods and services to global customers. An increasing amount of research is also being conducted into the feasibility of using next-generation airships for cargo transport in Alaska. Alaska is also a center for UAV research (see Arena 5.)

Aerospace. Aerospace S&T initiatives in Alaska include the launch of sounding rockets for auroral and atmospheric research, a low earth-orbit launch complex at Kodiak, and study of the physical and electrical properties of the ionosphere. 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 satellites affords it considerable potential for expanded aerospace S&T research.

Telecommunications and Information Technology. One state telecommunications priority is 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 agencies. Another need is to improve the state's ability to serve rural communities through remote delivery of healthcare, education, and governmental services, as well as to enable universal personal internet 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 Arena 5); each group that currently takes remote observations is on its own for communications, resulting in inefficiency, high costs, and considerable interference. Scalable wireless networks taking advantage of satellite connectivity and technologies offer opportunities for coordinated 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 to remote satellite communications would benefit multiple user groups, from fire crews to field researchers. The state must also improve techniques for laying fiber-optic cable in hostile Alaskan environments, such as river crossings and permafrost soil. Also important is improving microwave technology so that the backbone network used in rural Alaska can provide needed high-speed service.

Alaska is also cultivating the potential for IT research. The Arctic Region Supercomputing Center at UAF has recently upgraded its core system, and Alaska NSF EPSCoR support has improved connectivity on both the UAA and UAF campuses, as well as improved the capacity of the Planetarium and Visualization Theatre at UAA to deliver high-resolution interactive visualizations.

Strategies In 2012, state legislators established the Alaska Arctic Policy Commission, a 20-member panel charged with writing a comprehensive plan by 2015 to address future Arctic developments. Alaska is also funding Arctic 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, and the CCHRC is studying geopolymer concrete (see Arena 3.) 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; this center can play a significantly enhanced role in coordinating and conducting aviation S&T. Alaska has reached agreement with NASA to serve as an airship testing ground.

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. The upgrades will make Kodiak the West Coast home of Lockheed-Martin's new Athena III spacecraft starting in 2014. Sounding rocket and UAV testing takes place at UAF's Poker Flat Research Range, while the High Frequency Active Auroral Research Program studies the ionosphere.

Connectivity efforts are led by the Alaska Broadband Task Force, a government-industry panel charged with increasing broadband penetration in both urban and rural Alaska. The Task Force (with ISER support) released its draft report on the future of Alaskan broadband in 2013. In early 2012 a new broadband network was extended to 9,000 homes and 750 businesses in Southwest Alaska, with current plans to expand north into Kotzebue in 2014. The Arctic Slope Regional Corporation has received initial 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 may

benefit substantially from a pair of planned London-Tokyo fiber-

Introduction. The most significant way for the state of Alaska to contribute to S&T innovation is through ensuring quality K-12 and university educations, especially in science, technology, engineering and math (STEM) fields. The contributions that engineers, scientists, and other STEM workers make to the state are multifaceted, as they solve problems and bolster the economy.

Initiatives. K-12 Education. Alaska's biggest educational challenge is K-12 teacher retention, especially in rural areas. At issue is not just retention in general, but the need for teachers with expertise in given areas, such as math, science and special education. A closely related issue is professional certification for teacher aides, and methods to transition these aides

Improving Alaska's S&T landscape requires cooperation between leaders in government, academia, research groups, business, and NGOs. Perhaps the most important way state and local agencies can foster increased S&T development is to provide entrepreneurs with the support they need to cross the "valley of death," the challenging step between developing a product and actually producing and marketing it. This support can take the form of instruction and business connections, or the more direct form of venture capital. Several programs already exist in Alaska that provide financial support and other services to inventors hoping to establish a market for their innovations.

At UAA, the Alaska Technology Research and Development Center (TREND) provides workshops, one-on-counseling, and grant assistance to small businesses attempting to garner federal Small Business Innovation Research and Small Business Technology Transfer grants, which can be used to bring technology to market. The UAA Office of Research and Graduate Studies (ORGS) recently formed 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. UAA also established Seawolf Holdings to oversee the fund and to provide a corporate interface between the university and its enterprise companies.

The UAF Office of Intellectual Property and Commercialization (OIPC) works with UAF faculty, staff and student inventors to guide them through the process of intellectual property licensing and protection. It also works with industry partners interested in sponsoring research, licensing technology, or forming startups around UAF innovations. Among the office's products are handbooks for inventors and a guide for businesses interested in UAF partnerships.

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SCoR will work with the below entities to implement these policies over the next half-decade:

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, streamlining regulations, or changing procurement policies to build markets.

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. Encourage the dissemination of traditional knowledge through state 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 inventory state needs for research space and cyberinfrastructure (especially improved broadband access) and adjust the long-term development agenda accordingly.

ACEP: Alaska Center for Energy and Power
AFN: Alaska Federation of Natives
AHFC: Alaska Housing Finance Corporation
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 Aeronautics 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