Alaska & Micro-reactor Applications

U.S. NRC Regulatory Information Conference
Panel TH34 "Micro-Reactors: The 'Next Big Thing' Part 1 (The Drivers)"

12 March 2020
Bethesda, Maryland

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Alaska the 49th State

- Population < 750,000
- 663,300 sq miles
- Remote & isolated
- Challenging environment
- Resource-driven economy
- Not grid-tied to other regions
  - 250+ microgrids
  - 100 kW - 385 MW
- Power & heat required
- High energy costs
- Synergies in & beyond Arctic

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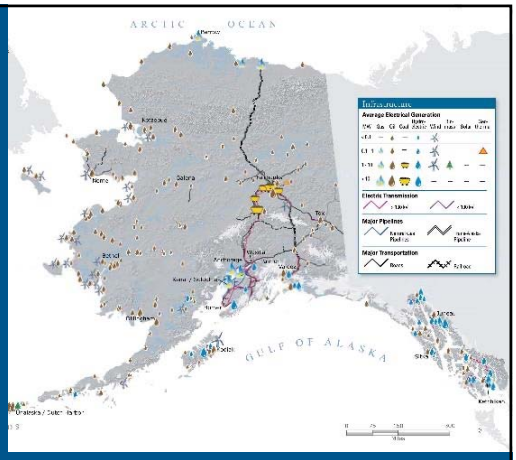
Energy in Alaska

- Fossil fuels
  - Diesel systems
  - Natural gas
  - Coal
- Renewable energy
  - Hydroelectric
  - Hydrokinetic
  - Wind
  - Biomass
  - Solar
  - Geothermal

- Energy efficiency
- Heat recovery
- Heat pumps
- Storage – electrical
- Storage - thermal
- Control systems
- Combined heat & power



- 100 kW – 385 MW Scale Systems
- Military – Industry – Urban - Rural
- Retrofit & Greenfield Opportunities

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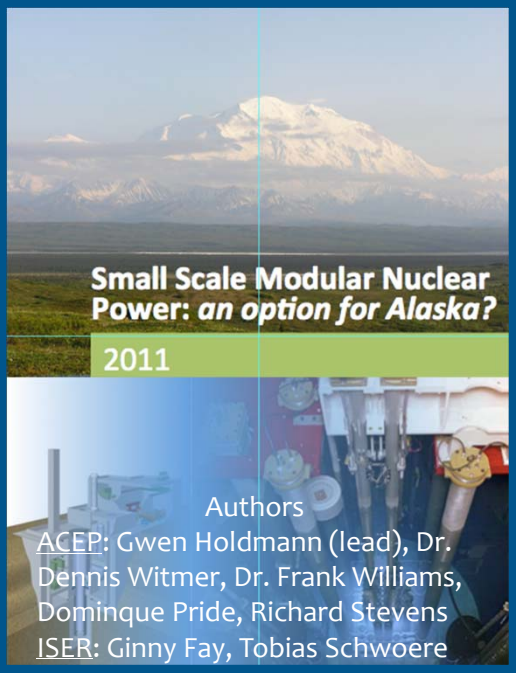
2010 Study of SMR's

"Small Modular Nuclear Power: *an option for Alaska?*"

- 2009 requested by Alaska State Legislature in response to 2008 Global oil price spike that exposed vulnerabilities of Alaska to annual / intra-annual oil price fluctuations
- Interest in solutions that can provide baseload power (many remote locations only have access to intermittent renewables)
- Interest in options that can offset heating loads as well as electric power

Available for Download at:
acep.uaf.edu under publications



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Multiple stakeholders

"I would like a viable alternative to coal"

"Where technically and economically feasible, nuclear microreactors should be considered as part of any future heat and energy solution for defense, urban, and industrial applications."

"The Alaska Energy Authority (AEA) is deeply involved in power generation and transmission planning, construction, and operation throughout Alaska. It also funds, designs, and constructs heat recovery and district heating systems in rural Alaska communities. AEA supports a rigorous study of the potential for nuclear microreactors in combined heat and power applications in Alaska."

"Alaska's requirements for, and experience with, combined heat and power systems present a compelling application for microreactors. There is an opportunity to integrate these reactors with existing technologies to provide electricity and heat in multiple economic sectors."

- Communities
- Defense sites
- Seafood
- Mining
- Oil & gas
- Tourism
- Transportation
- Government
- Academia
- ...

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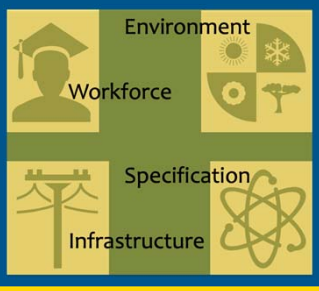
Alaska Micro-reactor Market Study

The topic of nuclear energy is not a new one in Alaska and has at times received pushback from rural communities. While the historical issues surrounding the topic may not reflect the actual risks of nuclear technology today, awareness of risks and benefits—especially in rural Alaska—could ultimately affect the success of a project. The study will gauge the extent of potential concerns about microreactors and market interest in Alaska.

1. Stakeholder and Market Awareness
2. Customer Discovery Exercise
3. Use Case Analysis



How do people feel about nuclear?

How do energy users get information on new technologies?

What are energy users looking for in future projects?

What motivates the energy decisions of operators?

What motivates the processes of energy stakeholders?

What are the concerns surrounding micro-nuclear?

What motivates energy technology decisions?

What were critical drivers of past energy projects?

What are the current awareness levels of nuclear?

What pushes users toward certain technologies?

What issues could micro-nuclear solve?

Who would be initial first users?

CED Center for Economic Development

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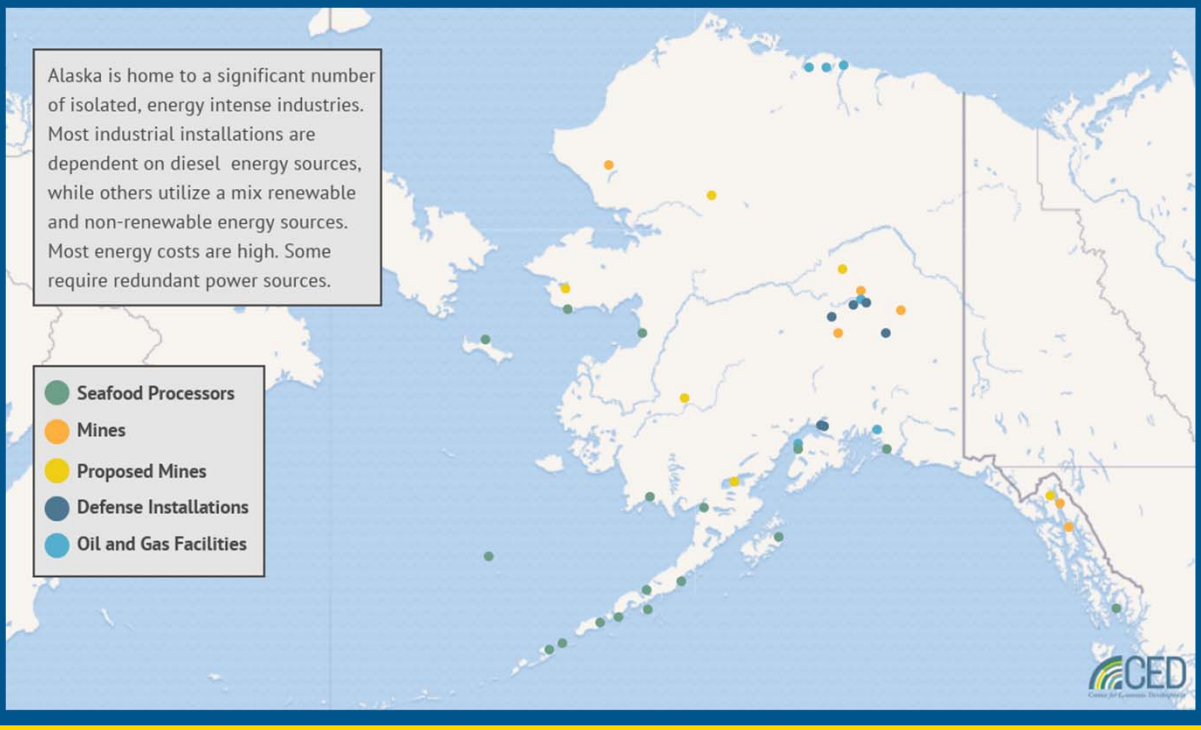
Energy-intense industry & military



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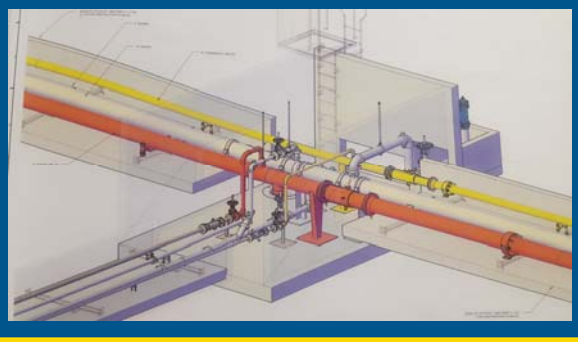
Defense sites?

- Existing heat & power network
- Known baselines
- Emission reductions
- Energy surety / security
- Existing utility interties
- Shared resilience initiatives



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Mining sites?

Current: coal, gold, lead, silver, zinc

Future: barite, copper, graphite, molybdenum, rare earth elements

CHP needs: extraction, value-add processing, facilities

Additional information: Alaska Miners Association, Resource Development Council

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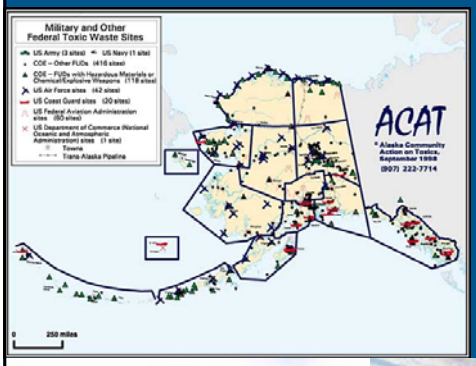
Waste management opportunities?



- Mobile / transportable reactors
- Drying / incineration
- Brownfield enablement
- Circulating or permanent

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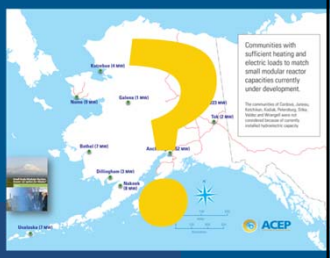
Nuclear micro-reactors in Alaska?

Cost, scalability, transportability, size, safety zone and regulatory treatment, passive safety features, standardization, fuel, …



Deployment path??

- Villages
- Hub towns
- Municipal utilities
- Remote industry
- Defense / municipality
- Defense sites

Safety Integration
Environment Benefit
Affordability Timing …

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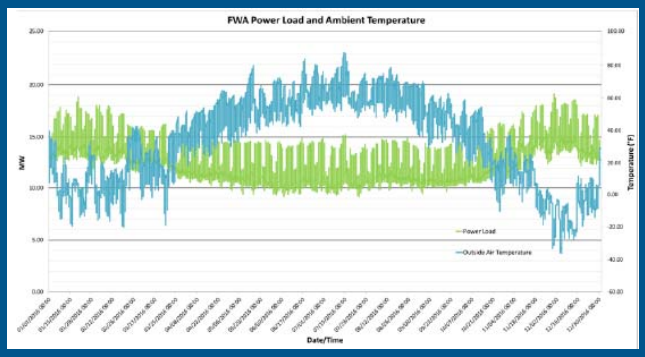
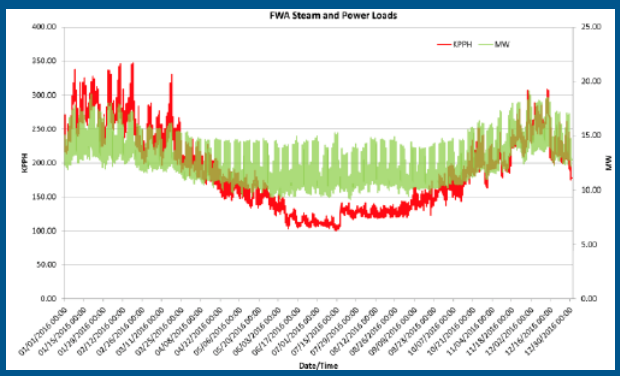
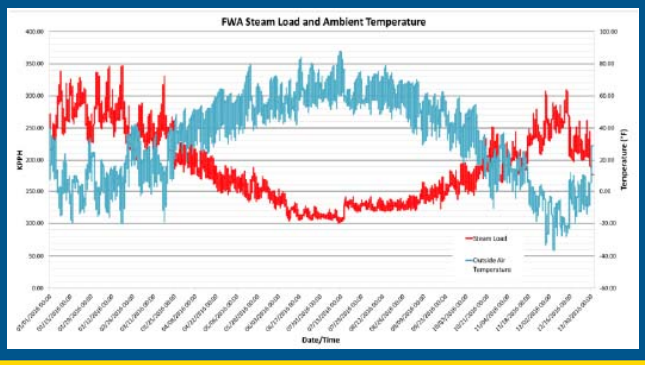
Energy use at Fort Wainwright (2017)



Electrical supply
- Peak load of 19 MWe
- Base load of 9 MWe





Steam supply
- Peak load of 350 kpph
- Base load of 100 kpph

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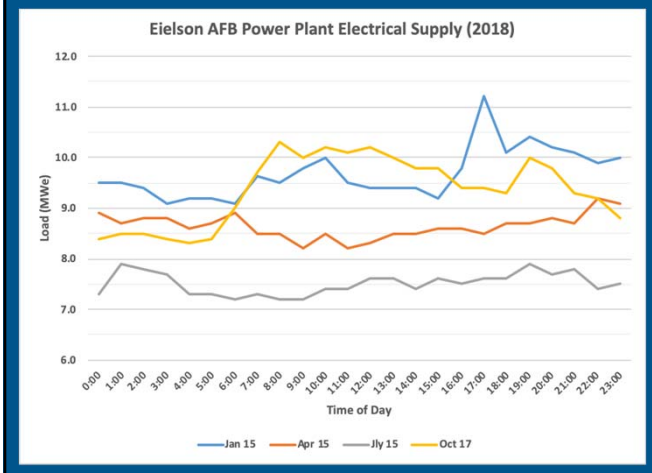
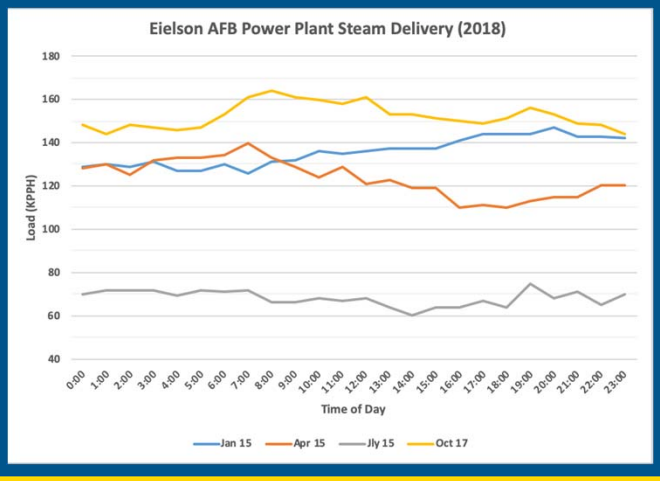
Energy use at Eielson AFB (2018)



Electrical supply
- Peak load of 11.2 MWe
- Base load of 7.2 MWe



Steam delivery
- Peak load of 164 kpph
- Base load of 60 kpph

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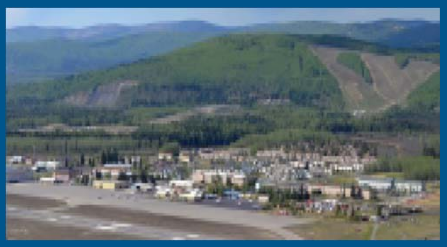
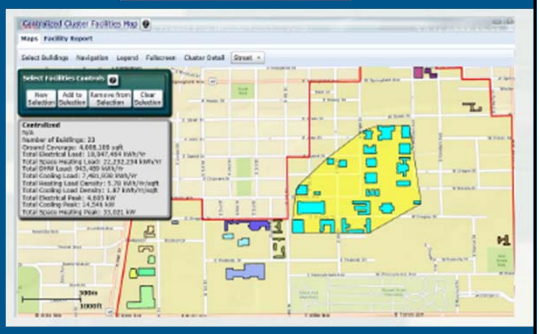
Secure & Resilient Power Generation in Cold Region Environments



- Techno-economic and resilience analysis of Fort Wainwright power and thermal energy system
  - System Master PLanner (SMPL) model
  - *In situ* building and environment measurements
  - Ice fog modeling
  - Conventional and advanced energy sources
- Pilot project at CRREL permafrost tunnel - energy requirements & replicable energy technologies



COLD CLIMATE HOUSING RESEARCH CENTER

ERDC

Project Principal Investigator: Jeremy Kasper, PhD
Deputy Director of Research

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Technology Needs

- Biomass
- Diesel Generator
- Energy Storage
- Heat Pump
- Hydroelectric Power
- Integration
- Organic Rankine Cycle
- Solar Photovoltaic
- Electrical Transmission
- Wind Power


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Alaska Energy Technology Reports
Overview Document

- Summary
- Technology trends
- Gaps and Barriers to Successful Project Development & Operation
- Recommendations

Available at Alaska Affordable Energy Strategy
http://www.akenergyauthority.org/

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Energy District Synergies

- **Micro-reactor & conventional**
- **Electrical & thermal networks**
- **Load management**
- **Thermal energy storage**

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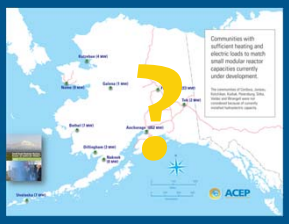
Micro-reactors in Alaska?



- Stakeholder pull?
- Permitting?
- Capacity?
- Logistics?
- Communications?
- Workforce?
- Fiscal resources?
- Contingency response?
- Application sequencing?

Safety – Environment – Affordability – Integration - Benefit

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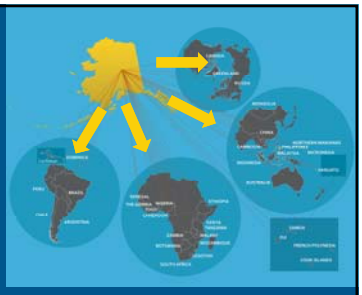
Why in Alaska?



- Diverse requirements
- Appropriate scale applications
- Existing sites for lower demonstration $$$
- Broad skills for adapting / tailoring systems
- Price of energy → earlier break-even
- Street credibility … "as proven in Alaska"
- Local → regional → global replication potential

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North to the future!

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