Small Scale Nuclear Power
an option for Alaska?

Gwen Holdmann,
Alaska Center for Energy and Power, University of Alaska Fairbanks

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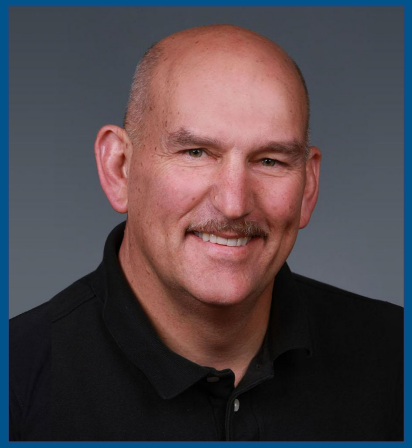
National Lab Technical Experts

Ashley Finan, Director, National Reactor Innovation Center, Idaho National Laboratory



Bruce McDowell, Senior Advisor, Energy and Environment Directorate, Pacific Northwest National Laboratory

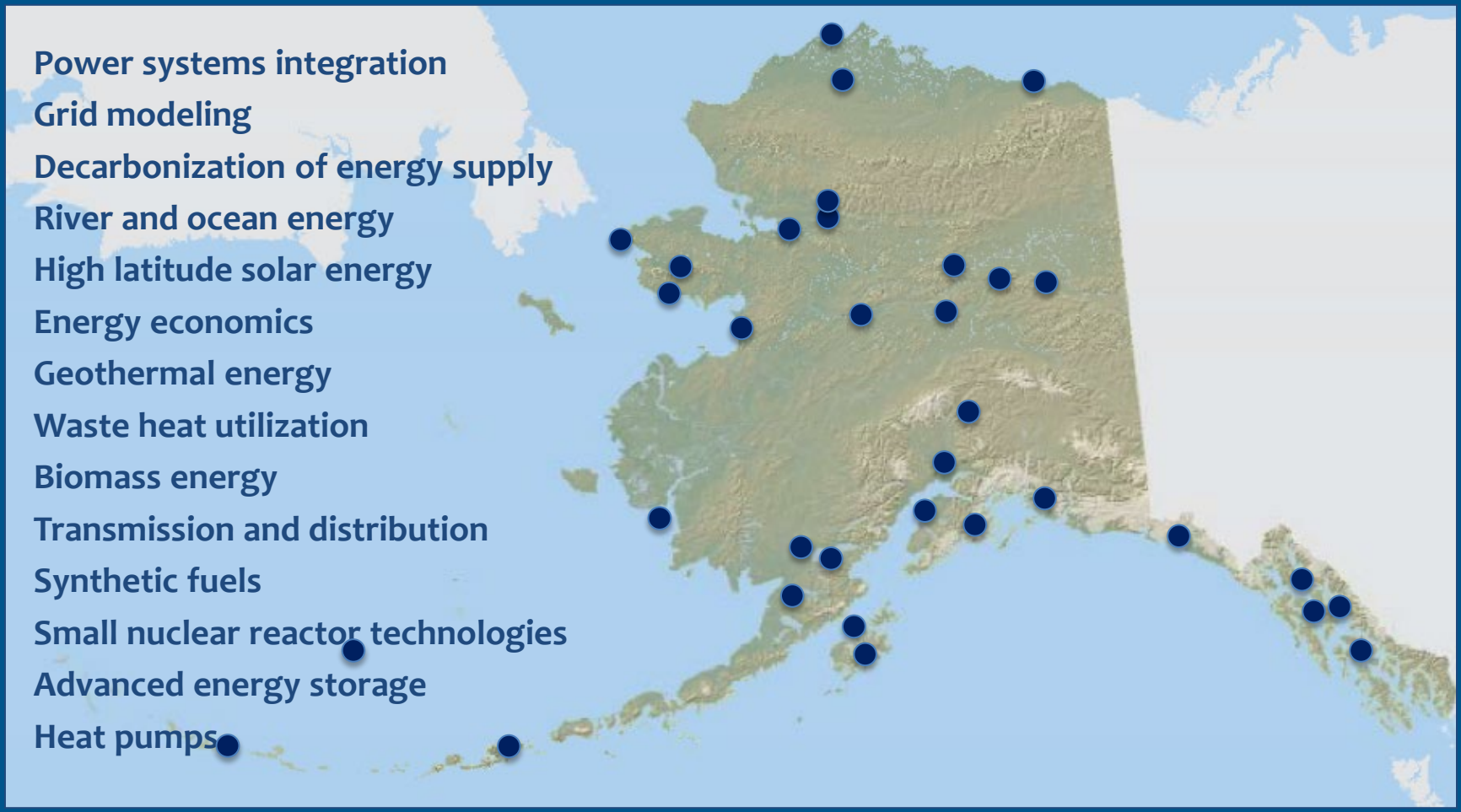
Mark Nutt, Deputy National Technical Director of the Integrated Waste Management program for DOE/NE, Pacific Northwest National Laboratory

Alaska Center for Energy & Power (ACEP)

Fostering development of practical, innovative and cost effective energy solutions for Alaska and beyond

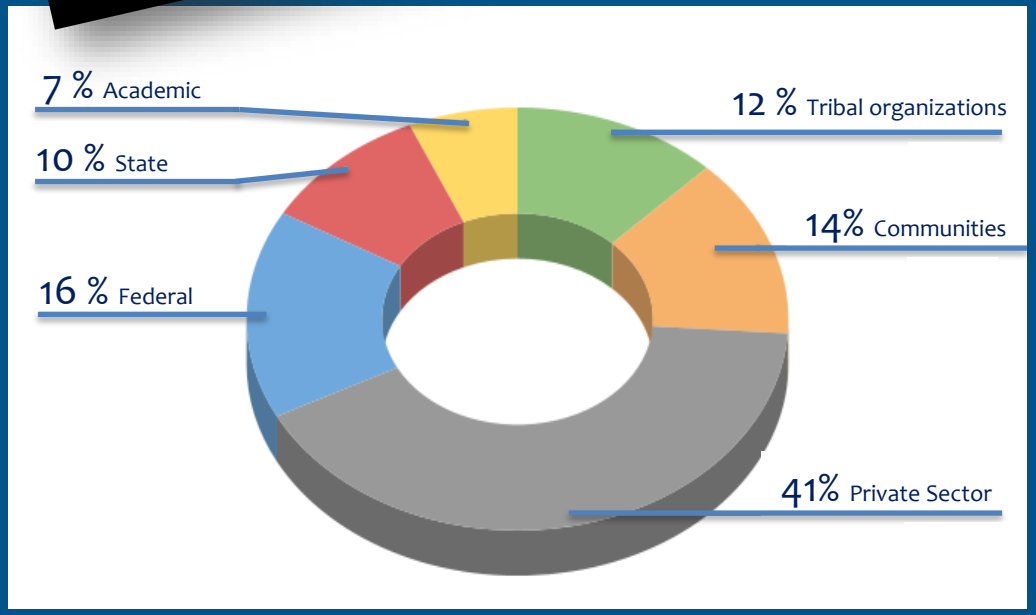
- Applied energy research
- Technology testing & optimization
- Energy systems modeling & analysis
- Commercializing energy innovation

ACEP Research is Statewide



ACEP Partnerships and Funding

ACEP generates $10 in external funding for every $1 invested by the State of Alaska through the UA budget



ACEP funding sources by project

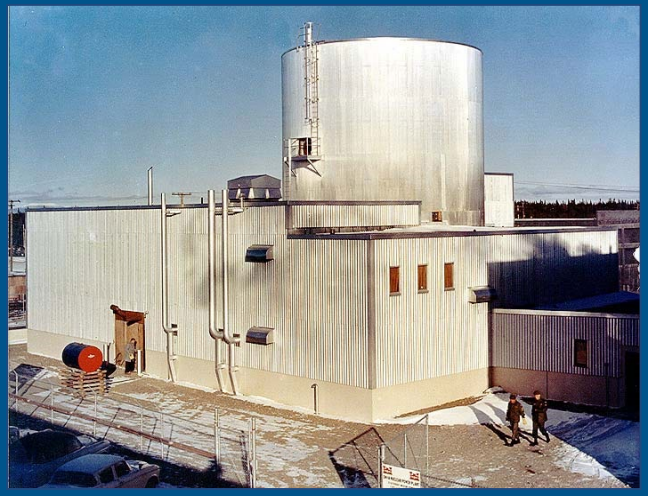
- Private Sector
- Utility Industry
- State & Federal Agencies (DOD, DOE)
- International Partnerships
- Native Organizations
- National Laboratories
- Communities

ACEP Small Nuclear Reports – 2011 & 2021

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

Available for download at: http://acep.uaf.edu

- Review history of nuclear energy in Alaska, including proposed projects
- Technology status (national, internationally)
- Consider technical, economic, and siting feasibility of proposed SMR technology in AK



Fort Greely SM1 primary reactor facility. Commissioned in 1962, decommissioned in 1972. 20.2 MW_{th}, generated 1.6 MW_e

ACEP Alaska Center for Energy and Power

2021: Updated Report to Legislature

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

Recommendations:

- Continue to track technology and policy/regulatory trends
- Create a state working group on Small Nuclear Energy as a forum to bring together stakeholders
- Create a roadmap for Alaska nuclear applications including specific use cases and a more robust economic analysis, especially for microreactors
- Review/revise AK state statutes related to nuclear energy

A few facts about nuclear energy …

- Nuclear energy supplies 20% of the U.S. electric power needs, more than all renewable resources combined (including hydro)
- The U.S. produces more nuclear energy than any other country in the world
- In the 60-year history of the nuclear power industry in 36 countries, there have only been 3 significant accidents at nuclear power plants.
- With the exception of Chernobyl, no nuclear workers or members of the public have ever died as a result of radiation exposure due to a commercial nuclear reactor accident (including Fukushima Daiichi)

What are Microreactors?

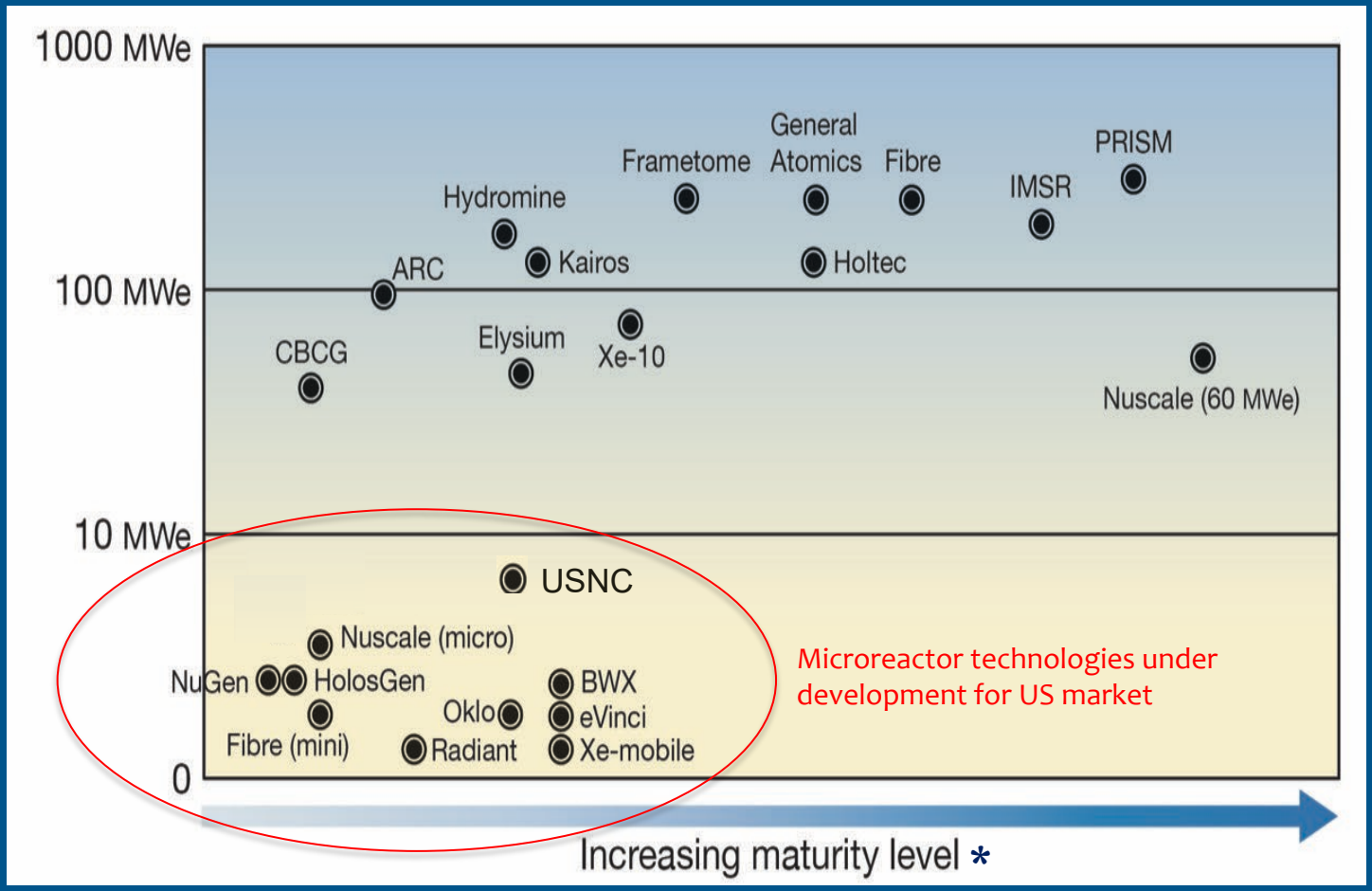
Microreactors are an emerging class of small advanced reactors with the following general attributes:

- Output of 1 to 10's of MWe **
- Capable of load following and non-electric applications (e.g., process heat)
- Factory fabricated and transportable nearly fully assembled. Requires a small operational footprint.
- Employs passively safe operating and fuel designs
- Semi-autonomous control system/minimum on-site staff
- Long intervals without refueling (e.g., 10 years)

*** we are aligning State definition with 42 U.S.C. 16271 (capable of generating no more than 50 MWe)*

Small Nuclear Reactors

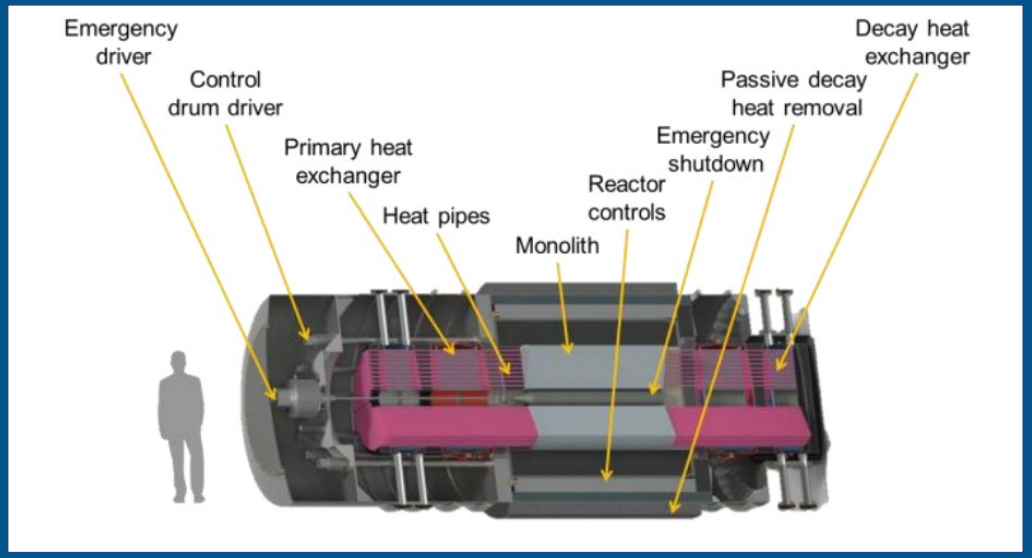
(under development in U.S., <300 MWe)



** Approximate maturity level is subjective based on 2021 publicly available information*

Example MNRs under development

Example microreactor:
Ultra Safe Nuclear Co.
(USNC) (~10MWe)

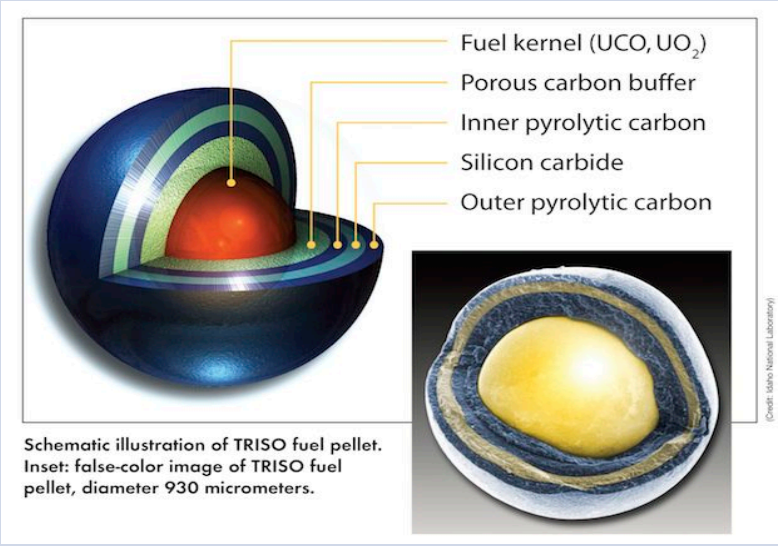


Example microreactor:
Westinghouse eVinci reactor
design (~5 MWe)

What Does Passive Safety Mean?

Fuel/fuel configuration

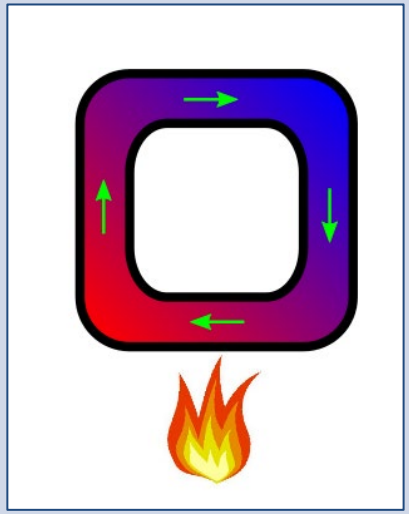
New fuel configurations such as TRISO particles **cannot melt in a reactor** and can withstand extreme temperatures and stresses that are well beyond the threshold of current nuclear fuels.



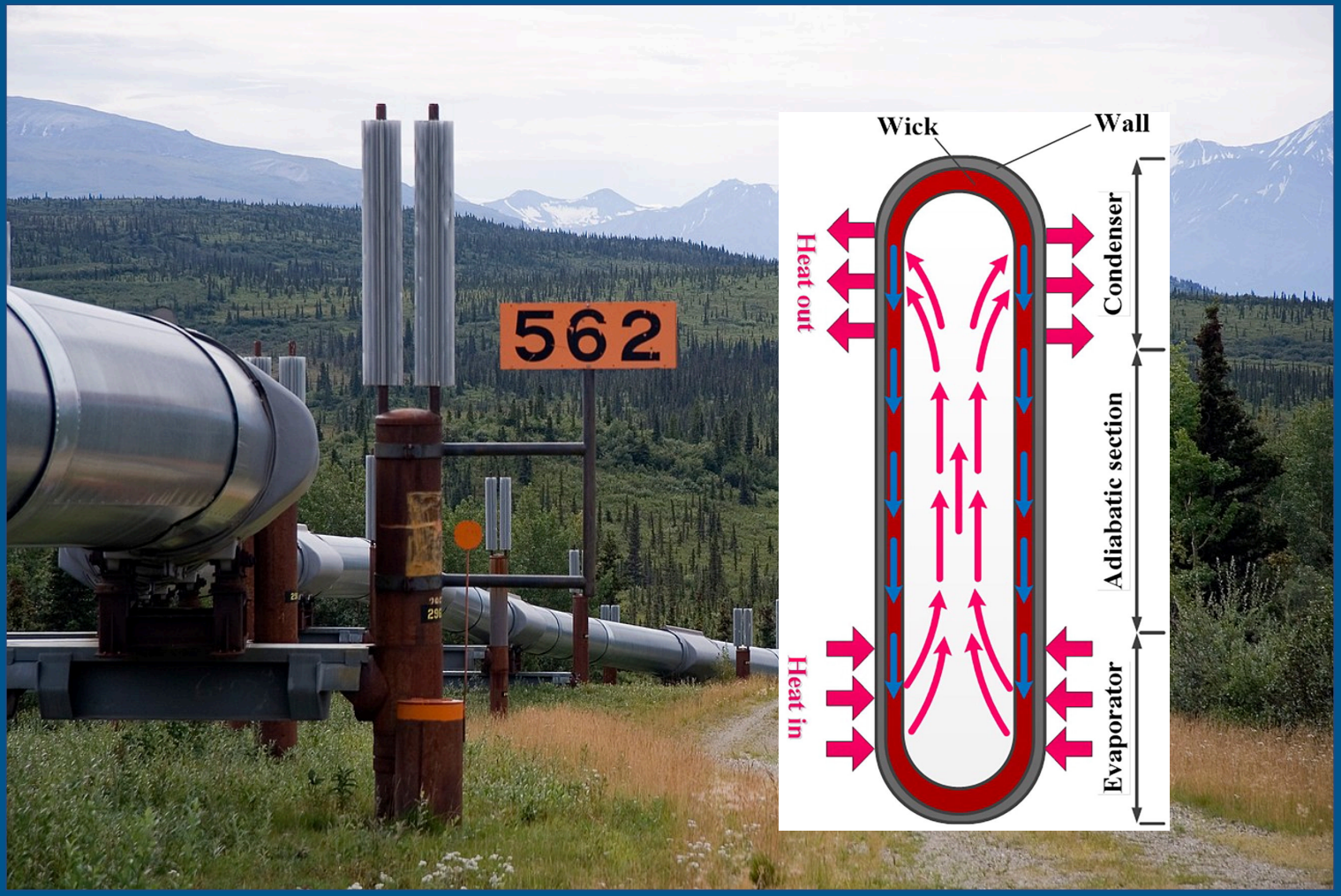
Schematic illustration of TRISO fuel pellet. Inset: false-color image of TRISO fuel pellet, diameter 930 micrometers.

Passive Cooling

Advanced reactors do not require active systems to cool the fuel in an emergency. Instead they rely on passive safety features which require no active controls or operational intervention to avoid accidents in the event of malfunction, and instead rely on gravity, natural convection, or resistance to high temperatures (or a combination thereof)



Question: *What does TAPS have in common with micro reactor technologies?*



State Statutes Relates to Nuclear Energy

- **Sec. 18.45.020** Requires an applicant to follow the NRC regulations;
- **Sec. 18.45.025** Requires DEC to provide permission to a nuclear developer, the state assembly to designate by law any land that would be used, and DEC to promulgate regulations for this section. If a municipality has jurisdiction over the proposed site, its approval is also required.
- **Sec. 18.45.027** Pertains to nuclear waste. If the fuel has been used for a period of time, this statute might restrict the reactor containing partially used fuel from being moved in state for further use.
- **Sec. 18.45.030** is an authorization of exhaustive/continuing studies of nuclear development related risks by DH&SS, DOL, DOT, DCCED, DF&G, DNR and other State agencies.
- **Sec. 18.45.040** relates to judicial enforcement of the law via governor-required processes.
- **Sec. 18.45.070** allows coordination with the federal government.
- **Sec. 18.45.090** is an exemption related to mining uranium
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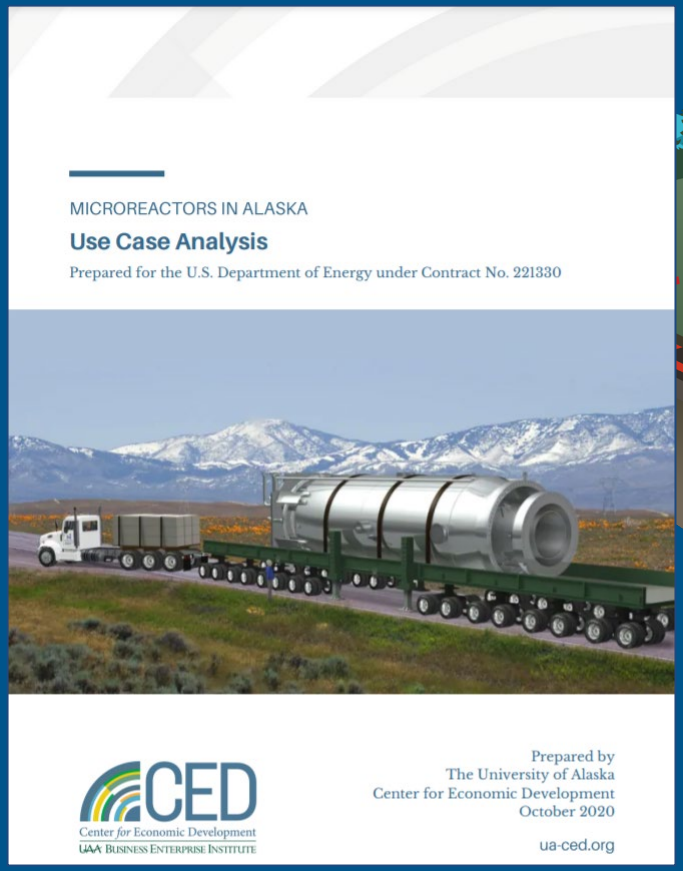
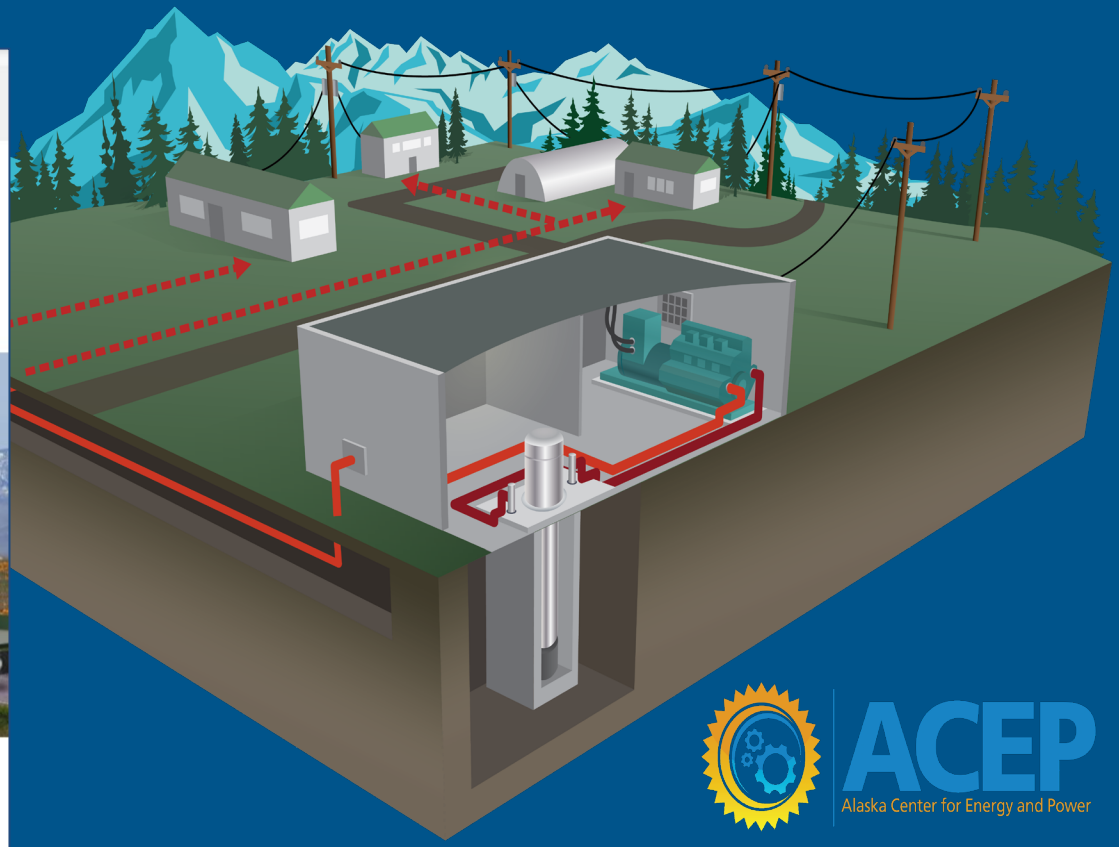
Question: Do microreactors have a role in Alaska's future energy mix?





ACEP
Alaska Center for Energy and Power

Rural Hub Community

Railbelt Application

Military base (e.g., Eielson AFB)

Mining Operation (E.g., Red Dog Mine)

National Reactor Innovation Center
(Idaho National Laboratory)

Eielson AF Microreactor Pilot

EIELSON AIR FORCE BASE

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Eielson AFB Announced as Site for Air Force Micro-Reactor Pilot

By SAF/IEE Installation Energy / Published October 15, 2021

PHOTO DETAILS / DOWNLOAD HI-RES 1 of 1

An F-35A Lightning II assigned to the 355th Fighter Squadron (FS) takes off from Eielson Air Force Base, Alaska, July 1, 2021. Also known as the 'Fighting Falcons,' the 355th FS is one of Eielson's two combat-coded F-35A squadrons. (U.S. Air Force photo by Airman 1st Class Jose Miguel T. Tamondong)

- 2019 National Defense Authorization Act (NDAA) required the DoD to seek to develop a pilot program for the development of at least one micro-reactor by December 2027.
- Managed through the Office of the Deputy Assistant Secretary of the Air Force for Environment Safety and Infrastructure (SAF/IEE, Mark Correll)

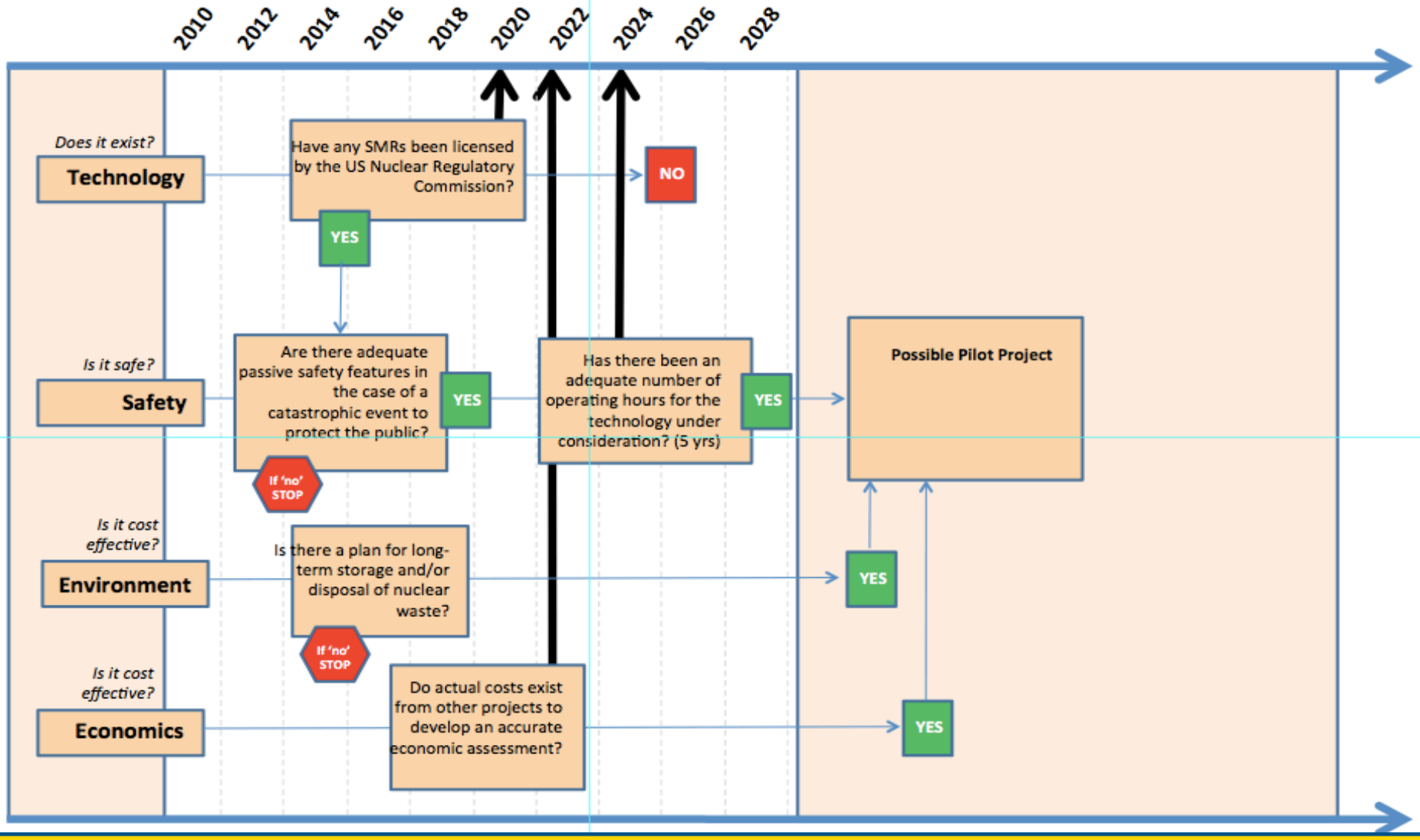
Eielson AF Microreactor Pilot

- 1-5 MWe
- Will not be grid connected; onsite heat and power only
- Will be licensed by the NRC; subject to state regs
- Privately owned/operated through PPA with USAF

Proposed Timeline:

- February/March 2022 RFP released
- Vender selected late 2022
- 2022-23 Permitting and licensing
- 2025 begin construction
- 2027 Commercial operation

Alaska Roadmap



Why I am interested in small reactors:

- *Provide baseload energy – heat and power*
- *Can load follow*
- *Carbon free*
- *Safer?*
- *Competitive Pricing?*
- *Better long-term certainty of energy costs?*
- *Reduced risk of environmental contamination?*
- *Possible complement to existing AK resource mix*

Thank you!

Gwen Holdmann
Alaska Center for Energy and Power
University of Alaska Fairbanks
Gwen.Holdmann@alaska.edu