Alaska Microgrids & Options

Brian Rogers, Alaska Microgrid Group

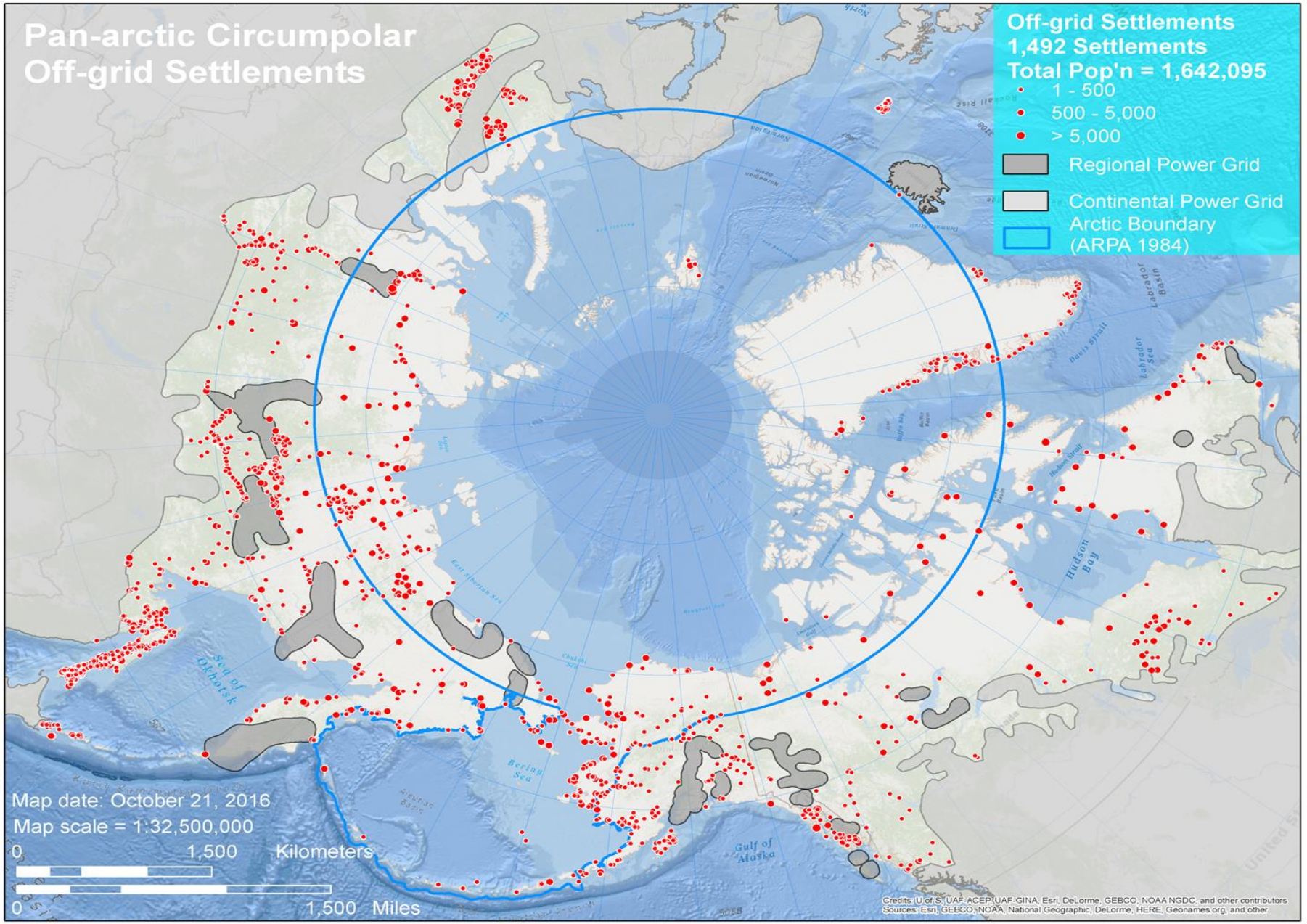
Jefferson County Library 1/27/2022

Alaska Realities

- **High energy costs**
- Fragmented electric grid
- Limited road network
- Harsh & changing climate
- End of supply lines
- Stranded resources
- Dispersed population

Electric power in rural Alaska costs .50-1.50/kWhr

Diesel for heating costs $3.50 to $10/gallon



International Centre for Northern Governance and Development

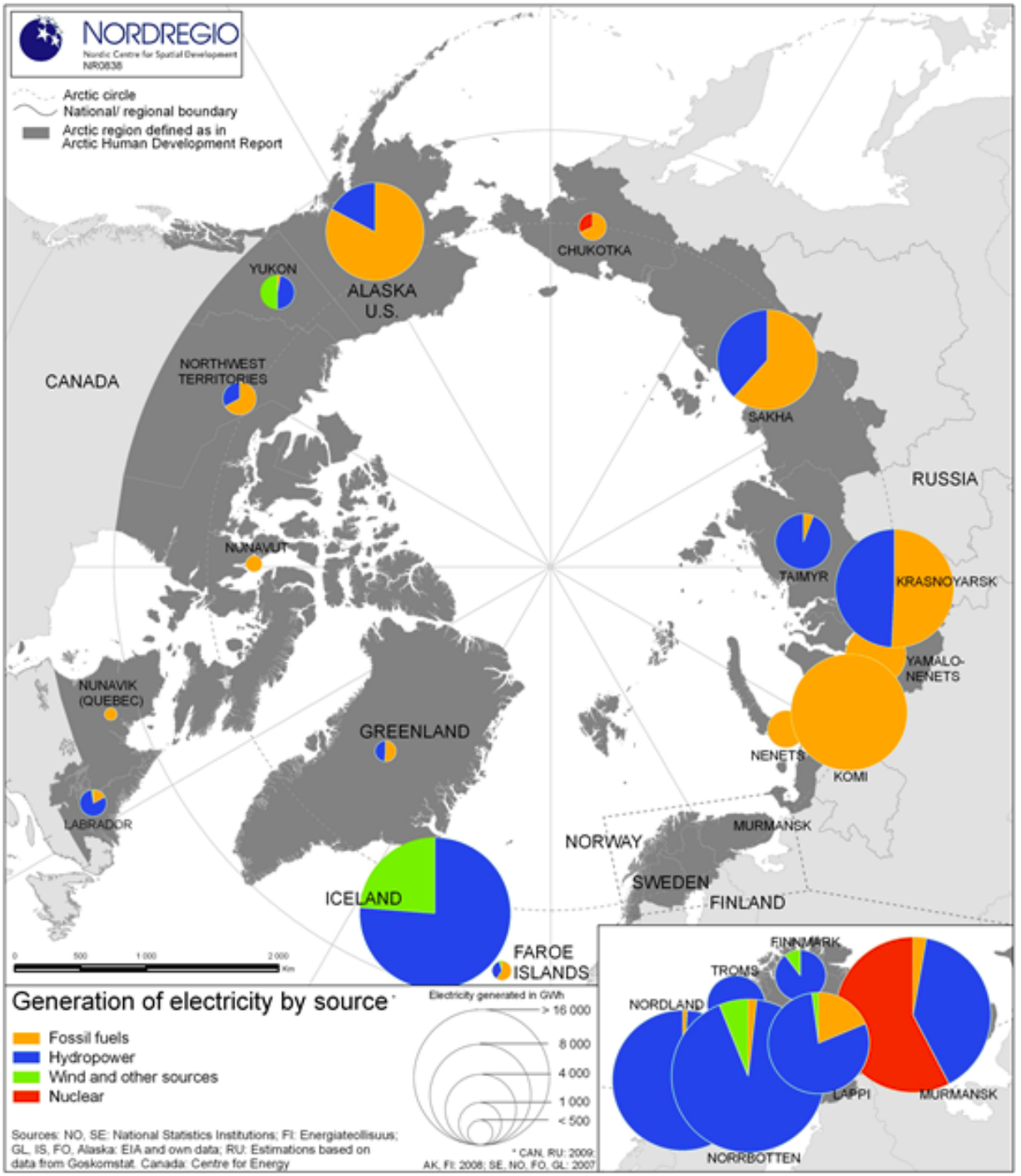
University of Saskatchewan

UAF University of Alaska Fairbanks

ACEP Alaska Center for Energy and Power

Geographic Information Network of Alaska
www.gina.alaska.edu

Arctic region is a global leader in Renewable Energy Technologies



From http://www.nordregio.se/en/Maps--Graphs/05-Environment-and-energy/Generation-of-electricity-in-the-Arctic/

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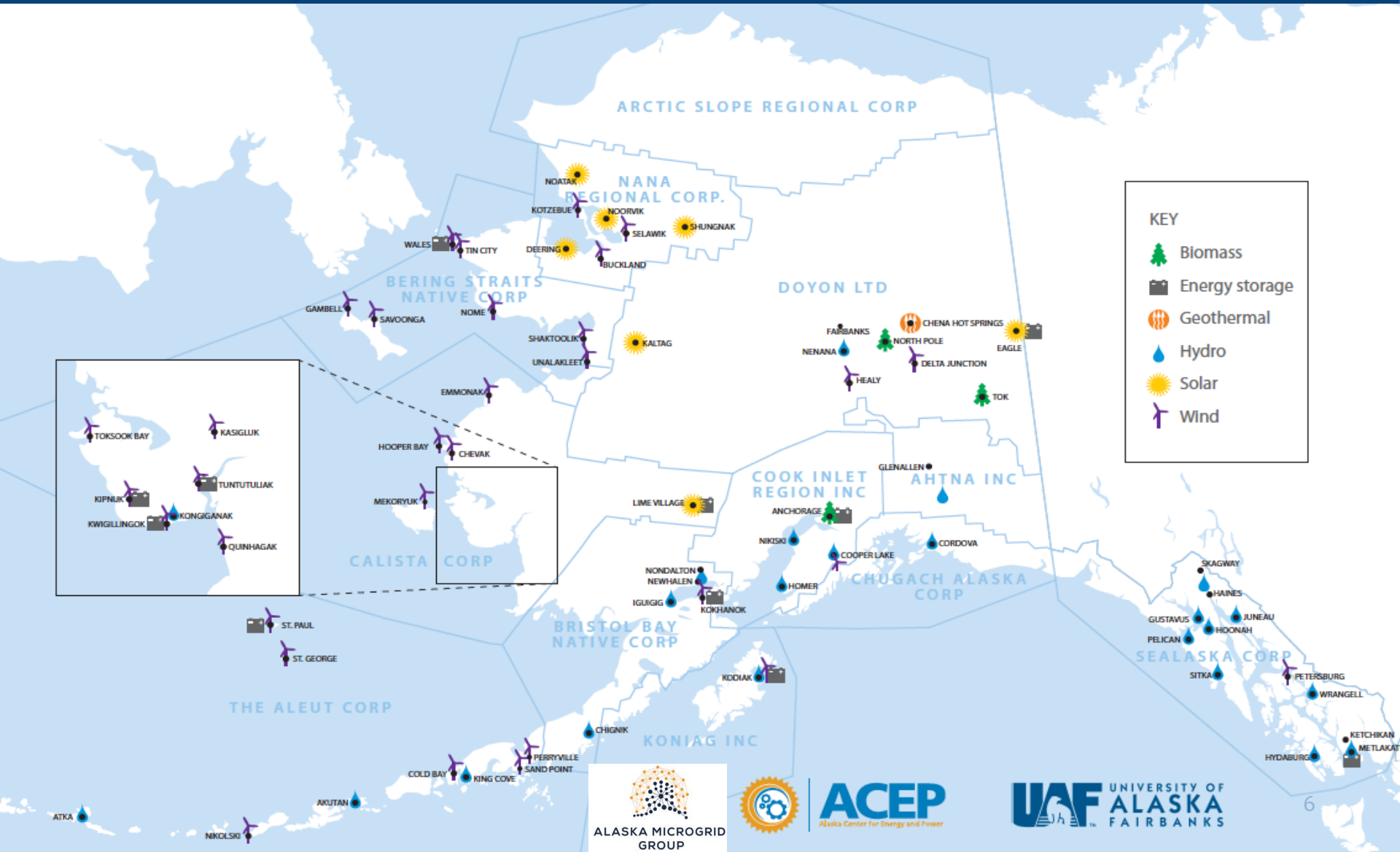
Alaska is the global leader in renewably-powered microgrids



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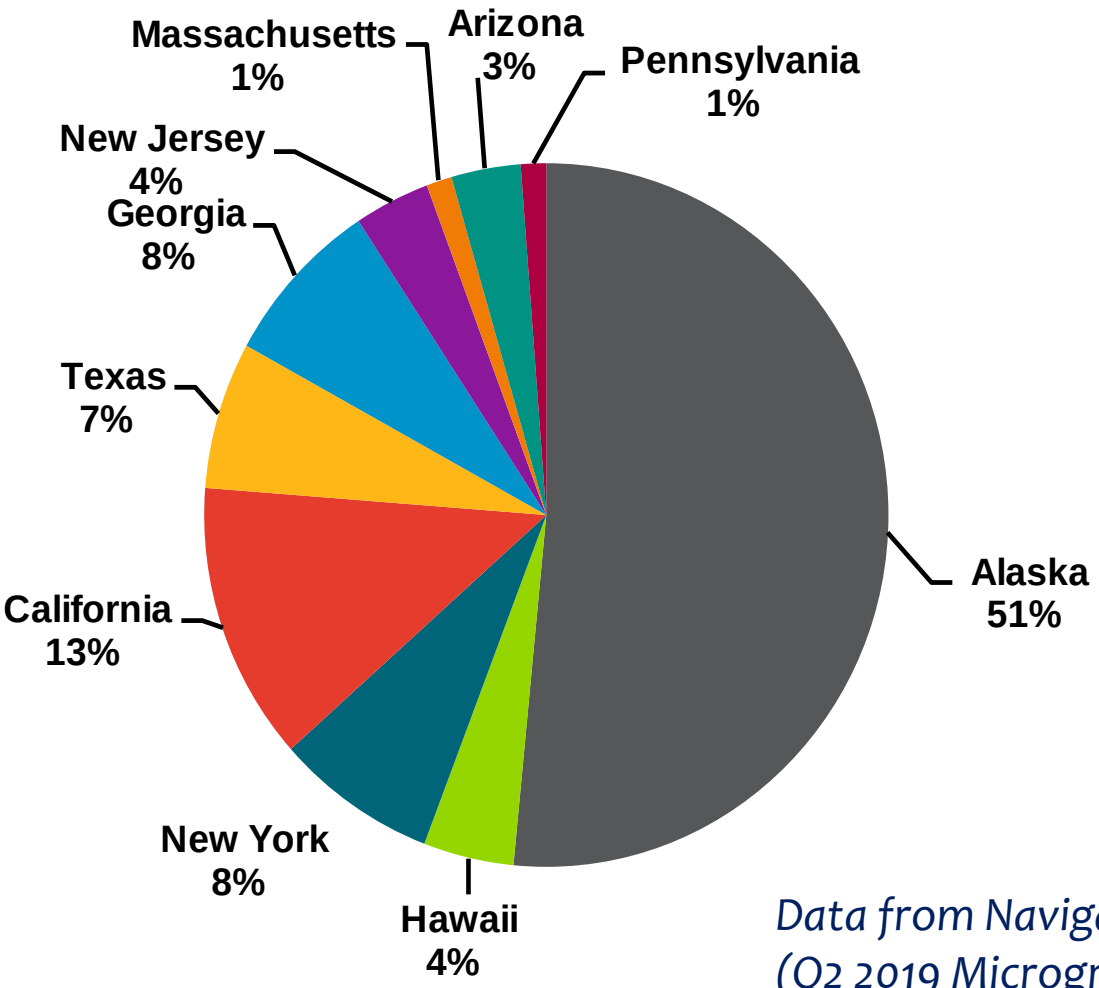
UAF UNIVERSITY OF ALASKA FAIRBANKS

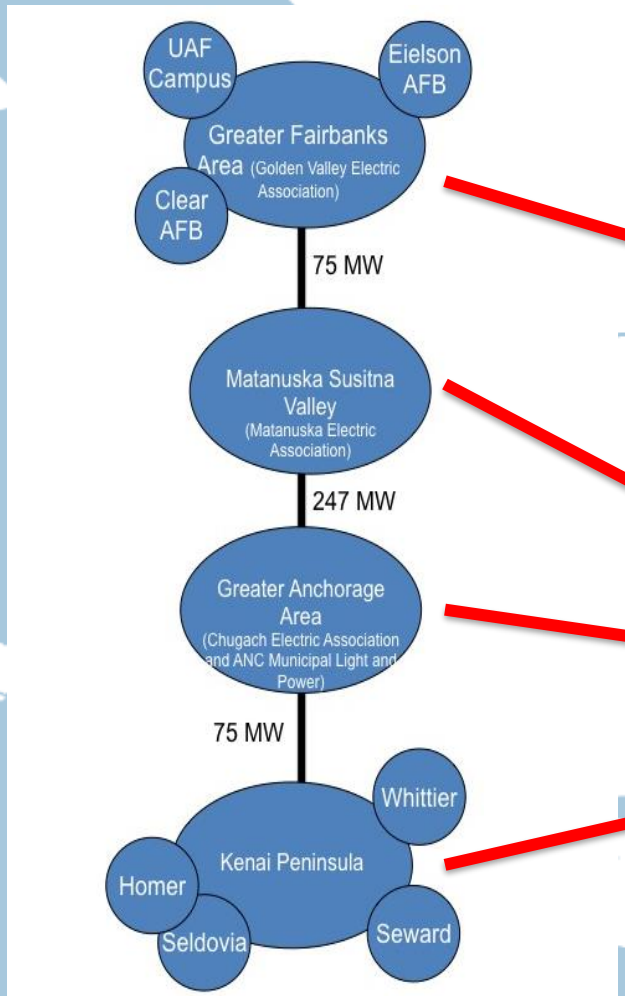
Top 10 States for Microgrid Capacity

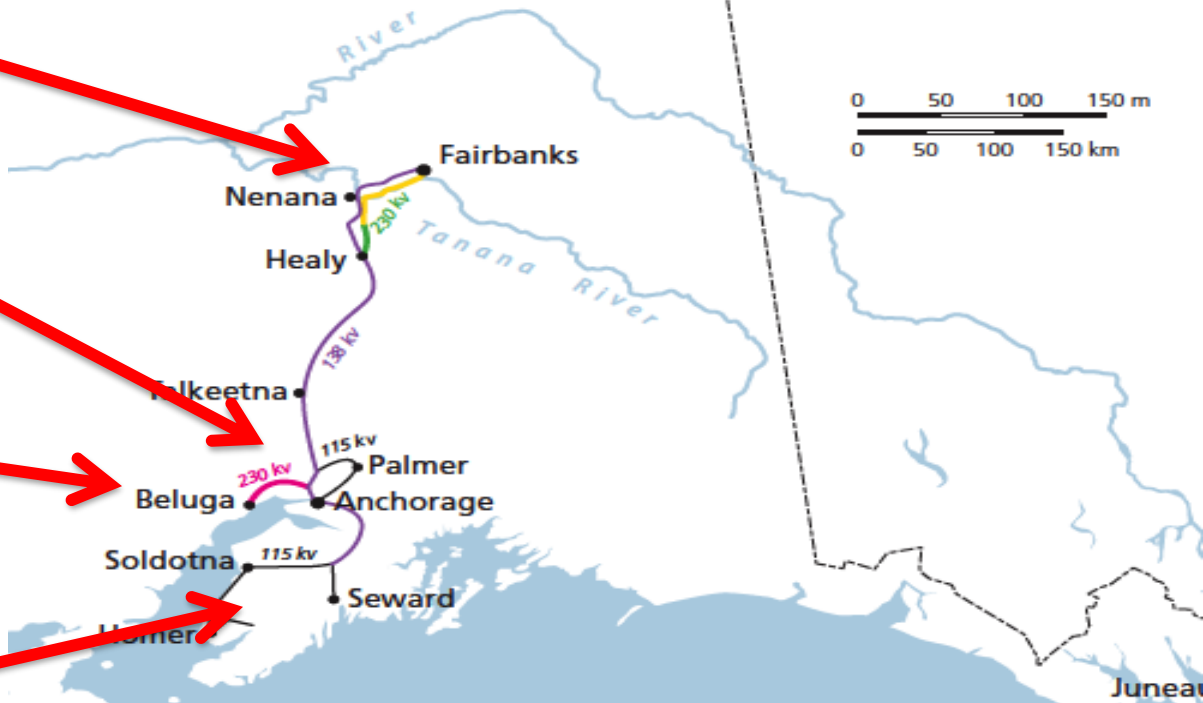


Data from Navigant Research (Q2 2019 Microgrid Tracker)

Alaska's "Railbelt" Grid

A series of nested and interconnected microgrids





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Railbelt energy sources

- Utilities
  - Anchorage & Kenai Peninsula – natural gas
  - Fairbanks – coal, diesel, some natural gas, wind, solar, hydro (from Southcentral AK)
- Home heating
  - Anchorage & Kenai Peninsula – natural gas
  - Fairbanks – diesel, wood

Southeast AK & Rural energy sources

- Utilities
  - Southeast – hydro
  - Rural – diesel, wind
- Home heating
  - Southeast – diesel, hydro
  - Rural - diesel

Fairbanks utility decarbonization

- 2020 ACEP-AMG Study goal: reduce 27% CO_2
- Replace one coal-fired power plant
- Replace diesel generation with natural gas
- Install new utility wind, solar, consumer energy generation
- Beneficial electrification & consumer energy efficiency
- Consider new wind/pumped hydro
- Monitor nuclear, CCS, battery, hydrogen

Community Microgrid

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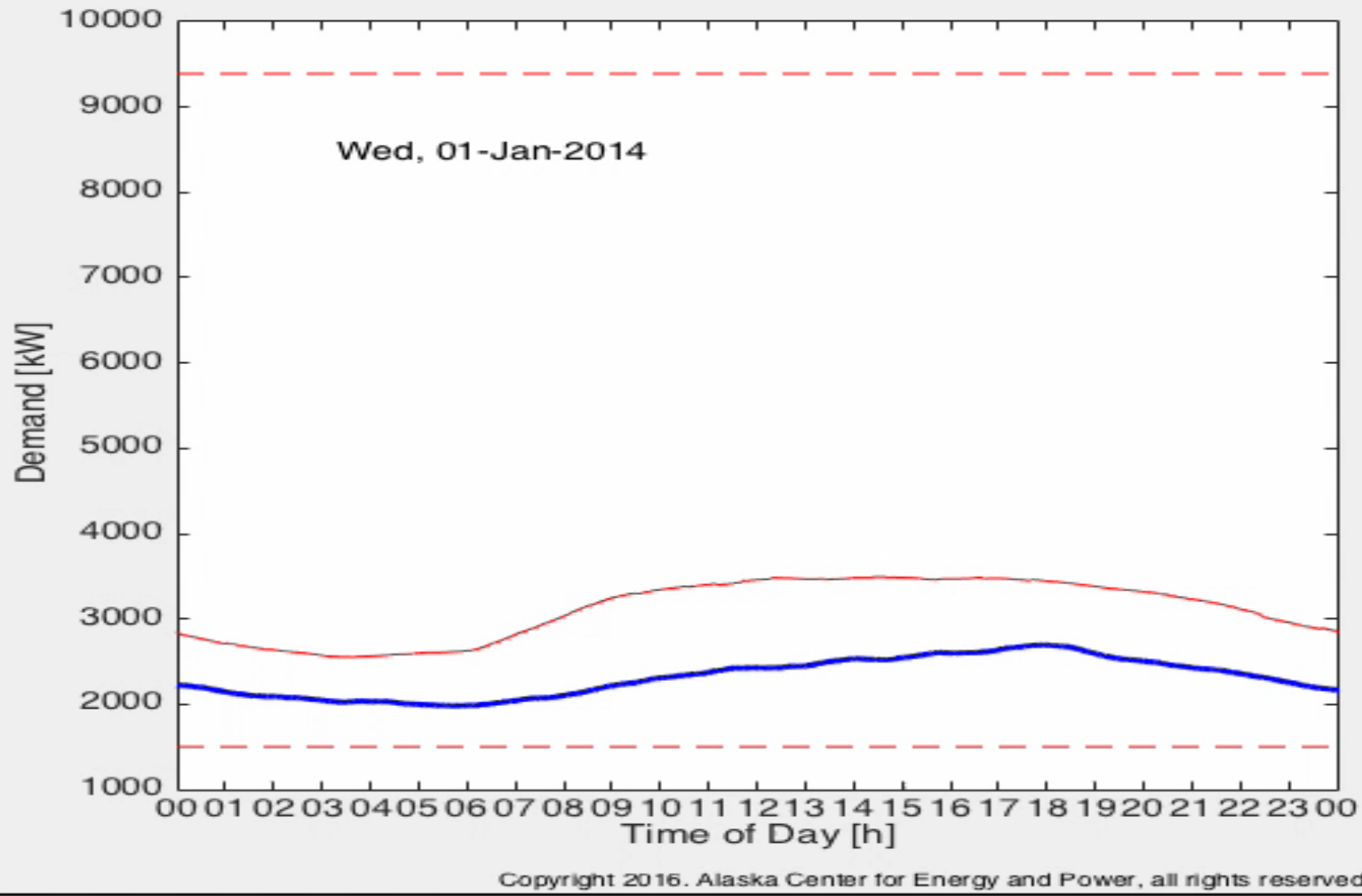
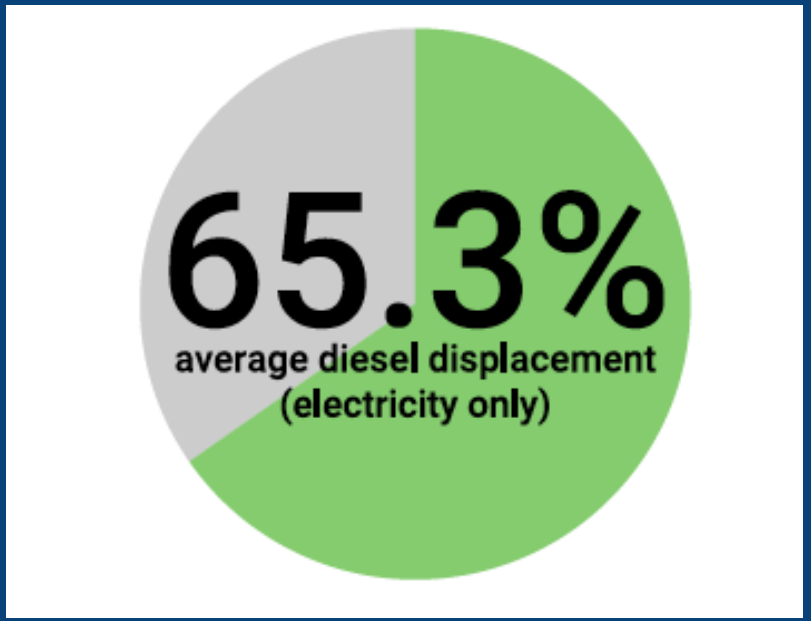
Design Challenges



Seasonal Demand Swing – Cordova, AK

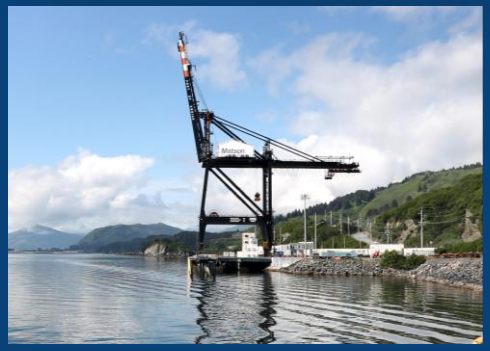
Kongiganak (population 439)



In January 2019, Kongiganak displaced over 65% of diesel for electric power generation with wind, including 7 consecutive days of diesel off operation

Kodiak Island: 100% renewable generation

Hydropower + Wind + Energy Storage (Battery and Flywheel)



Small Scale Nuclear Power
an option for Alaska?

Alaska Center for Energy and Power, University of Alaska Fairbanks

Updated Report to Legislature

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

1. Overview of nuclear energy at the national and international level
2. Technology update – especially related to MNRs
3. Policy at state and national level, relevant international examples
4. Economic analysis of a theoretical SMR deployment
5. Recommendations for action

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Small Nuclear Reactors

Advanced Reactor Technologies

Modular Nuclear Reactors

?

Microreactors

Light water/heavy water reactors

Transportable Reactors

Breeder Reactor

Small Nuclear Reactors

Small Reactors
(<300 MWe)

Safer! Most serious nuclear accidents have involved loss of cooling. Less nuclear material = passive safety

Modular Reactors

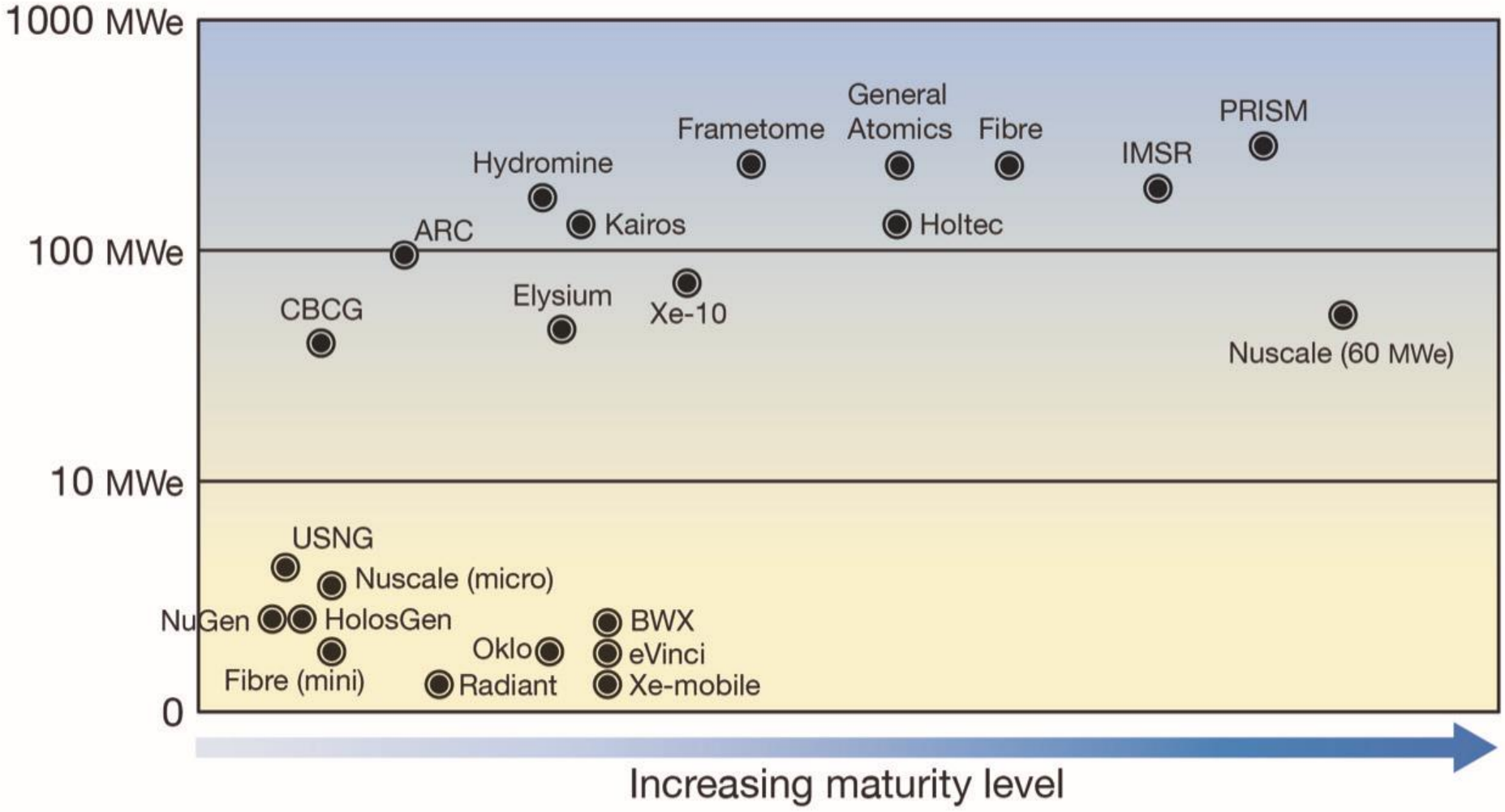
Economies of Scale. Multiple factory-built modules installed at a single site.

Advanced Reactor

Better efficiency, longer time between refueling. Usually not light water reactors, and novel fuel types/configurations. Also load-following capability.

Small Nuclear Reactors

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



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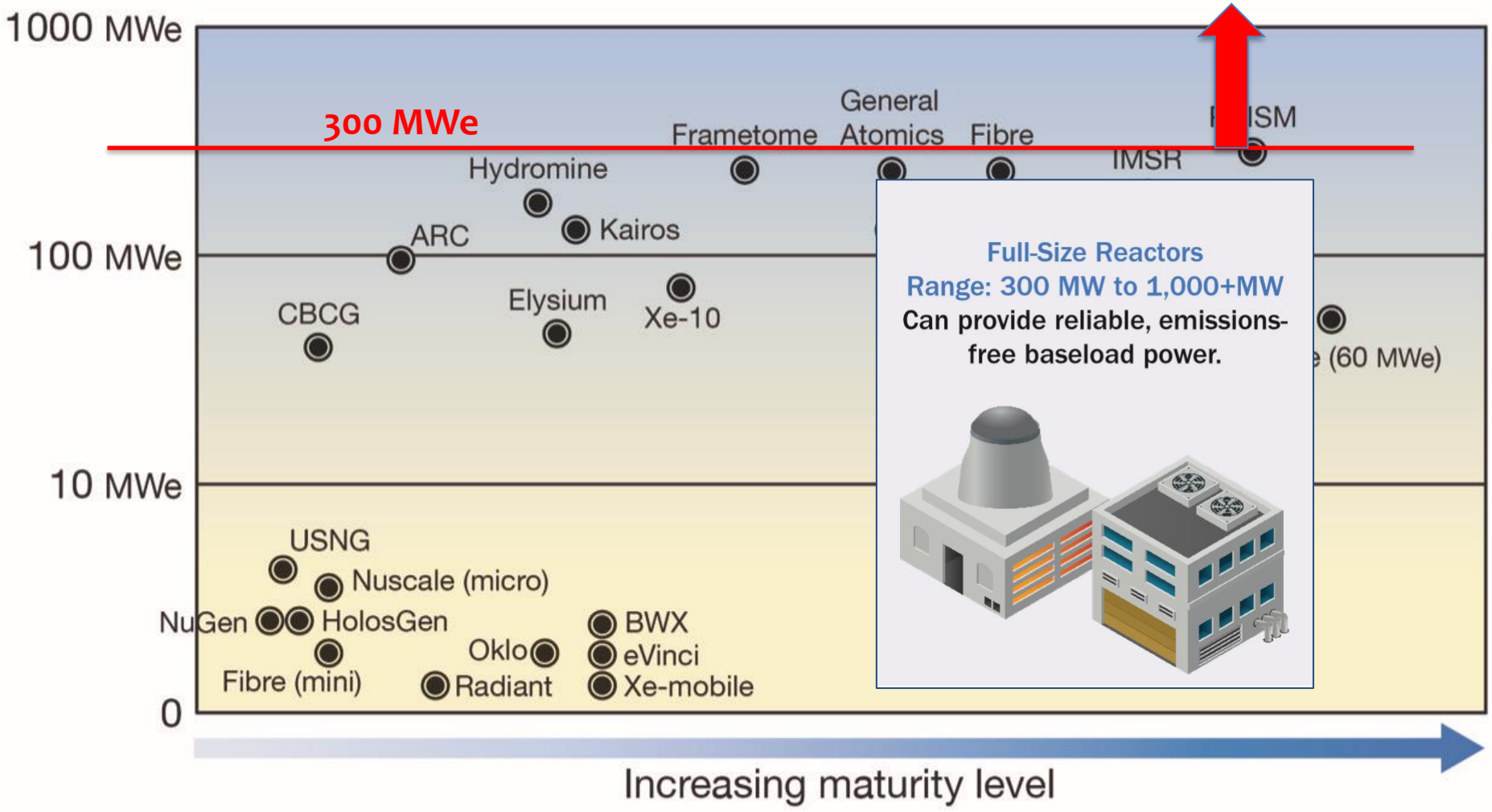
Small Nuclear Reactors

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



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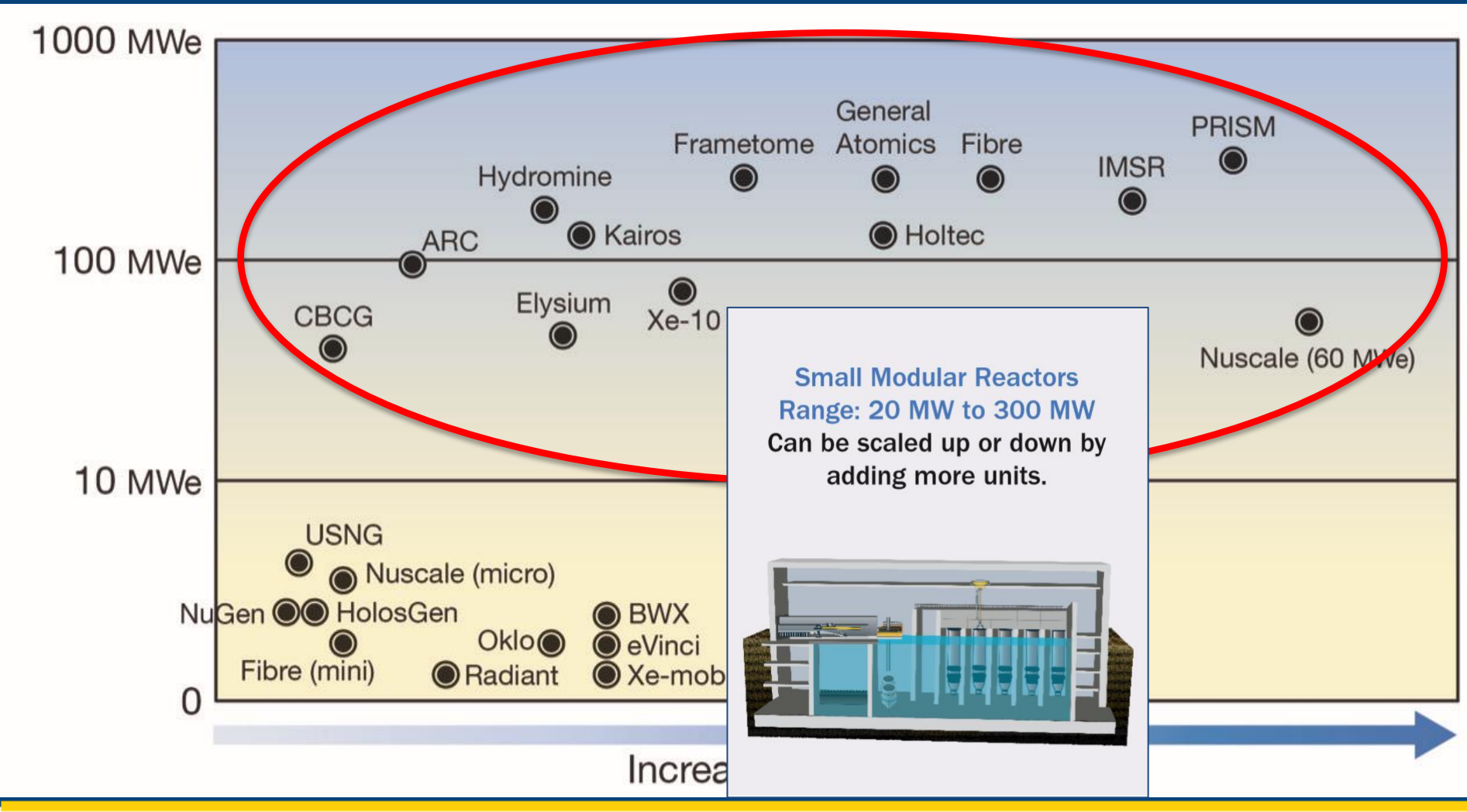
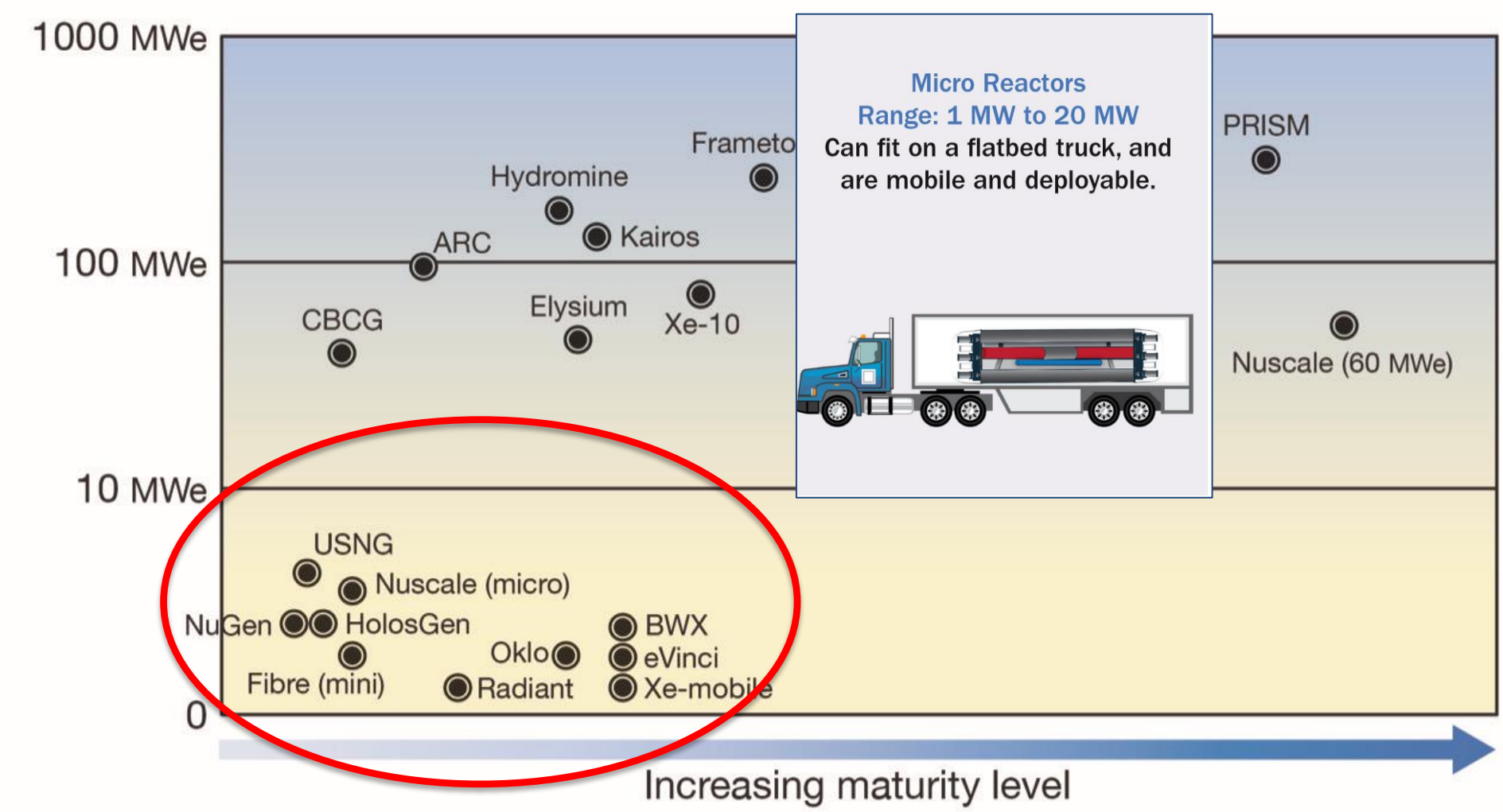
Small/Modular Nuclear Reactors

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



Micro- Nuclear Reactors

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



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Why the interest in small reactors:

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

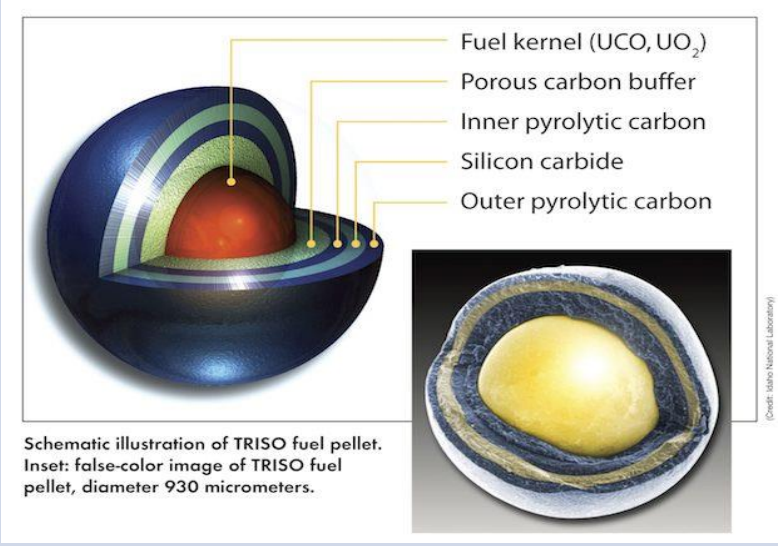
Project Pele

- DOD project (Strategic Capabilities Office)
- Purpose is to design and build a transportable nuclear power reactor for remote operating bases
- small nuclear micro-reactor 1-5 megawatt (MWe)
- DOD awarded three development contracts in March 2020:
  - BWX Technologies ($13.5 million)
  - Westinghouse Government Services ($11.95 million)
  - X-energy ($14.3 million)
- One design will be selected to be built as a prototype in 2022, possible Alaska base deployment

MNR/SMR Safety

Fuel/fuel configuration

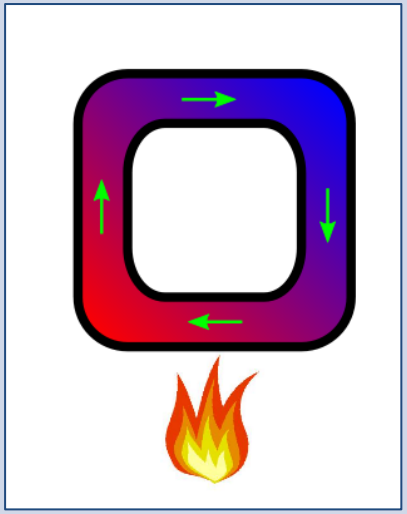
New fuel configurations such as TRISO particles **cannot melt in a reactor** and can withstand extreme temperatures and stresses that are well beyond the threshold of current nuclear fuels.



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

Cooling

Heat cannot melt down fuel or compromise fuel containment. 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)



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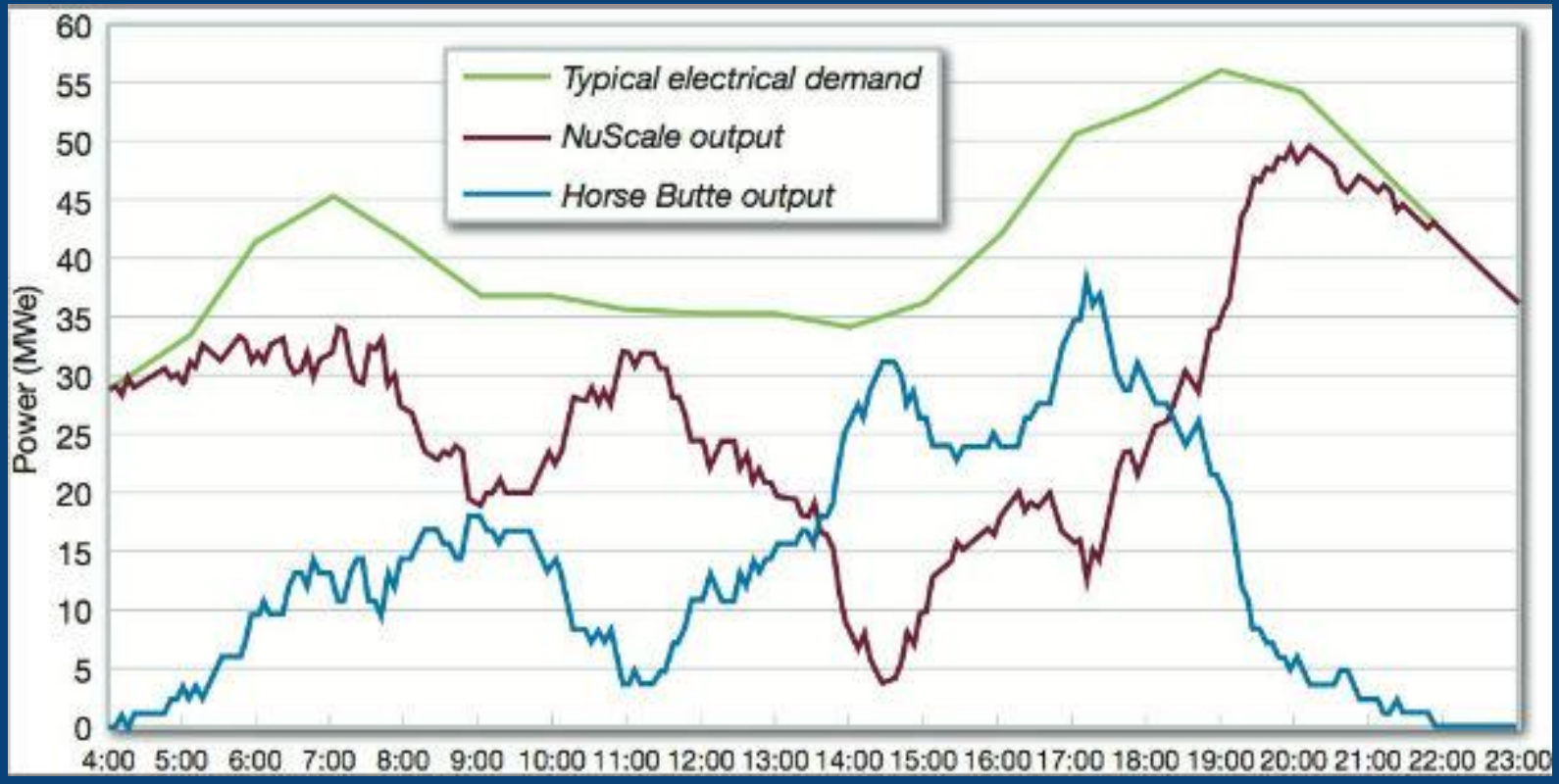
Question: *What do micro reactor technologies have in common diesel generators?*



Load Following Capability (and ability to "back" renewables)

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Report Findings

- Continue to track technology and policy/regulatory trends
- Convene stakeholder meetings to understand AK interests/concerns
- Participate in discussions at national level to ensure Alaska use cases and concerns are heard and addressed
- Create a roadmap or strategy for Alaska nuclear applications and continue to develop criteria/requirements
- Conduct a more robust economic analysis, especially for MNRs
- Review/revise AK state statutes related to nuclear energy

Thank you!

Brian Rogers
Alaska Microgrid Group
brian@akmicrogrid.org

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