



# Microreactor Regulatory Considerations

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BANR Commercial Program



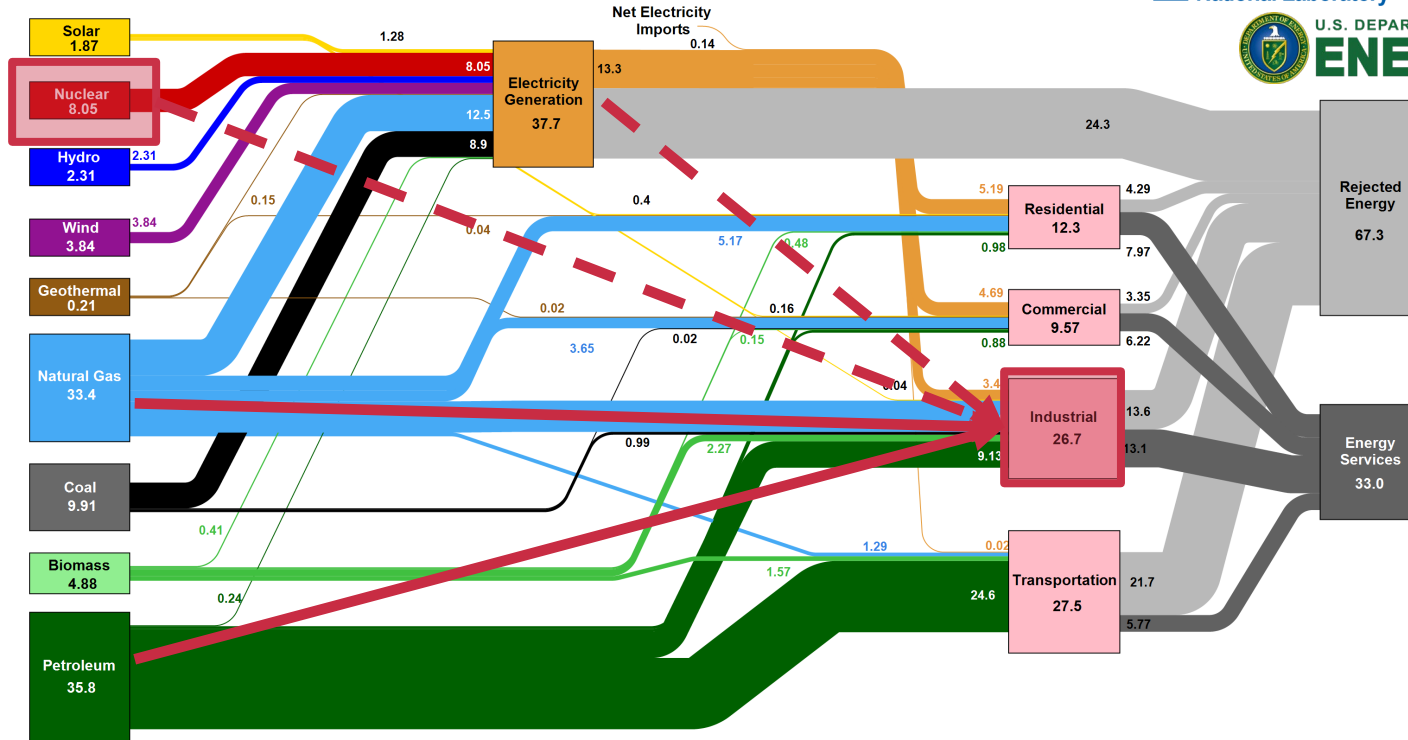
- Context
- BWXT's Advanced Nuclear Reactor (BANR) Development Overview
- Microreactor Deployment Model Development
- Project Hotshot Objectives

# Market: There's a Significant Demand for Clean Energy



Estimated U.S. Energy Consumption in 2022: 100.3 Quads

Lawrence Livermore  
National Laboratory



Source: LLNL July, 2023. Data is based on DOE/EIA SEDS (2021). If this information or a reproduction of it is used, credit must be given to the Lawrence Livermore National Laboratory and the Department of Energy, under whose auspices the work was performed. Distributed electricity represents only retail electricity sales and does not include self-generation. EIA reports consumption of renewable resources (i.e., hydro, wind, geothermal and solar) for electricity in BTU-equivalent values by assuming a typical fossil fuel plant heat rate. The efficiency of electricity production is calculated as the total retail electricity delivered divided by the primary energy input into electricity generation. End use efficiency is estimated as 0.65% for the residential sector, 0.65% for the commercial sector, 0.49% for the industrial sector, and 0.21% for the transportation sector. Totals may not equal sum of components due to independent Rounding. LLNL-MI-410527



## DOE Advanced Reactor Demonstration Program (ARDP)

- ✓ Technology development & reactor design
- ✓ Enhanced fuel form for longer core life and higher core power
- ✓ Advanced sensors for semi-autonomous controls
- ✓ Commercialization & supply chain development

*Geopolitics, economics, and new laws are driving increased and genuine interest in nuclear technologies for heat and power applications*



### WEA Project Phase 1 (under contract)

- Microreactor design
- Supply chain assessment
- Licensing roadmap/strategy

### WEA Project Phase 2 (future option)

- Design maturation
- Supply chain dev.
- Continued regulatory engagements

### WEA Project Phase 3 (notional)

- Demonstration

# BWXT Advanced Nuclear Reactor (BANR)



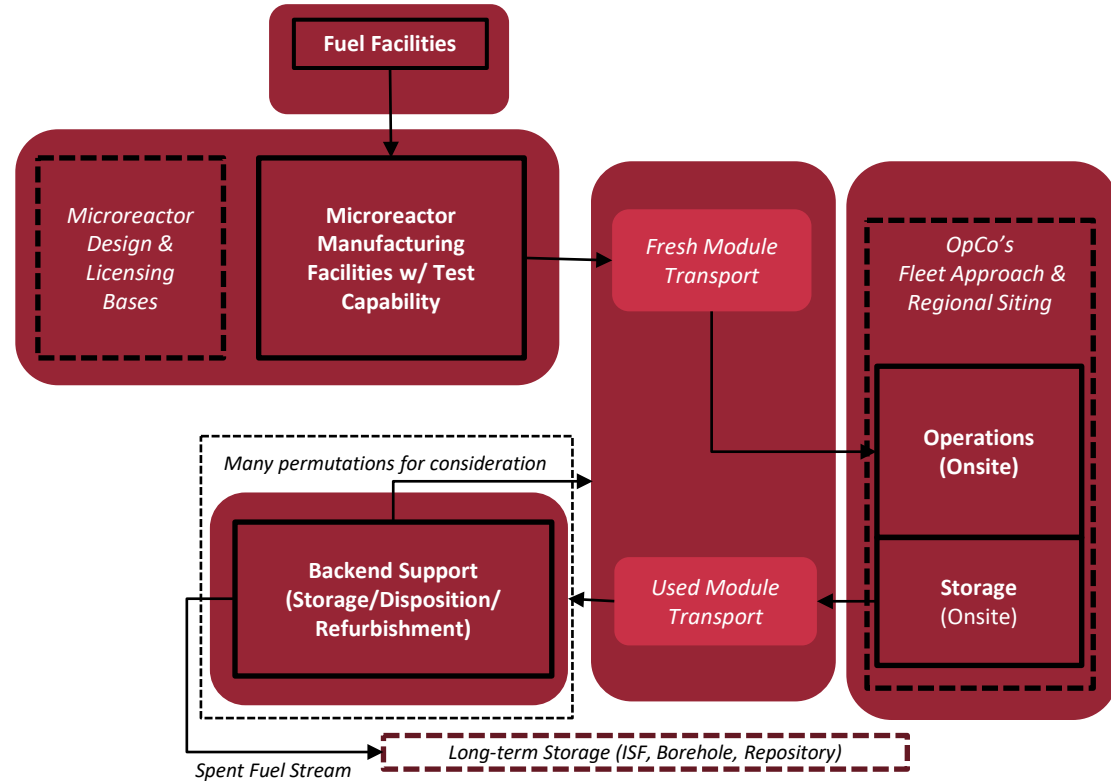
- ❖ Target 50 MWth per reactor, scalable to site needs
- ❖ Flexible power conversion: heat, electricity or co-generation
- ❖ High-temperature gas-cooled (HTGR) technology
- ❖ High density, BWXT-fabricated fuel enables 5+ year refueling cycles
- ❖ Passive inherent safety features
- ❖ Design for transportability considerations



# Deployment Models: Products, Projects, and Regulatory Frameworks



- ❖ Microreactor business/deployment models incorporate a full lifecycle of activities from manufacture through end-of-life considerations: regulator has multiple touchpoints.
- ❖ Each element represents a potential “mode” for the microreactor and intersection with the regulatory framework.
- ❖ Commercial success for any concept will depend on effective regulatory resolutions to each element and their transitions.

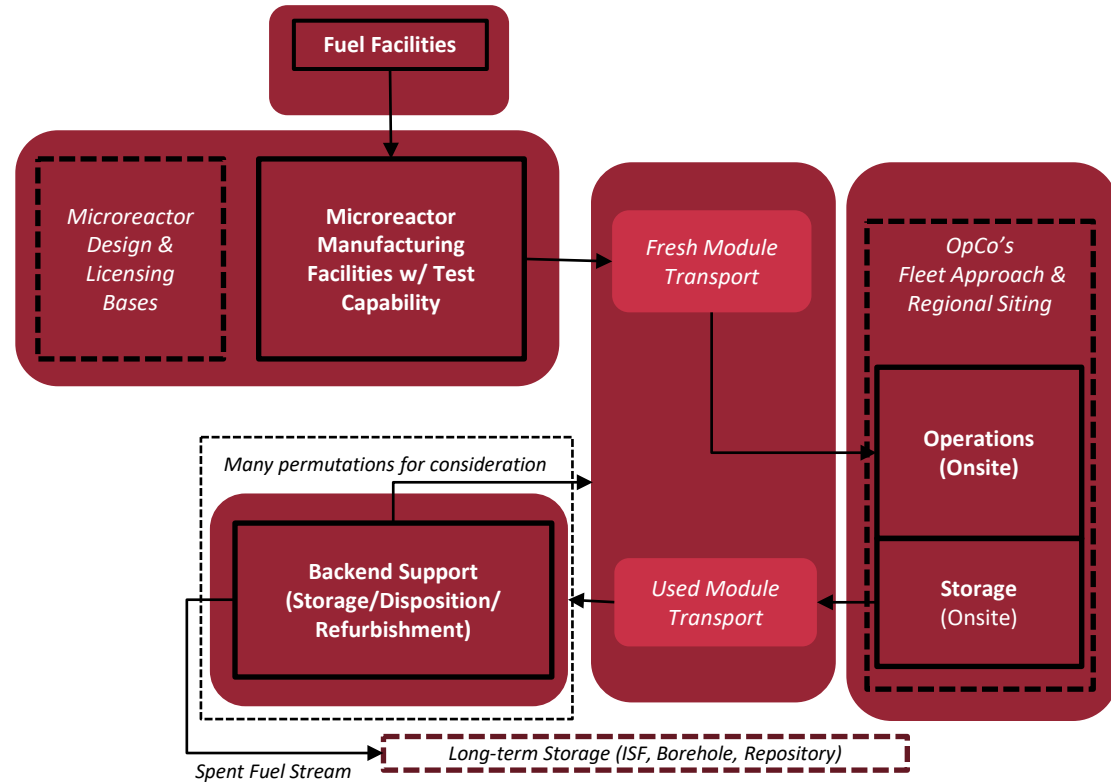


# Deployment Models: Regulatory Framework Elements



Resolution of microreactor-specific topics generically will allow demonstration of implementation through the many licensing actions of the deployment model. Example:

- ❖ BANR Design: Part 52 Manufacturing License
- ❖ BANR Manufacturing: Part 70 Material License
- ❖ BANR Test Facility/Capability: Part 50 Test Rx License
- ❖ BANR Fuel Fabrication: Part 70 Fuel Fab. Facility
- ❖ Transportation: Build on Part 71 framework
- ❖ Site Licensing: Many options in Parts 50 or 52.
  - ❖ Fleet-implementation of Operating programs
  - ❖ Bounding site parameter envelope to deploy efficiently
- ❖ Backend: Recognize there will be facilities to facilitate receipt, storage, disposition, and either disposal or refurbishment of used reactor modules with a path for spent fuel management





Participation in Project Hotshot offers a test case to address the resolution of identified microreactor regulatory topics with a prospective business case (NOVSP), technology (BANR), and deployment model to meet end-user identified project constraints.

- NEI's list of Microreactor Regulatory Topics (~33) all intersect with an element of the deployment model:
  - Technology development & Safety case demonstration,
  - Operating Company (Owner/Operator) Fleet-level management of many microreactors,
  - Need to accommodate efficient site characterization, environmental permitting, and site licensing to meet market constraints,
  - Microreactor-unique regulatory matters recognized by industry and the NRC.
- Resolutions will lead to project-specific engagements in the future for BWXT and prospective Operating Companies.
- Resolutions will provide clarity for reactor developers to implement in the technology development cycle to improve regulatory engagement effectiveness (improvements in topics, timing, and level of detail) beyond the current advanced reactor regulatory framework elements like ARCAP.