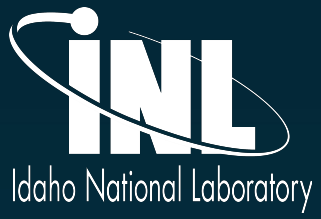


National Reactor Innovation Center

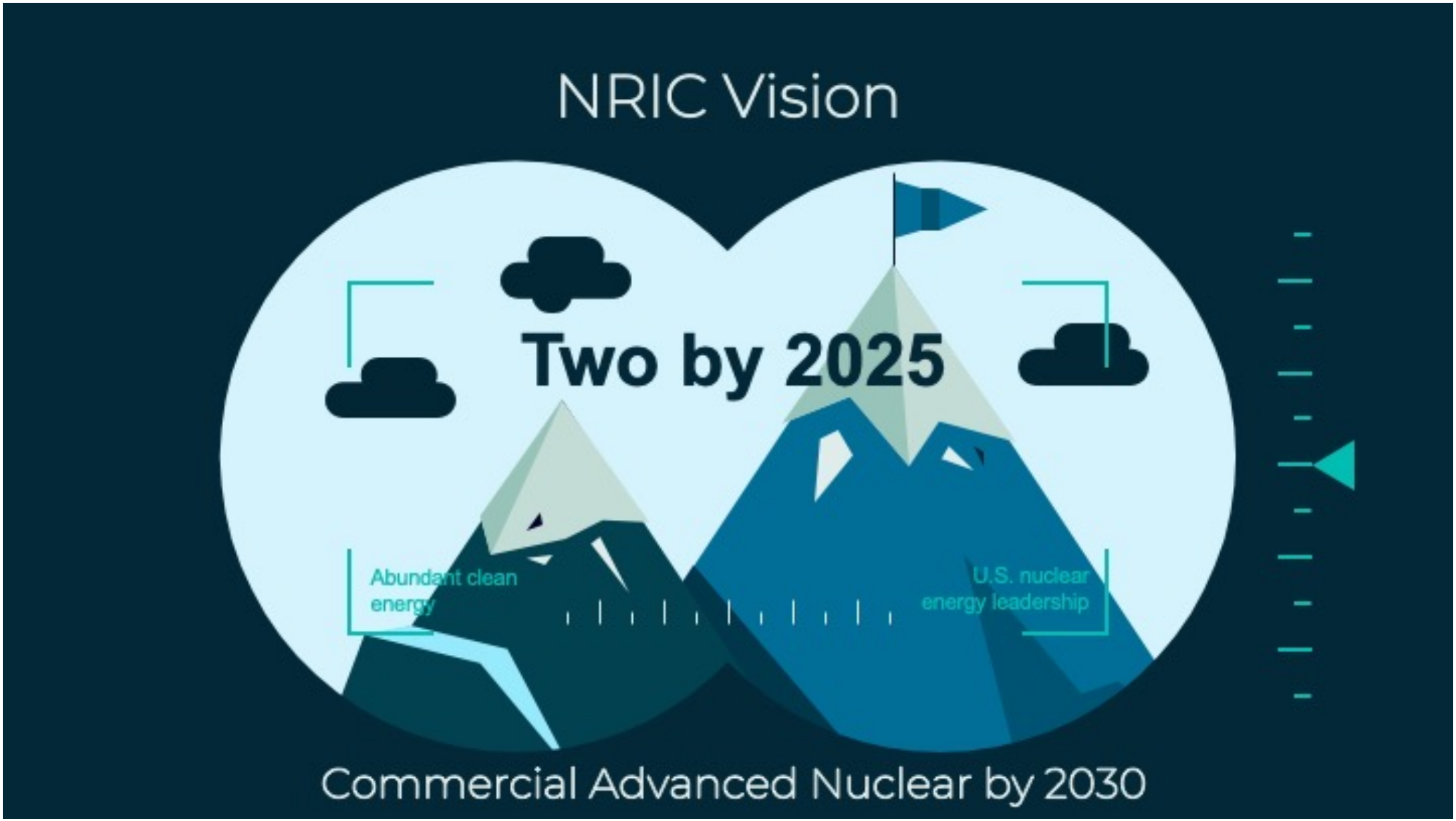
November 15, 2021

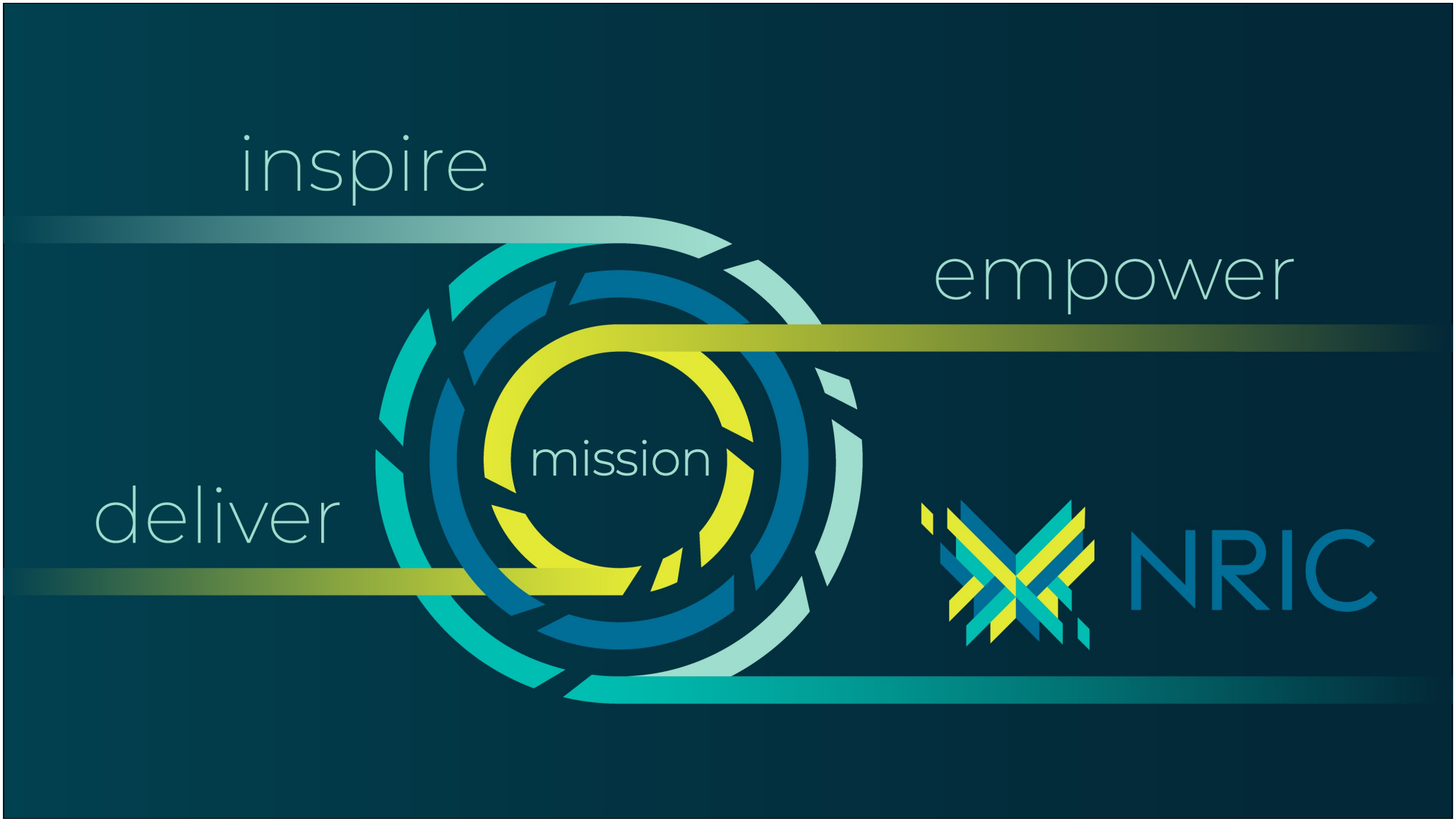
NASEM: "Laying the Foundation for New and Advanced Nuclear Reactors in the United States"

Ashley E. Finan, Ph.D., NRIC director

ashley.finan@inl.gov

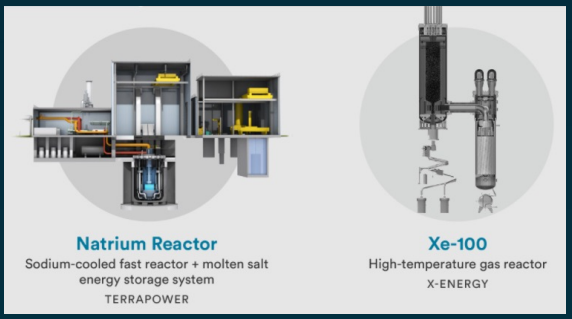
nric.inl.gov


NRIC Vision
Two by 2025
Abundant clean energy
U.S. nuclear energy leadership
Commercial Advanced Nuclear by 2030


inspire
empower
mission
deliver
NRIC

ARDP Projects

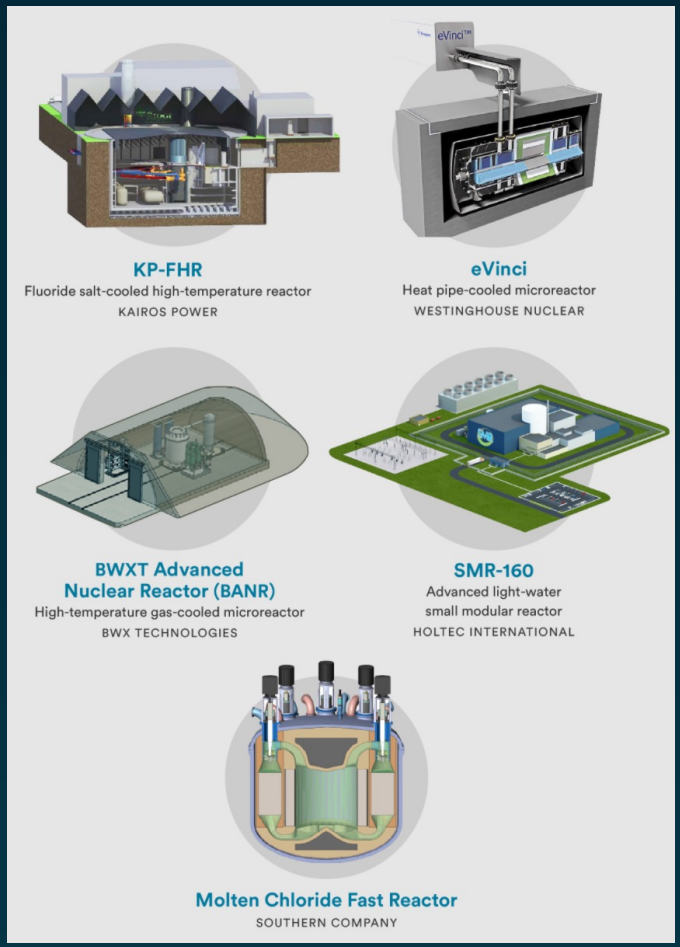
Demonstration



Natrium Reactor
Sodium-cooled fast reactor + molten salt energy storage system
TERRAPOWER

Xe-100
High-temperature gas reactor
X-ENERGY

Risk Reduction



KP-FHR
Fluoride salt-cooled high-temperature reactor
KAIROS POWER

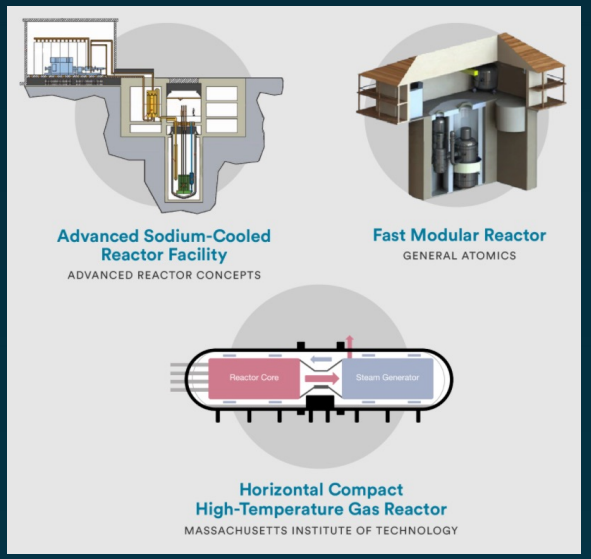
eVinci
Heat pipe-cooled microreactor
WESTINGHOUSE NUCLEAR

BWXT Advanced Nuclear Reactor (BANR)
High-temperature gas-cooled microreactor
BWX TECHNOLOGIES

SMR-160
Advanced light-water small modular reactor
HOLTEC INTERNATIONAL

Molten Chloride Fast Reactor
SOUTHERN COMPANY

Concept Development



Advanced Sodium-Cooled Reactor Facility
ADVANCED REACTOR CONCEPTS

Fast Modular Reactor
GENERAL ATOMICS

Horizontal Compact High-Temperature Gas Reactor
MASSACHUSETTS INSTITUTE OF TECHNOLOGY

Slide content courtesy of U.S. DOE-NE

Additional Projects with NRIC Support

- Oklo
- Micronuclear
- Radiant
- Westinghouse
- GERA
- MARVEL

OKLO

RADIANT

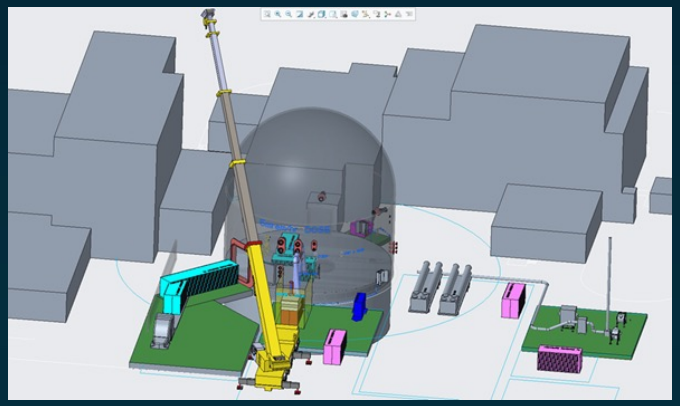
Westinghouse

NRIC INL

Priority: Two by end of 2025

04	01	16
Years	Months	Days

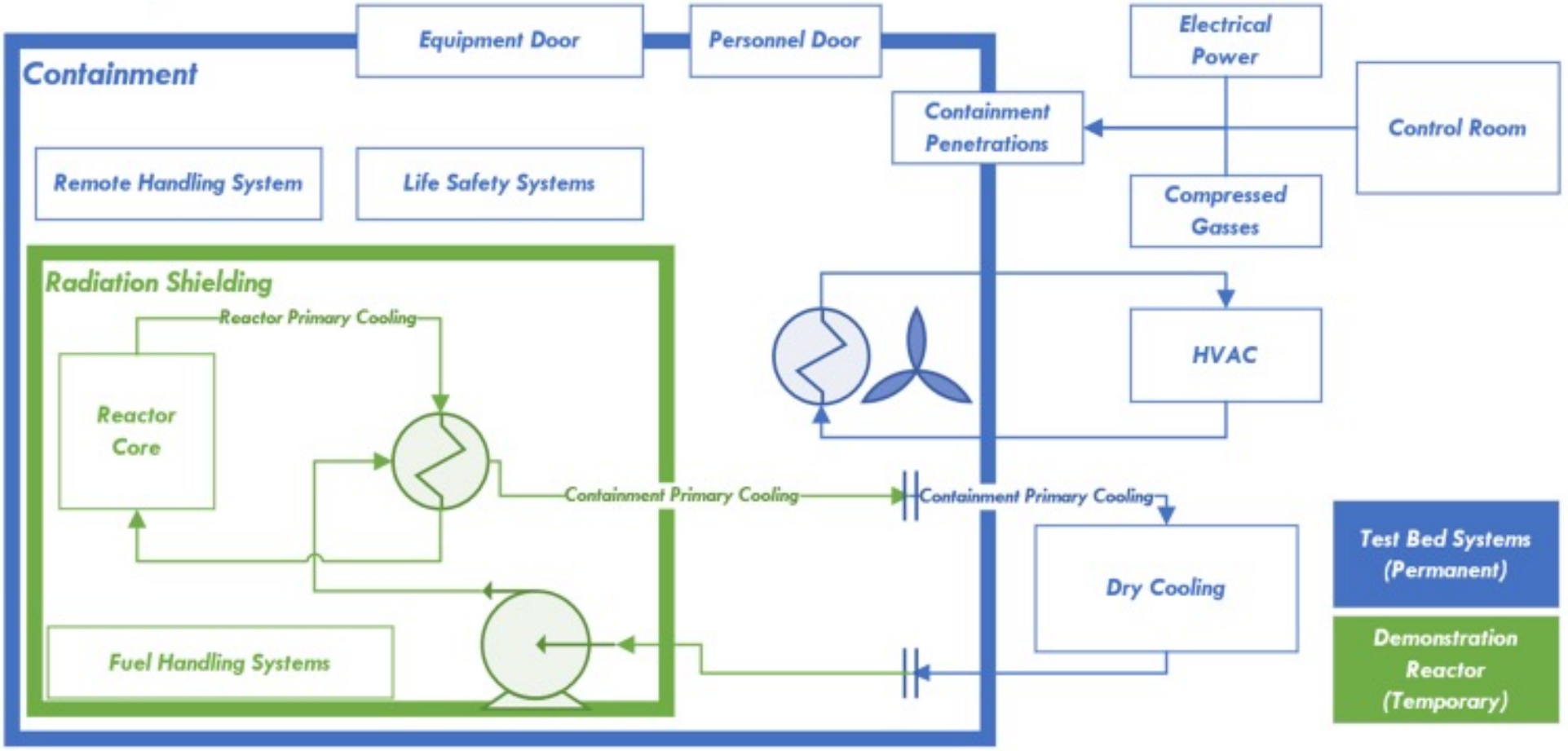
NRIC INL



Demonstration Test Beds In Development

- Enable continuing innovation by refurbishing and leveraging existing infrastructure for multiple demonstration projects
- Pre-conceptual design completed in FY20
- Initial trade studies, updated costs completed in FY21
- Conceptual design planned for completion in early FY22

NRIC Demonstration Reactor Test Bed Concept



NRIC-DOME Test Bed

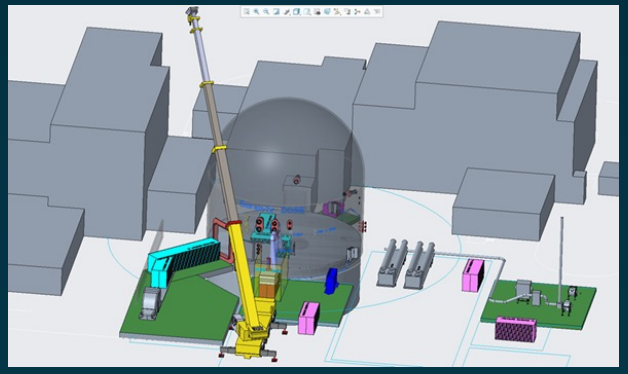
(Demonstration of Microreactor Experiments)

Strategy:

- Repurpose EBR II which operated from 1964 – 1994
- Establish a demonstration platform that is flexible enough to test 4-5 known small modular reactors such as high temperature gas reactors

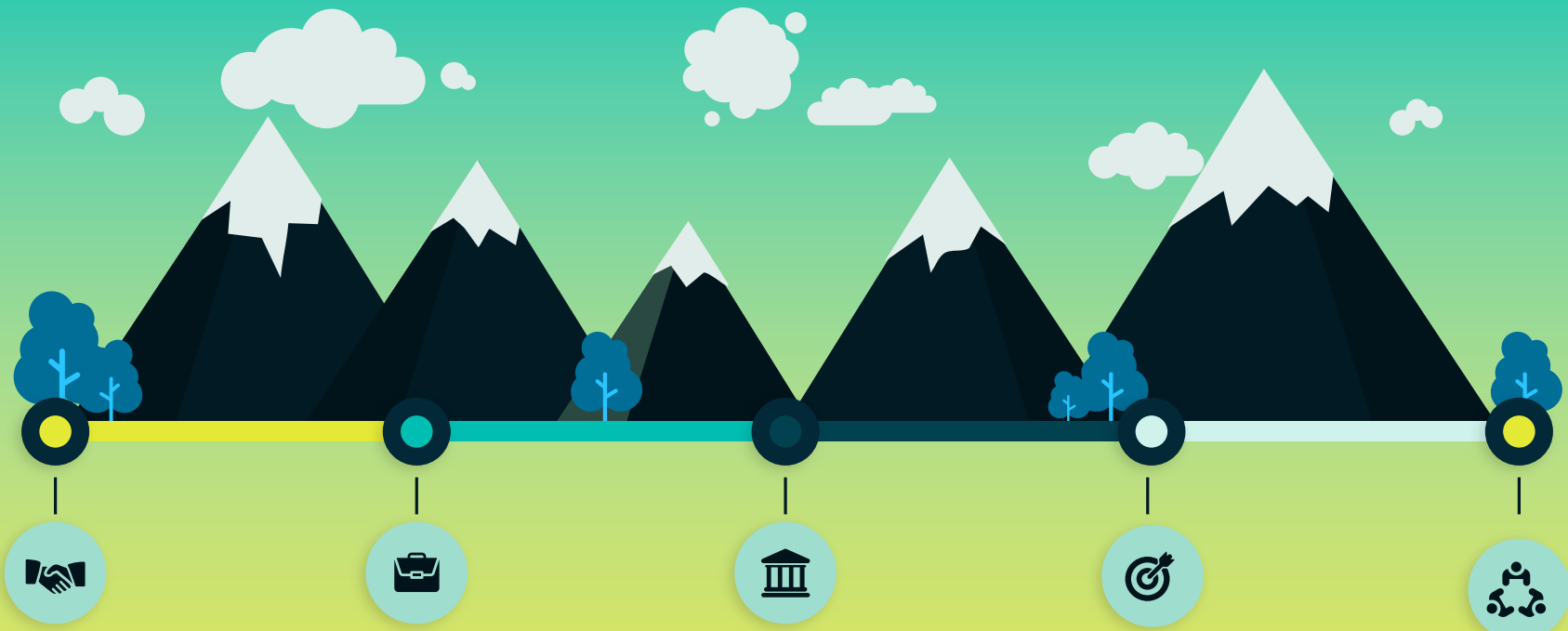
Capabilities:

- Small Modular Reactors (SMR) up to 20MW thermal power
- High-Assay Low-Enriched Uranium (HALEU) fuels < 20% enrichment
- Safety-Significant confinement for reactors to go critical for first time



NRIC INL

NRIC Timeline for Microreactor in 2024 (example)



2021
Design DOME & perform Helium Component tests @ MAGNET

2022
Complete DOME design; award construction contract

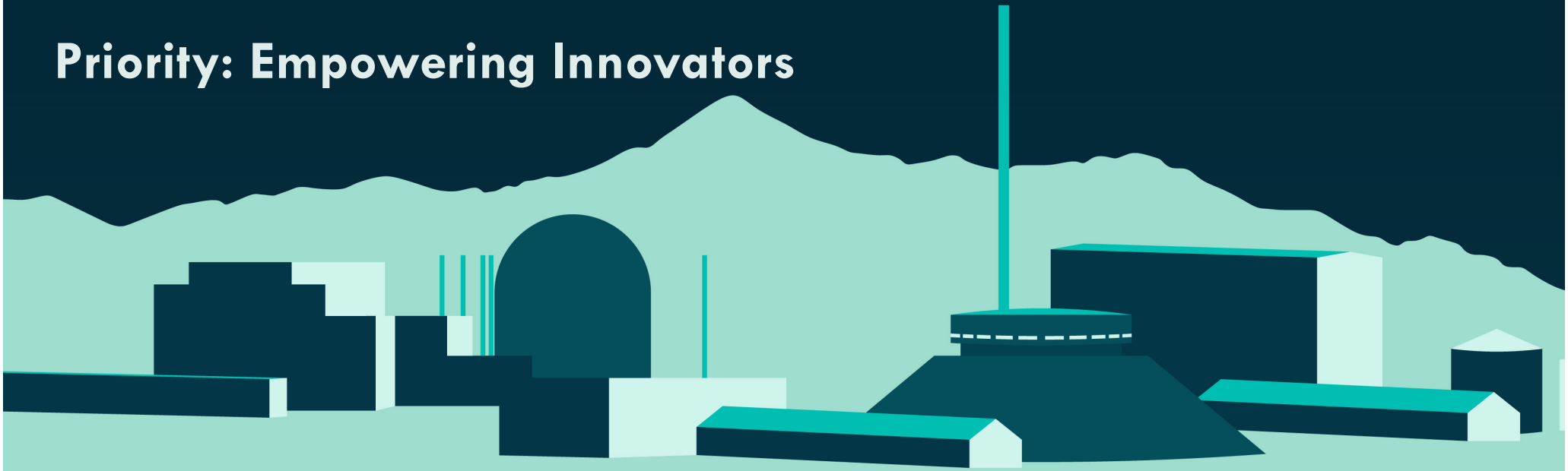
2023
DOME Refurbishment

2024
DOME Readiness Final Preparations and Reactor integration; Startup

2025
Reactor Operations

NRIC INL

Priority: Empowering Innovators



- Demonstration Resource Network (https://nricmapping.inl.gov/)
  - Test beds – DOME, LOTUS
  - Demonstration Sites
  - Experimental Facilities – MSTEC, fast response
- Regulatory Risk Reduction
- Virtual Test Bed
- NRIC Resource Team
- MARVEL

NRIC INL


Stage 1
Research
Stage 2
Development
Stage 3
Demonstration
GAIN
&
NRIC
Concept
Commercial
Product

Siting Preparations Underway

- National Siting Study – UMichigan, ANL, ORNL
- NNSS, PNNL siting studies
- Identified 9 candidate INL sites and initiated preparation for demonstration projects
  - Meteorological; grid access; water; cultural & biological resources; regulatory issues.

- Early Site Permit Roadmap
- Power needs analysis
- Plant parameter envelope
- Mapping

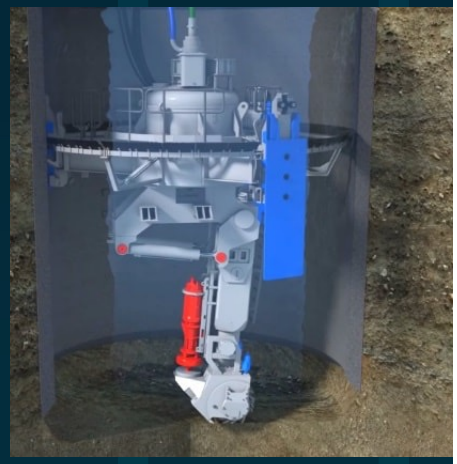
NRIC INL

Addressing Cost and Markets

- Advanced Construction Technologies – Selection made
- Digital Engineering – test bed system level architecture
- Construction Readiness – initial scoping, workshops
- Integrated Energy Systems – EOI, pre-conceptual design efforts

NRIC INL

Advanced Construction Technology

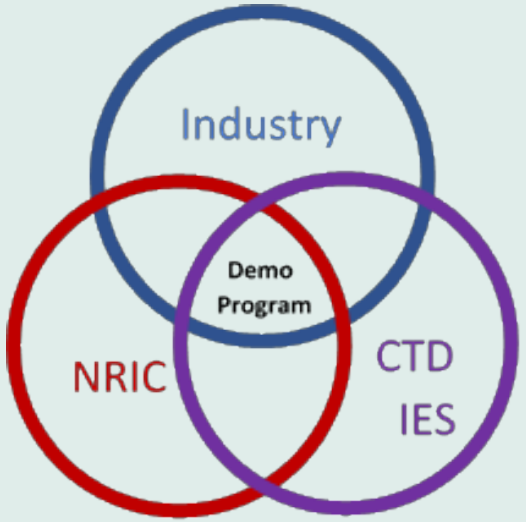


- 8/18/2020 BEA released RFP #02859160 for ACT initiative
- Proposal Team - General Electric Hitachi
  - EPRI, Black & Veatch, Purdue, UNCC, Nuclear Advanced Manufacturing Research Centre, Caunton Engineering w/Modular Walling Systems Ltd and Tennessee Valley Authority
- Demonstrate 3 technologies: 1)Vertical Shaft, 2) Steel Bricks™3) Advanced Sensors and Digital Twin
- Contract in negotiations
- Involve Regulators and NRC early
- Phase 1: 12 months
- Phase 2: 2-3 years

NRIC INL

Industry Outreach for NRIC IES Demonstration Program

- NRIC and IES issued an EOI request this spring for industry stakeholder participation in a potential multi-year demonstration program at INL test beds
  - Pre-phase: Planning and analysis
  - Phase 1: Emulation of nuclear energy production
  - Phase 2: Microreactor demonstrations
  - Phase 3: Pilot-scale advanced reactor demonstrations
- Report accompanying EOI describes INL sites and possible uses for nuclear energy in various industries
- 22 companies have expressed interest in participating
  - Advanced nuclear developers
  - Equipment suppliers and concept designers
  - Integration and implementation partners
  - Potential end users (and our outreach continues)

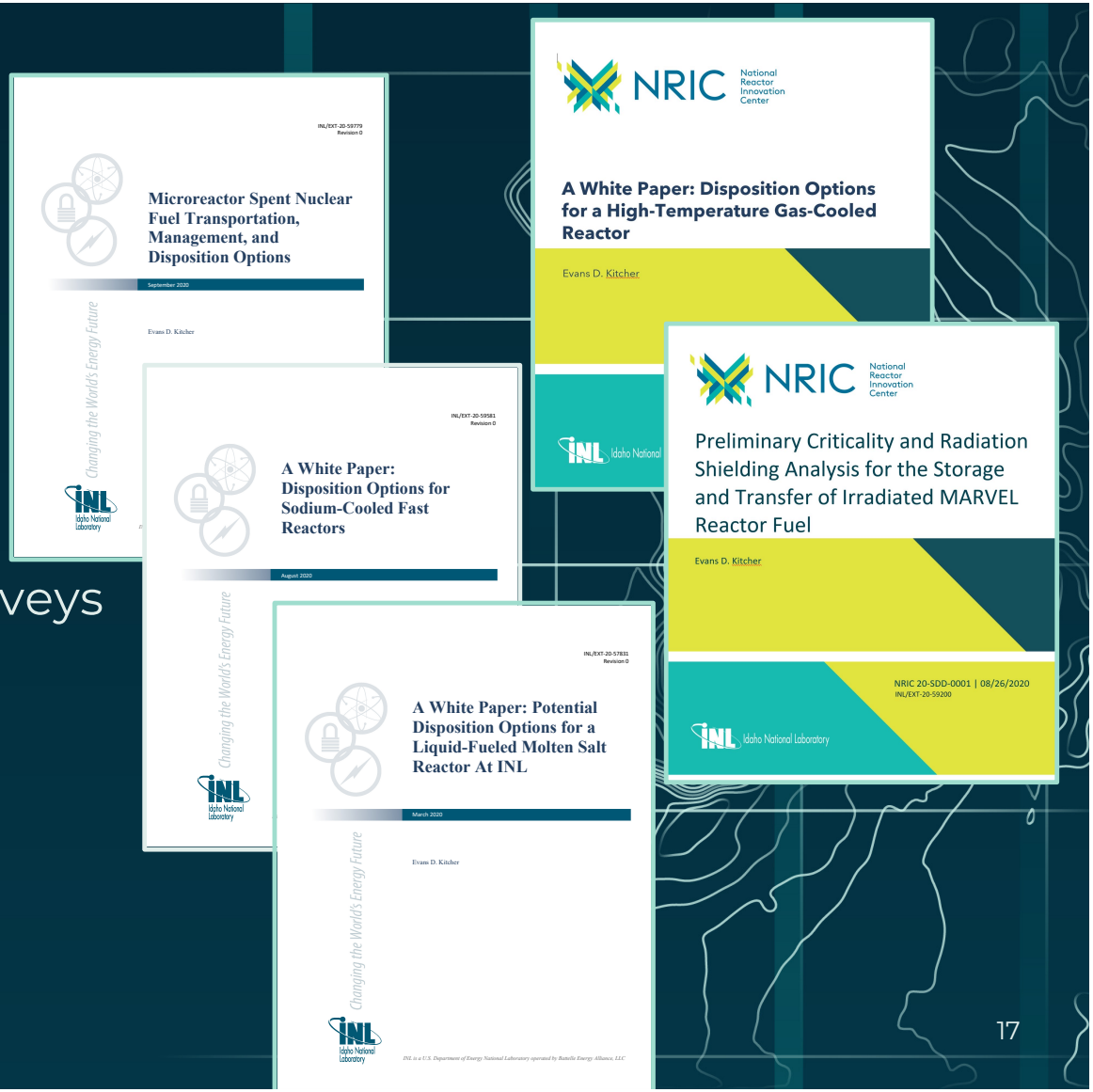


The demonstration program would occur at the intersection of industry clean energy needs, NRIC's mission, and the CTD IES program's R&D activities

NRIC INL

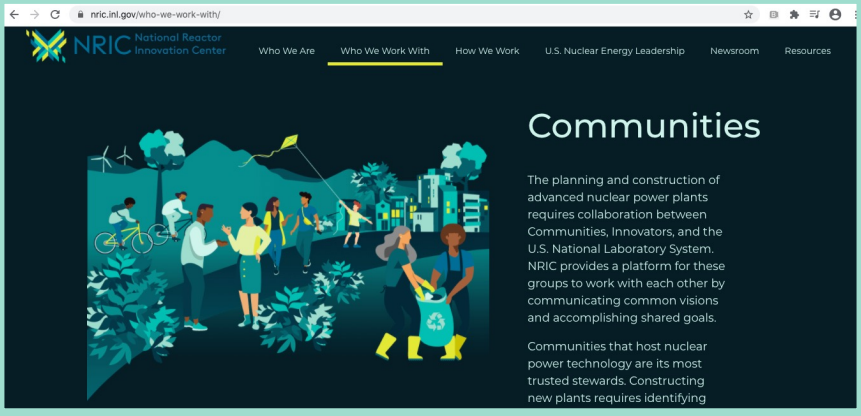
Proactive Impact Management

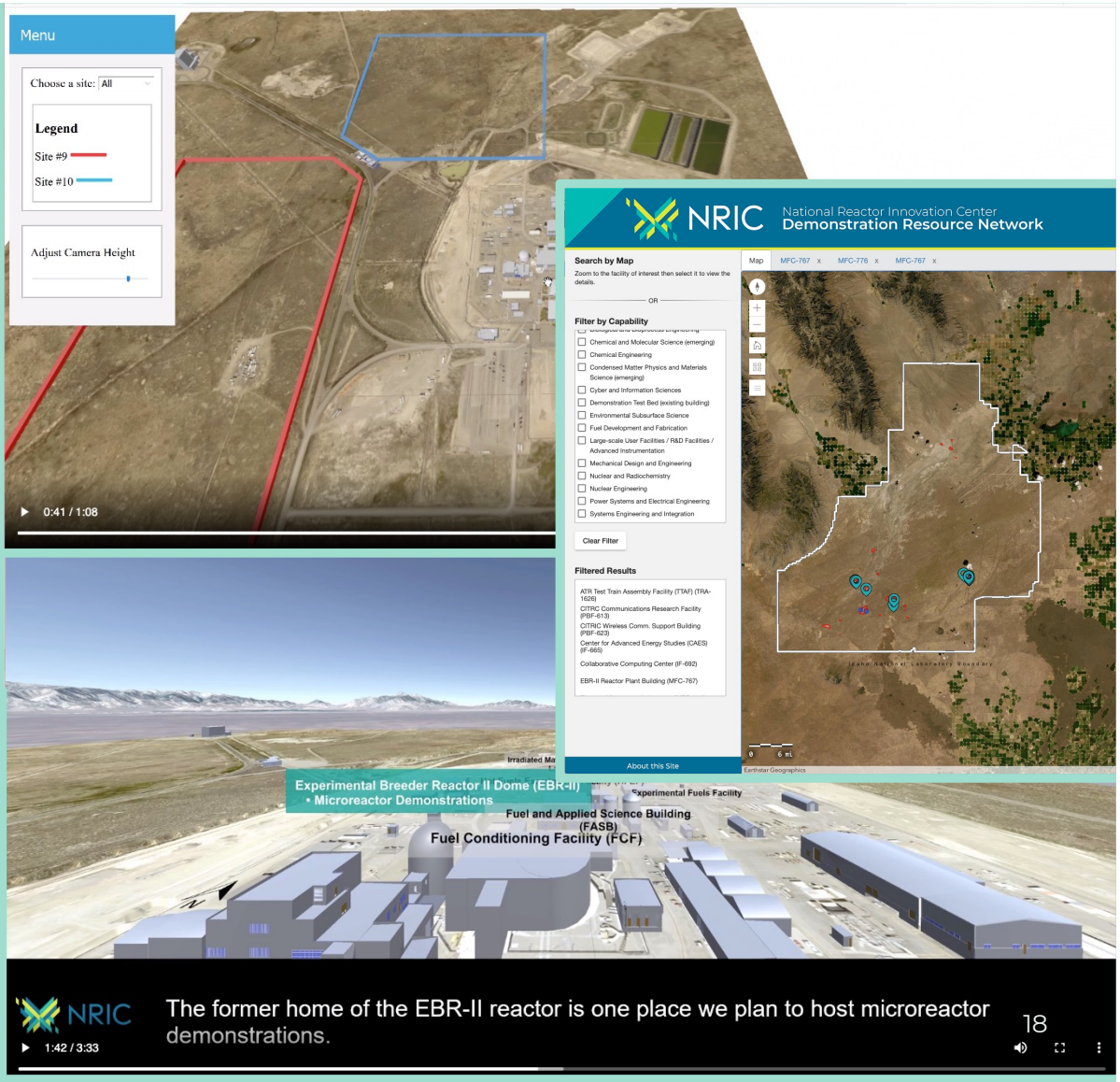
- Environmental impact assessment
  - Cultural and biological surveys
  - Plant parameter envelope
  - Water use
- Packaging, storage, and transport



Engagement

- Tools
  - Web/Social
  - Flyover, Mapping, Videos
- Best practices development
  - University of Michigan, FPTZ



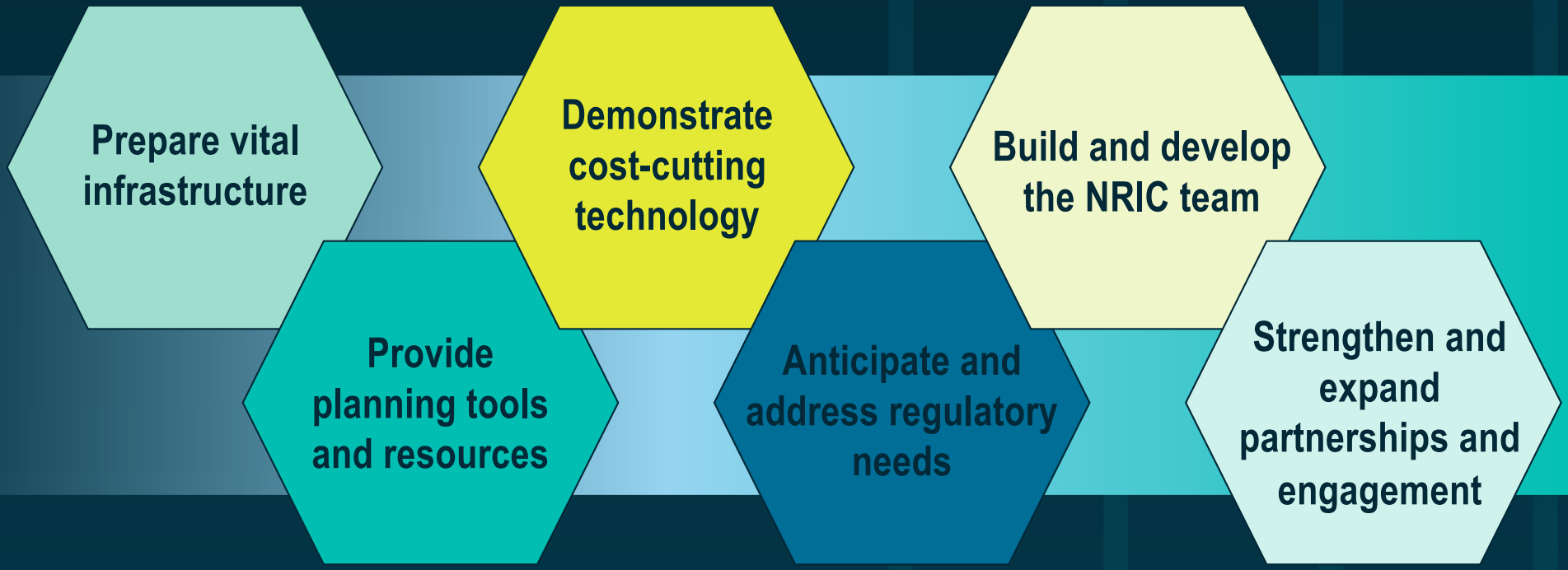


NRIC is a National Program and Central Integrator for Partners and Collaborators

NRIC INL

Goals for FY22

Maintain progress to support demonstrations by the end of 2025 and sustained innovation



NRIC INL

Thank you!

Questions?

NRIC INL