National Reactor Innovation Center

DOE Advanced Reactor Demonstrations & NRIC

U.S. NRC Commission Meeting: Briefing on Advanced Reactor Preparedness Through Regulatory Engagement and Research Cooperation

April 13, 2021

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Historical Context

- **Reactor Demonstration Programs**
  - Atomic Energy Commission
  - National Reactor Testing Station
  - Production Reactors
  - Cooperative Power Reactor Demonstration Program
  - International Demonstration Programs

- **Recent Policy Actions**
  - Nuclear Energy Innovation Capabilities Act
  - Nuclear Energy Innovation Modernization Act
  - Advanced Reactor Demonstration Program
  - Energy Act of 2020

Advanced Reactor Demonstration Program

- Objectives:
  - Develop, construct, and demonstrate several advanced reactors with beneficial capabilities
  - Support diversity of advanced designs
  - Stimulate private sector companies/supply chains
- Funding pathways aligned with varied maturity levels:
  - Advanced Reactor Demonstration (Demos) awards
  - Risk Reduction for Future Demonstration (Risk Reduction) awards
  - Advanced Reactor Concepts-20 (ARC-20) awards

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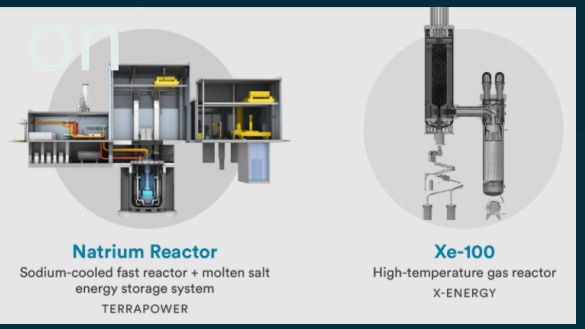
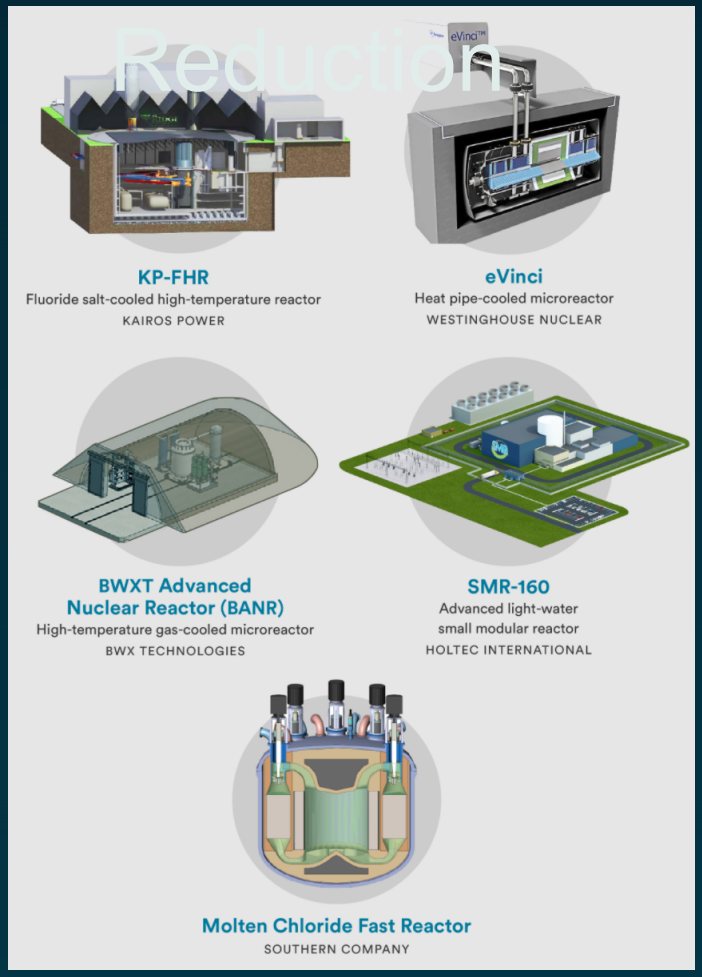
Demonstrati



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

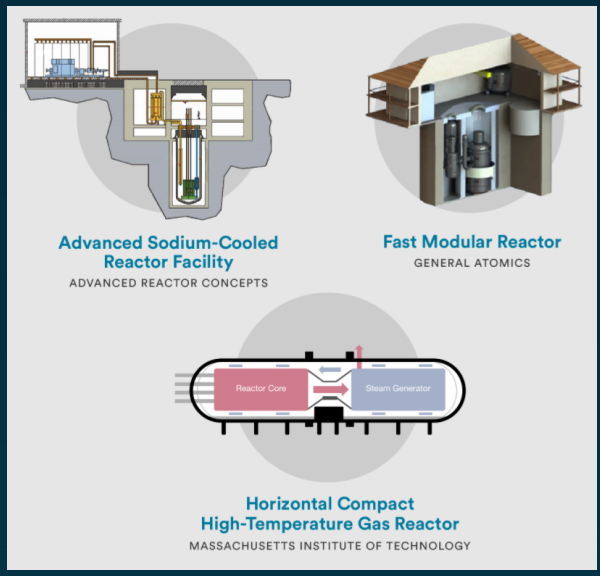
eVinci
Heat pipe-cooled microreactor
WESTINGHOUSE NUCLEAR

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

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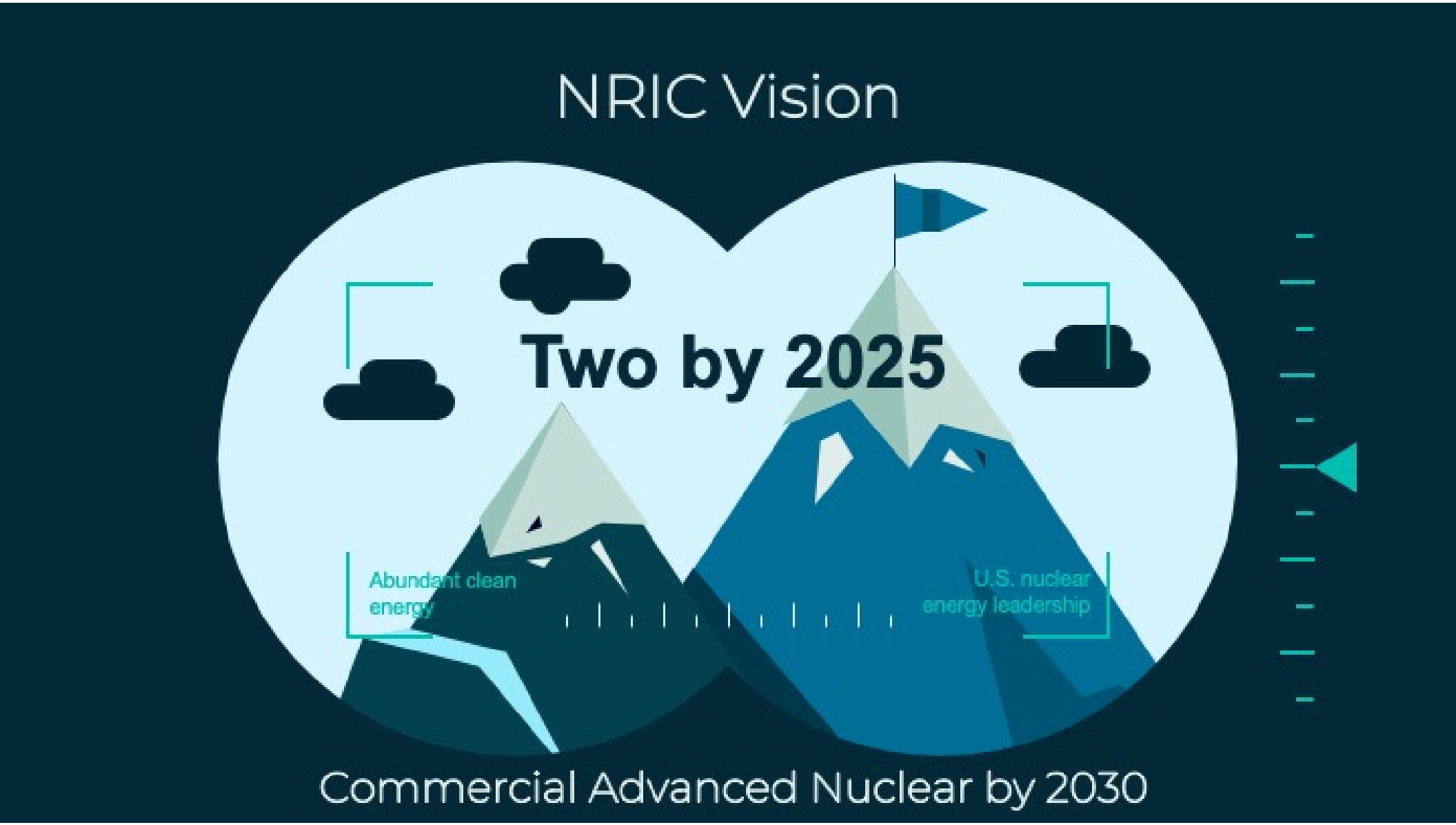
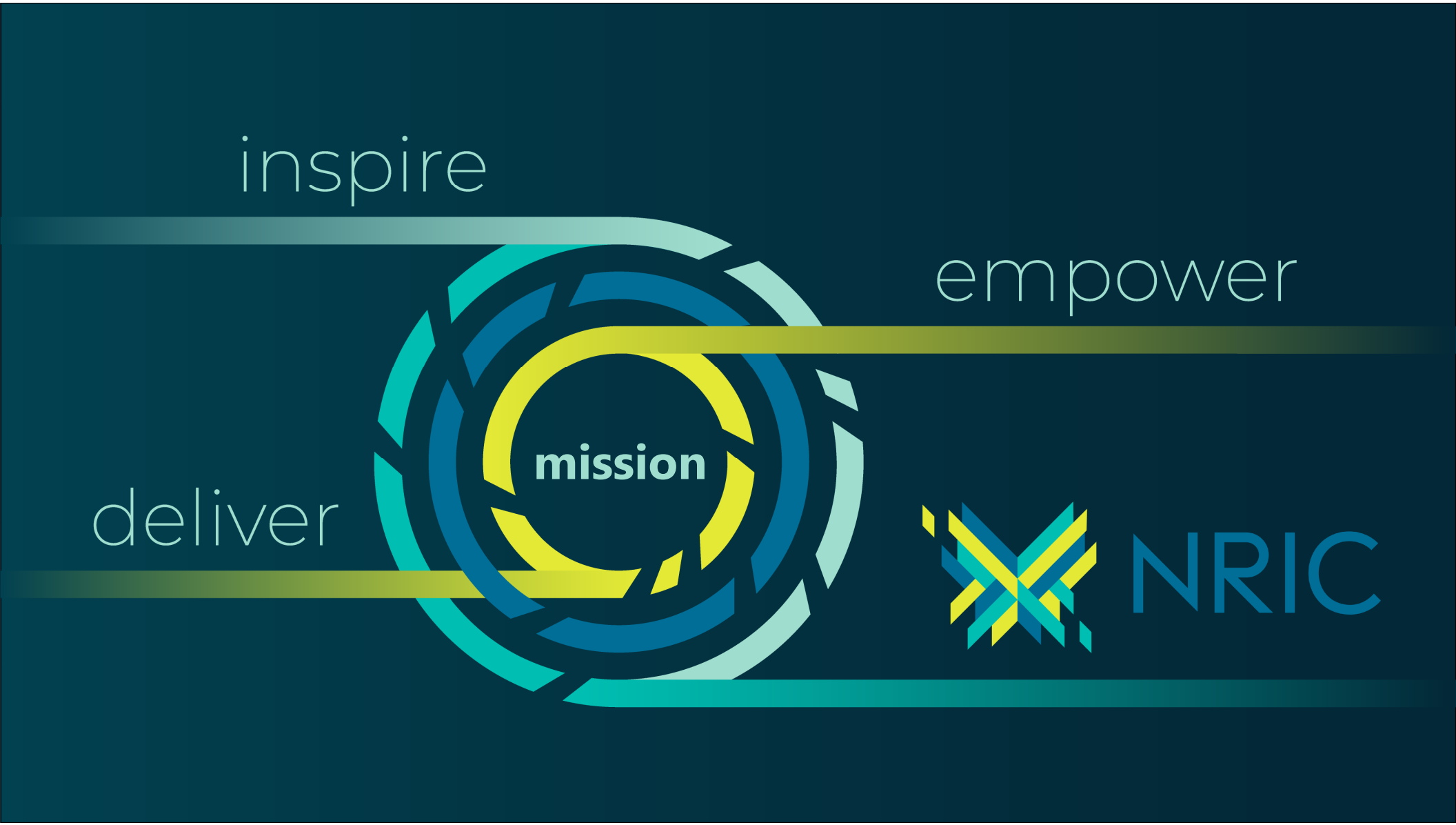
Slide content courtesy of U.S. DOE-NE


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


inspire
empower
mission
deliver
NRIC


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

Empowering Innovators

- Demonstration Resource Network
  - Test beds
  - Demonstration Sites
  - Experimental Facilities
- Regulatory Risk Reduction
- Economic Risk Reduction
- Virtual Test Bed
- NRIC Resource Team

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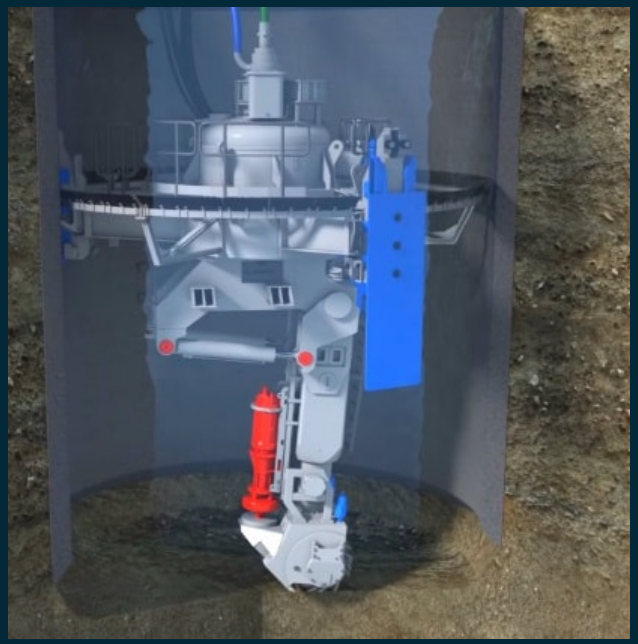
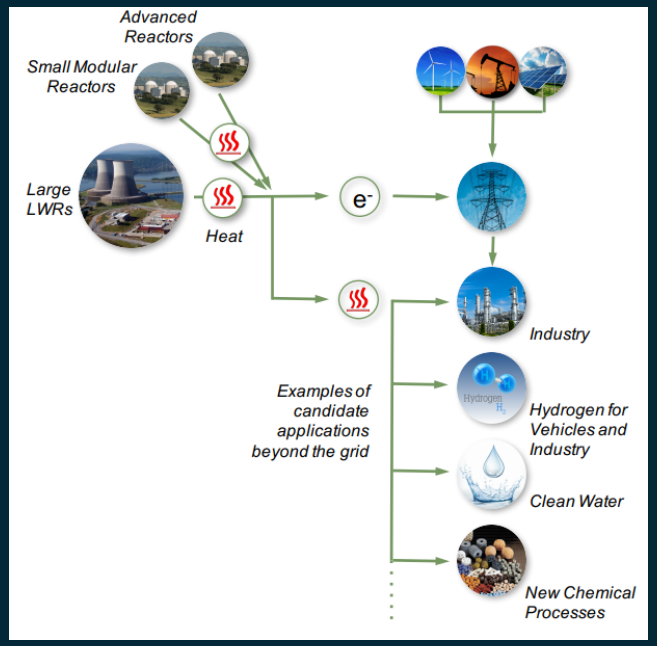
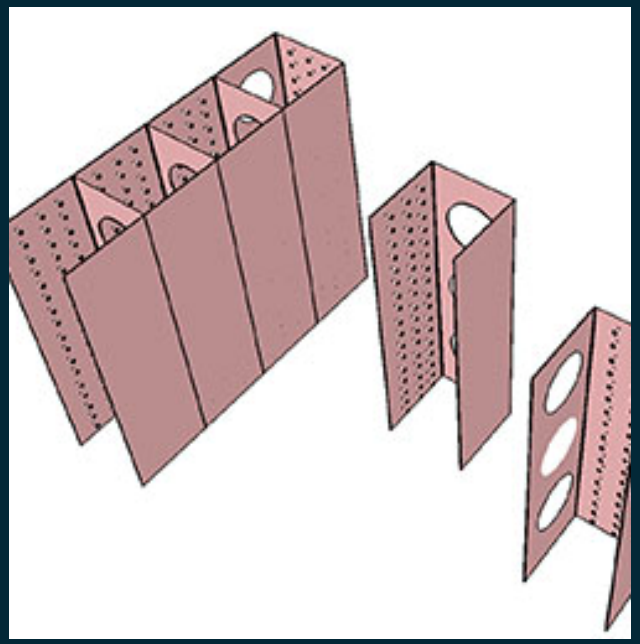
Addressing Cost and Markets

- Digital Engineering – work underway, open sourcing tools
- Advanced Construction Technologies – award forthcoming
- Integrated Energy Systems – EOI forthcoming
- Construction Readiness – initial scoping







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

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Thank you!

Questions?

Backup slides

5-Year NRIC Program Objectives

Enable demonstration of at least 2 advanced reactors

- Make available infrastructure, sites, materials, expertise
- Provide regulatory support
- Best practices in public engagement

Prepare DOE/labs for continuing innovation and demonstration

- Develop best practices for planning/construction/demonstration of nuclear projects
- Develop enduring infrastructure and expertise
- Establish methods for efficient coordination among laboratories

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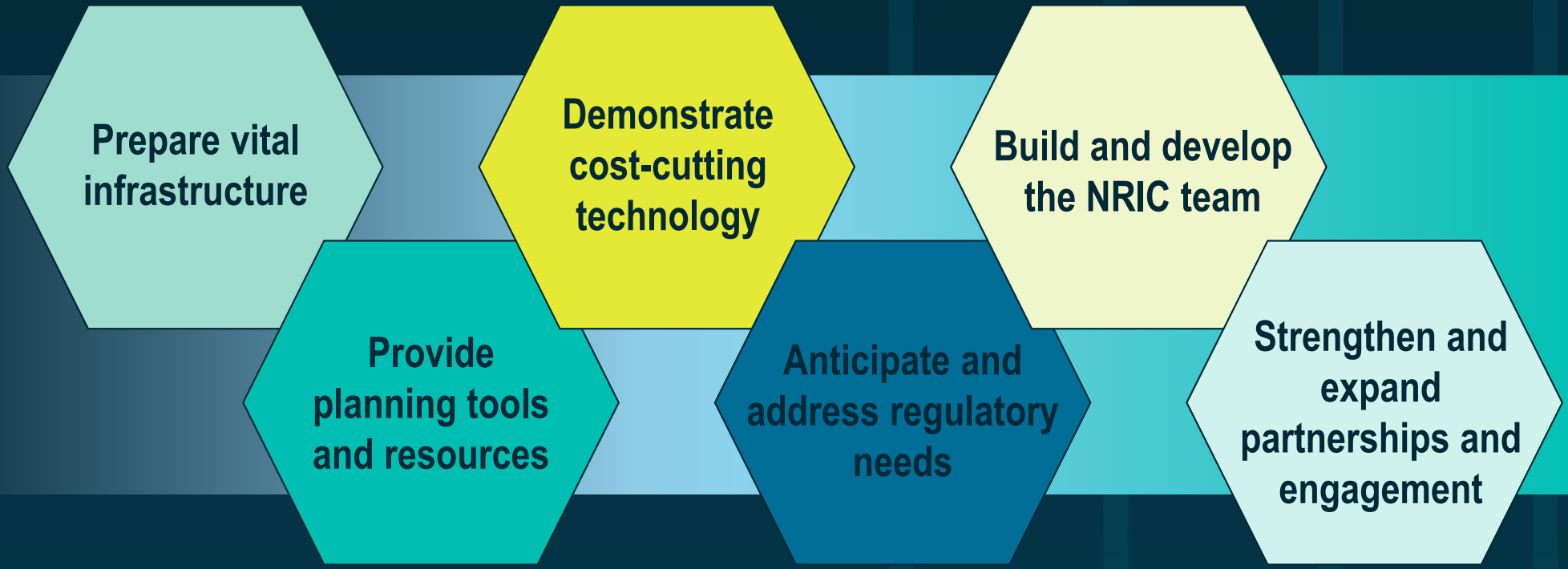
Goals for FY21 – Maintain progress to support demonstrations by the end of 2025 and sustained innovation



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NE Advanced Reactor Development R&D Campaigns

- **Fast Reactor Technologies**
  - Demonstrate feasibility of advanced systems and component technologies
  - Methods and code validation to support design and licensing
  - Qualification of legacy metallic fast reactor fuel performance data
- **Gas Reactor Technologies**
  - Advanced alloy and graphite materials qualification
  - Scaled integral experiments to support design and licensing
  - TRISO-coated particle fuel development and qualification
- **Molten Salt Reactor Technologies**
  - Investigate fundamental salt properties
  - Materials, models, fuels and technologies for salt-cooled and salt-fueled reactors
- **Microreactors**
  - Non-nuclear and nuclear integrated system testing supporting commercial demonstrations and end-user applications
  - Maturation of innovative components and semi-autonomous operating regimes

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Other NE Programs Supporting Advanced Reactor Development

- **Advanced Reactor Demonstration Program (ARDP)**
  - Major cost-shared awards to construct and demonstrate two concepts in 5-7 years
  - Other cost-shared awards supporting development of emerging innovative concepts
- **National Reactor Innovation Center (NRIC)**
  - Supporting domestic advanced reactor demonstrations by establishing innovative testing infrastructure, performing siting analyses, and conducting stakeholder outreach
- **Advanced Reactor Regulatory**
  - Crosscutting non-LWR licensing framework activities
  - Close collaboration with campaigns, industry stakeholders, and NRC
- **Nuclear Cybersecurity**
  - Developing methods and technologies for cost-effective, cyber-secure digital instrumentation, control, and communication for current and future nuclear plants
- **Advanced Reactor Safeguards**
  - Developing optimized methods and technologies for advanced reactors to meet domestic materials accountancy and physical protection requirements
- **Integrated Energy Systems**
  - Developing tools and technologies to support the demonstration and commercialization of a broad range of non-electric applications for current and future nuclear plants

DOE Fuel Cycle Programs Supporting Advanced Reactor Development

- **Mission:** to **enable innovation** and the implementation of advanced technologies to **optimize** U.S. nuclear energy systems and to support U.S. industry opportunities for global deployment
- Shifting emphasis towards balanced portfolio to support **Advanced Reactor Demonstration and Deployment** and **Innovative Fuel Cycle R&D for the future**
- **Versatile Test Reactor**: An essential domestic capability to support the development of innovative fuels, materials and technologies
- **Fuel for Advanced Reactors**: Metal, carbides, nitrides, and dissolved/liquid fuel concepts
- **Recycling Technologies**: To sustain options for improved fuel utilization and higher performing waste forms
- **Material Protection, Accounting and Control Technologies (MPACT)**: To improve fuel cycle efficiency and effectiveness in accountancy and proliferation resistance
- **Systems Analysis**: To improve fuel cycle efficiency and effectiveness in accountancy and proliferation resistance

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