U.S. DEPARTMENT OF ENERGY | Office of NUCLEAR ENERGY

U.S. Nuclear Energy Priorities

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Nuclear NH Study Commission
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Office of Nuclear Energy Mission

To advance nuclear energy science and technology to meet U.S. energy, environmental, and economic needs.

Priorities

- Keep existing U.S. nuclear reactors operating
- Deploy new nuclear reactors
- Secure and sustain our nuclear fuel cycle
- Expand international nuclear energy cooperation

Recent Nuclear Energy Appropriations

Annual Appropriations Office of Nuclear Energy

$1.773B in **FY23***

$1.682B in **FY22**

$1.535B in **FY21**

$1.493B in **FY20**

Infrastructure Investment and Jobs Act (IIJA)

$2.5B
Advanced Reactor Demonstrations, Office of Clean Energy Demonstrations

$6B
Civil Nuclear Credits, Grid Deployment Office

$8B
Regional Hydrogen Hubs, at least one nuclear, OCED

Inflation Reduction Act (IRA)

$700M HALEU

$150M INL Infrastructure

$15/MWh Production Tax Credits

30% Investment Tax Credit[1]

[1]Percentage of capital cost in tax credit in 1 year of operations

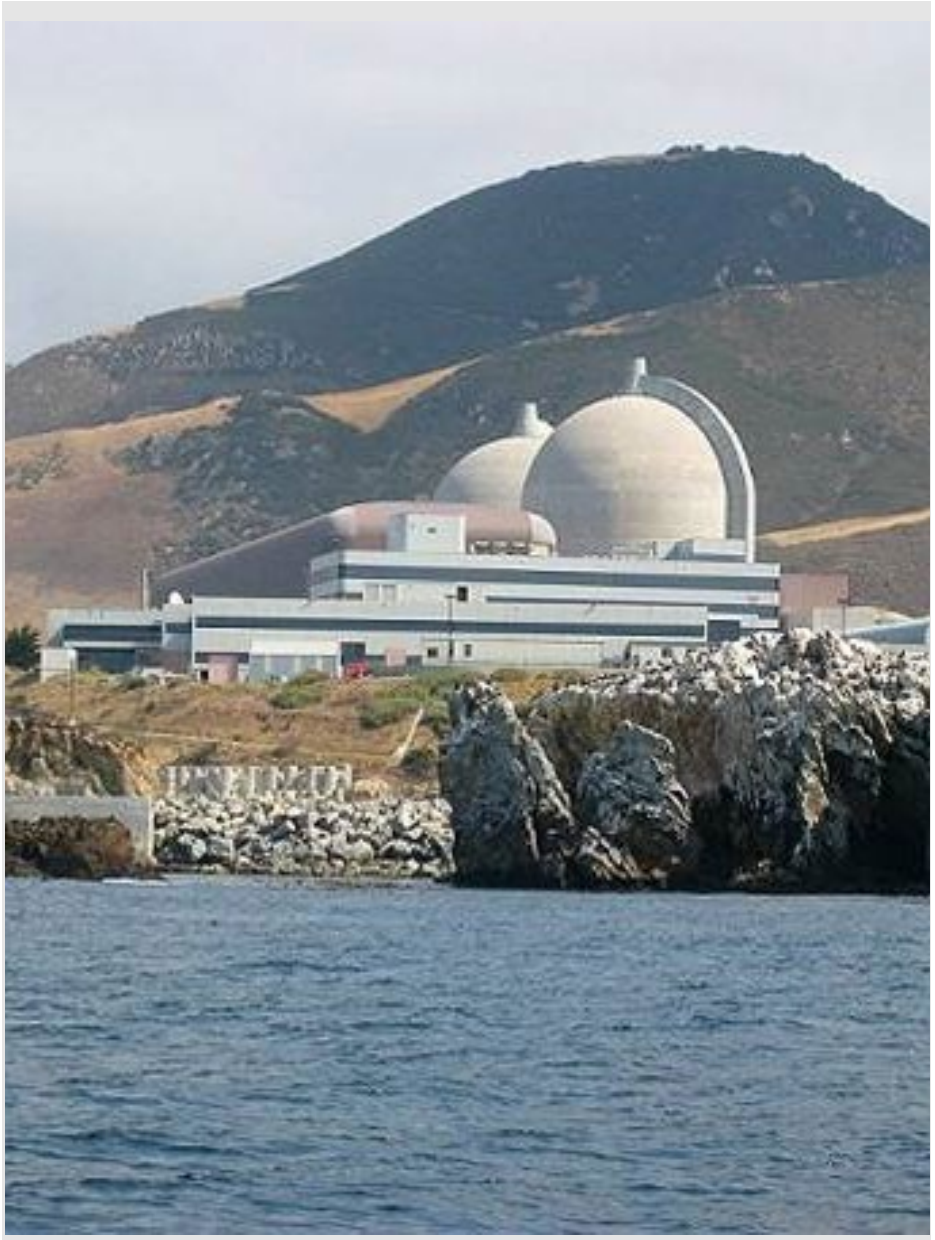
Priority 1: Enable continued operation of existing U.S. nuclear reactors

Nuclear power is carbon-free energy.

It's the **largest source of carbon-free electricity** in the United States!

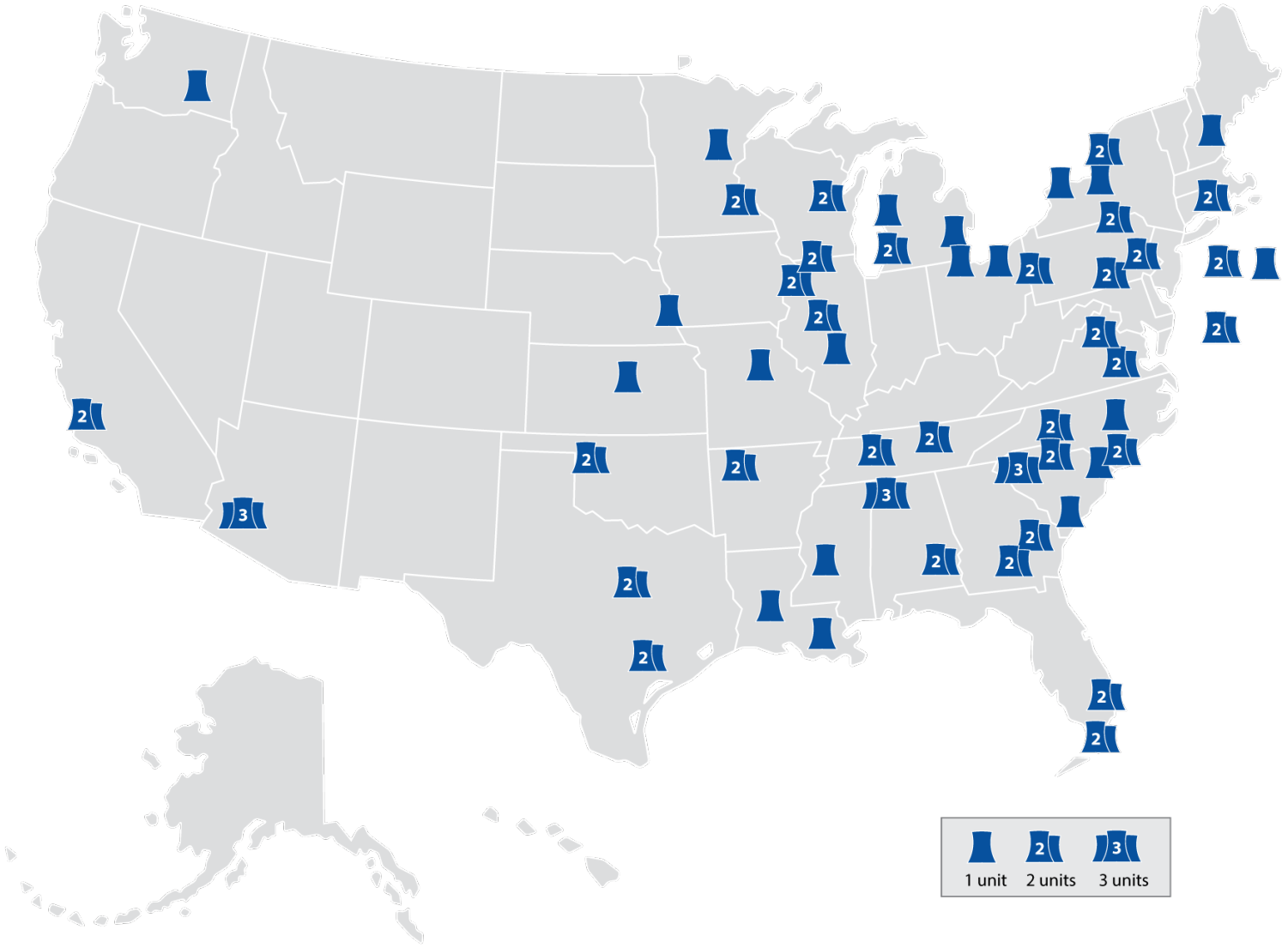
18% of **all electricity generated** in the U.S.

47% of **all emissions-free electricity** in the U.S.



Nuclear Energy in the United States

- **18%** Total Electricity Generation
- **47%** U.S. Clean Energy
- **93%** Capacity Factor
- **28** States Have Nuclear Reactors
- **93** of World's 439 Commercial Nuclear Reactors
- **1** Commercial Reactor Under Construction



Keep Existing Plants Open

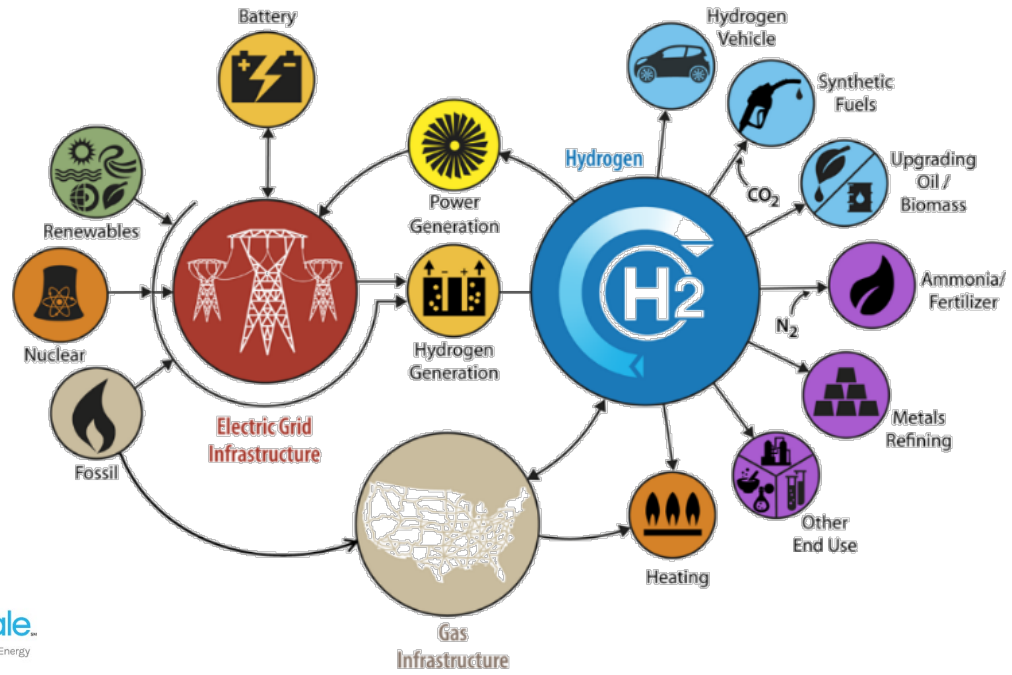

Credit: STP Nuclear Operating Company

- ❑ Enhance Performance
- ❑ Reduce Operating Costs
- ❑ Internalize Externalities

  - Digitize analog systems
  - Provide technical analysis for continued long-term operation
  - Commercialize Accident Tolerant Fuels
  - Identify new markets and use cases
  - Demonstrate hydrogen production
  - IIJA/BIL – Civil Nuclear Credit
  - IRA – 45U Production Tax Credit

Keep Existing Plants Open

Joint Hydrogen Production Demonstrations



H2@Scale U.S. Department of Energy

LWRS Light Water Reactor Sustainability

Davis-Besse

Nine Mile Point

Prairie Island

Palo Verde

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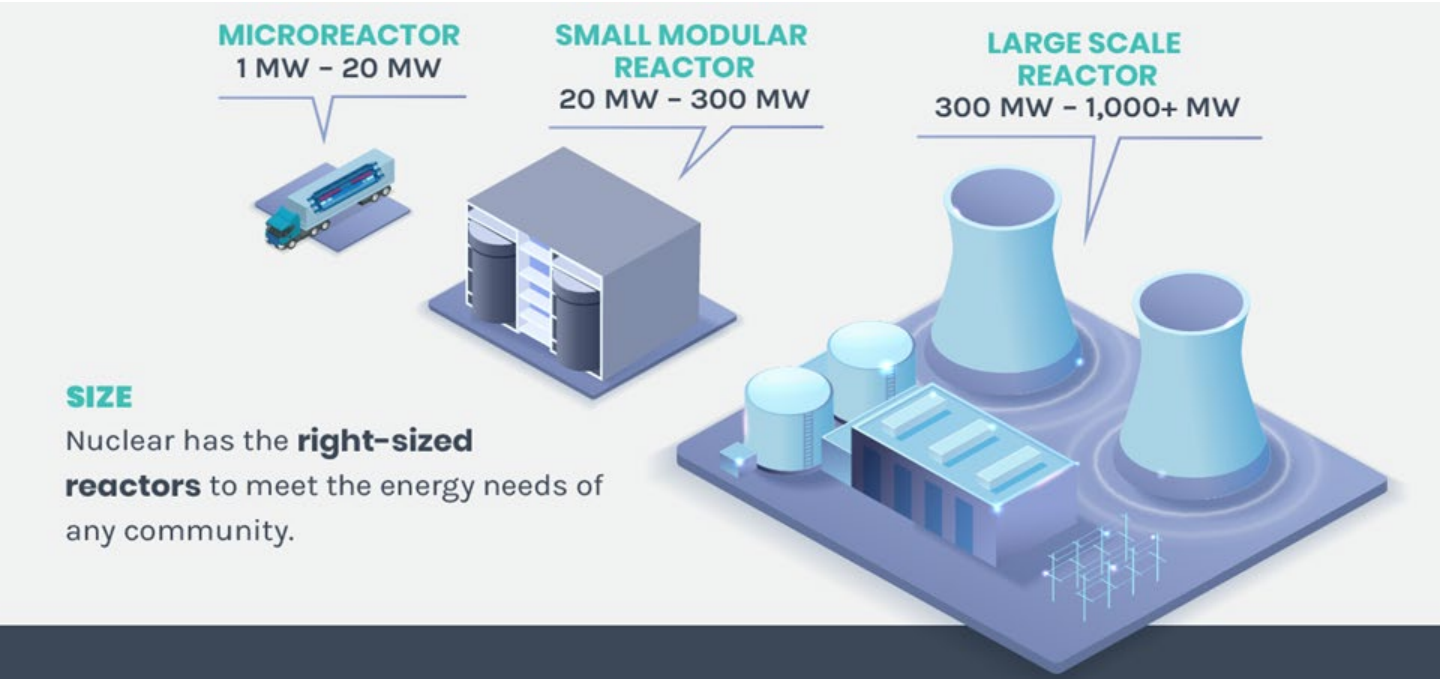
Priority 2: Enable deployment of advanced nuclear reactors



- Essential to tackling climate crisis, supplying clean energy, and decarbonizing the economy
- Demonstrating reactors with advances in sustainability, safety and reliability, resource utilization, and economics
- Developing small modular reactors to offer siting flexibility, scalability, and energy uses beyond electricity
- Developing microreactors for off-grid communities, remote industrial locations, and disaster relief missions
- Exporting advanced U.S. reactors ensures continued leadership to influence international safety, security, and nonproliferation norms

Pathways to Commercial Liftoff

Power source	Clean?	Firm?	Low land use?	Low transmission buildout?	Concentrated local economic benefits?	Additional applications?[1]	Cost competitive today?
Nuclear	High	High	High	High	High	High	Low
Hydropower	High	Medium	Low	Medium	High	Low	High
Geothermal	High	Medium	High	Medium	Medium	Medium	Medium
Renewables + storage[2]	High	High	Low	Low	Low	Medium	Low
Renewables: offshore	High	Medium	High	Low	Low	Low	Low
Renewables: onshore	High	Low	Low	Low	Low	Low	High
Natural gas + CCS	Medium	High	Medium	High	Medium	Medium	Low
Coal + CCS	Medium	High	Medium	High	High	Medium	Low
Natural gas	Low	High	Medium	High	Medium	Medium	High
Coal	Low	High	Medium	High	High	Medium	Medium

1. Additional applications include clean hydrogen generation, industrial process heat, desalination of water, district heating, off-grid power, and craft propulsion and power
2. Renewables + storage includes renewables coupled with long duration energy storage or renewables coupled with hydrogen storage

Select elements of nuclear energy's value proposition as compared to other power sources.

Do we need new nuclear for net zero? Likely **100-200 new GW** in the U.S. by 2050, especially given renewables buildout

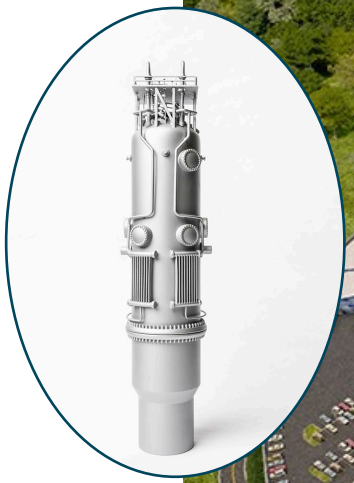
Why will it be different than recent over-budget builds? SMRs may avoid historical cost and constructability challenges; Vogtle provides lessons on the importance of rigorous pre-construction planning

https://liftoff.energy.gov

Deploy New Reactors

Carbon-Free Power Project

NuScale Power Demonstration Project
at Idaho National Laboratory



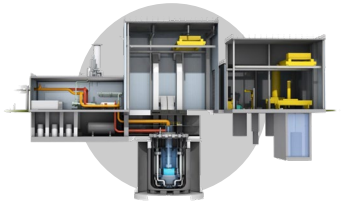
Attributes

- 6 Nuclear Power Modules - 462MWe (77 Mwe per module)
- Leverages proven and commercially-available LWR fuel
- Air Cooled Condensers – substantially reduces water use
- Initial site characterization work completed
- First module operation planned for 2029

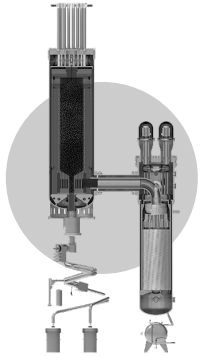
Deploy New Reactors

1 DEMONSTRATION

Bipartisan Infrastructure Law/IIJA – Office of Clean Energy Demonstrations - $2.5 B



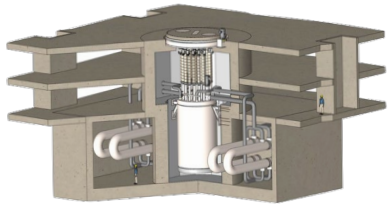
Natrium Reactor
Sodium-cooled fast reactor + molten salt energy storage system
TERRAPOWER
Kemmerer, WY



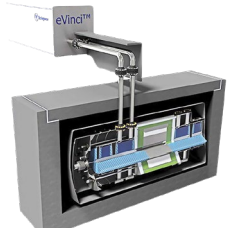
Xe-100
High-temperature gas reactor
X-ENERGY
Seadrift, TX

2 RISK REDUCTION

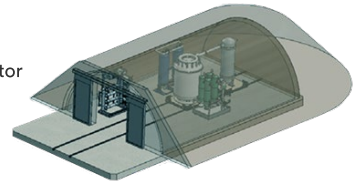
Solve technical, operational and regulatory challenges to support demos within 10-14 years



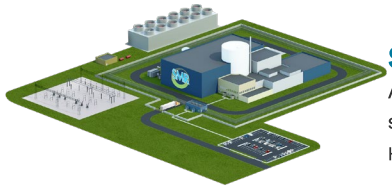
KP-FHR
Fluoride salt-cooled high-temperature reactor
KAIROS POWER



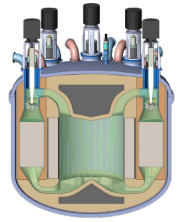
eVinci
Heat pipe-cooled microreactor
WESTINGHOUSE NUCLEAR



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



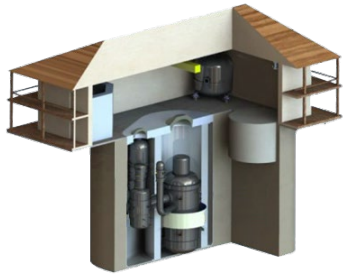
SMR-160
Advanced light-water small modular reactor
HOLTEC INTERNATIONAL



Molten Chloride Fast Reactor
SOUTHERN COMPANY

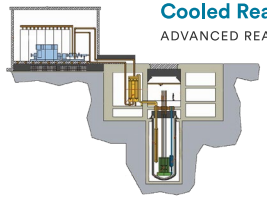
3 CONCEPT DEVELOPMENT

Solidify concept to mature technology for potential demo in mid-2030s



Fast Modular Reactor
GENERAL ATOMICS

Horizontal Compact High-Temperature Gas Reactor
MASSACHUSETTS INSTITUTE OF TECHNOLOGY



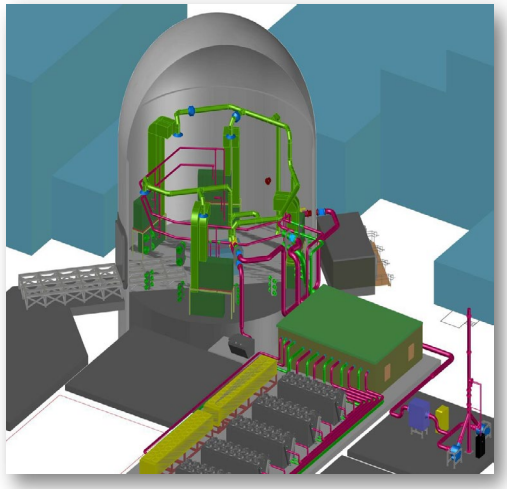
Advanced Sodium-Cooled Reactor Facility
ADVANCED REACTOR CONCEPTS

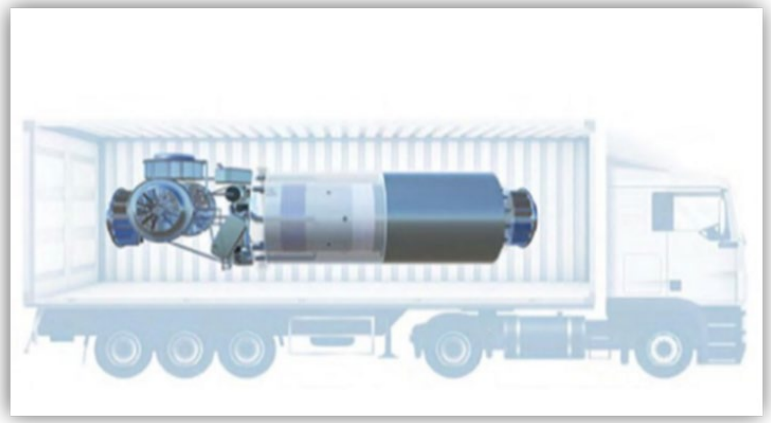
Key Programs and Projects

- **Demonstration and Operation of Microreactor Experiments (DOME) Test Bed**
  - Capable of hosting experimental/test microreactors
  - Several industry led reactor projects in discussions with DOE on use of DOME
  - Ready to host first experiment in 2027
- **MARVEL**
  - 100-kWth microreactor for R&D
  - Test applications like load-following, process heat production, hydrogen production, and water purification
  - Will provide U.S. companies information about building, installing, and operating microreactors
  - Startup in 2024
- **Project Pele - DoD**
  - Project with Defense Department (DoD) Strategic Capabilities Office (SCO)
  - 1 to 5 MW microreactor for military use
  - Will limit military's dependence on liquid fuel and reduce its carbon footprint
  - Startup in 2024

MARVEL

DOME

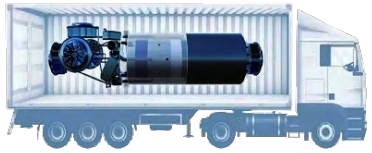




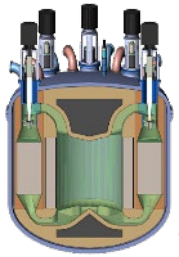
PROJECT PELE

State of Technology

MARVEL
DOE

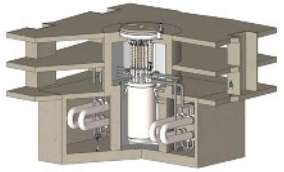


Project PELE Microreactor
DoD SCO | BWXT



TerraPower
Southern Company

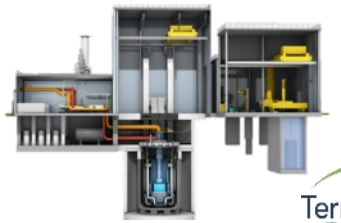
MCRE
Southern Co. & TerraPower



Kairos Power
Hermes
Kairos

DRACO
DoD

HITACHI
BWRX-300
GE-Hitachi



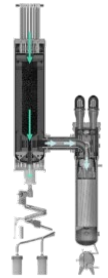
TerraPower
HITACHI
Natrium Reactor
TerraPower &
GE-Hitachi

2030

CFPP
UAMPS &
NuScale

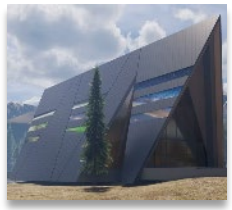
UAMPS
NUSCALE

Xe-100
X-energy
energy



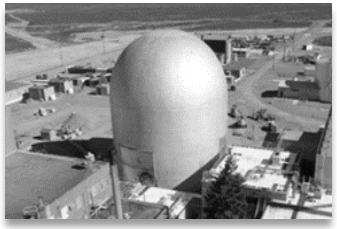
Eielson AFB
DoD

Aurora
Oklo Inc.
OKLO



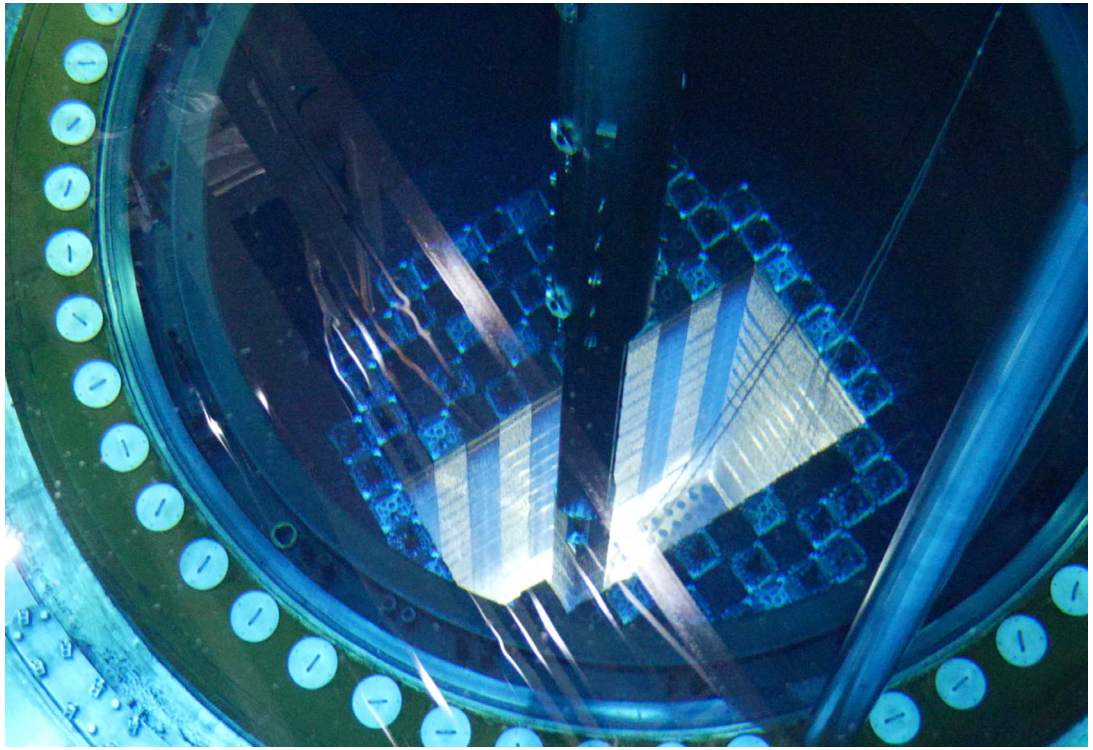
LOTUS Test Bed
NRIC

DOME Test Bed
NRIC



NRIC National Reactor Innovation Center

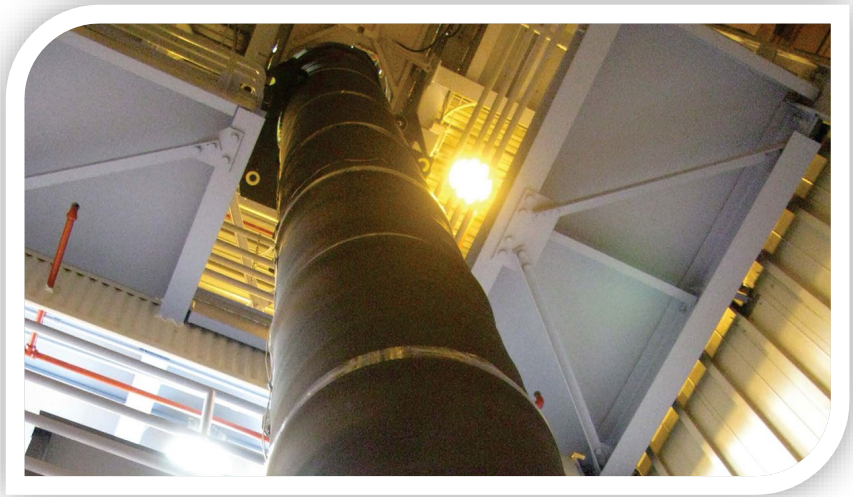
Priority 3: Secure and sustain the global nuclear fuel cycle



- Addressing gaps in the domestic nuclear fuel supply chain for existing and advanced nuclear reactors
- Encouraging expansion of domestic commercial capacity in conversion and enrichment services to assure the supply of low enriched uranium (LEU) and high-assay low-enriched uranium (HALEU)
- Developing strategy for the integrated waste management of spent nuclear fuel
- Developing a consent-based approach to siting interim storage facilities

HALEU

HIGH-ASSAY LOW-ENRICHED URANIUM



- $700M in IRA
- Only commercial scale supplier is Russia

WHAT IS IT?

Uranium enriched between

5% AND 20%

in uranium-235—the main fissile isotope that produces energy during a chain reaction.

Low-Enriched Uranium
<20% U-235
- Existing Reactors (up to 5%)

HALEU
5%-19.75% U-235
- Advanced Reactors
- Nuclear Thermal Propulsion Rockets

Highly-Enriched Uranium (HEU)
≥20% U-235
- Naval Reactors (>90%)

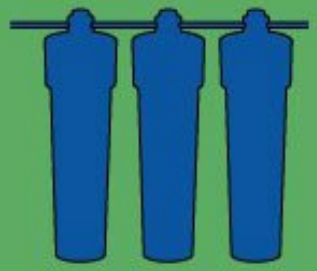
ALLOWS FOR...

- Smaller Designs
- Longer Life Cores
- Increased Fuel Efficiency
- Less Waste

HOW IT'S MADE

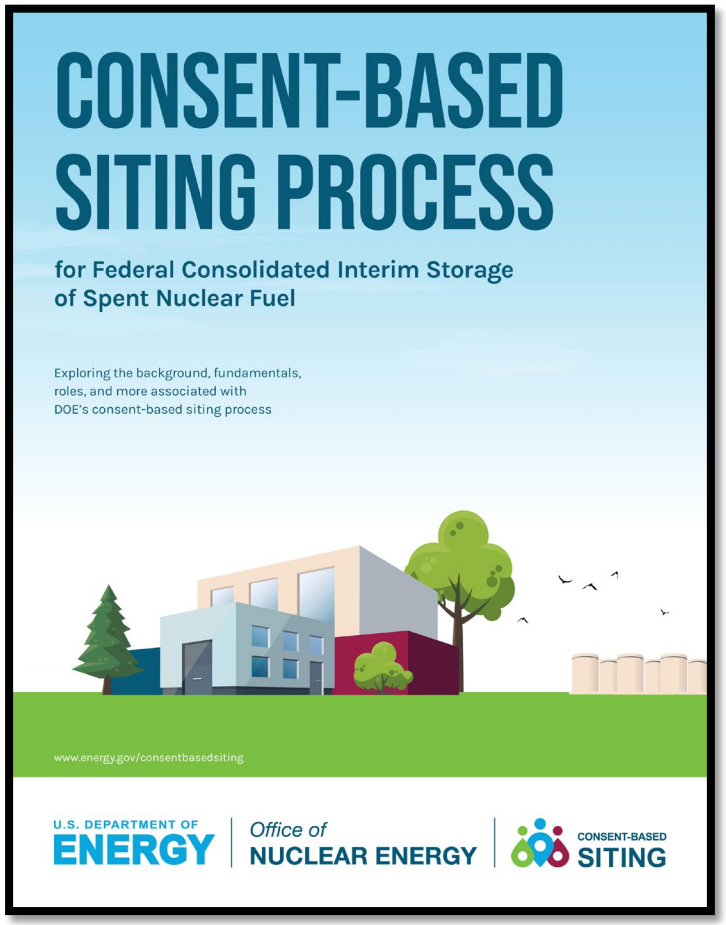
Chemical Processing
Recycle used government-owned HEU and downblend to HALEU.

Enrichment
Gas centrifuges separate uranium isotopes by weight to produce a higher percentage of U-235 in the uranium.



THE CONSENT-BASED SITING PROCESS

The U.S. Department of Energy is pursuing one or more federal consolidated interim storage facilities to store the nation's spent nuclear fuel in the near-term using a multi-stage consent-based approach that puts communities' interests at the forefront.



- Prioritizes people and communities
- Centers equity and environmental justice
- Collaborative, phased, and adaptive

PROCESS STAGES

Stage 1: Planning and Capacity Building

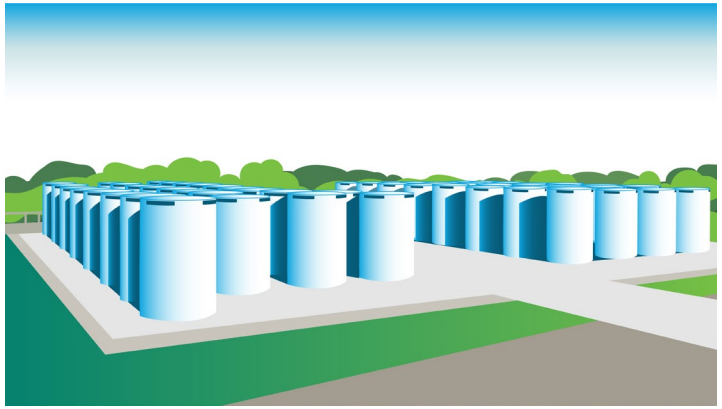
Build relationships, encourage mutual learning, develop a common understanding of nuclear waste management-related topics.

Phases 1A & 1B
ANTICIPATED REMAINING DURATION 2-3 YEARS

Stage 2: Site Screening and Assessment

Issue screening and assessment criteria, community-led development of additional criteria; preliminary and detailed assessments.

Phases 2, 3, & 4
ANTICIPATED DURATION 4-7 YEARS



Stage 3: Negotiation and Implementation

Negotiate agreements with willing and informed host communities with licensing, construction, and operation activities to follow.

Phases 5, 6A, & 6B
ANTICIPATED DURATION TO INITIAL OPERATION READINESS 4-5 YEARS

Priority 4: Expand International Nuclear Energy Cooperation

- The world nuclear energy market has been projected to double or triple by 2050
- The U.S. export opportunity for nuclear technology could be $1.9 T
- United States must compete with financing backed by state-owned nuclear technology companies

Thank you!

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