NARUC Summer Policy Summit

Subcommittee on Nuclear Issues – Waste Disposal
Sunday, July 14 | 2:45 – 3:45 pm ET

Bringing Advanced Nuclear to Market

Moderator: Hon. Tim Echols, Georgia

Panelists:
Dr. Michael Goff, U.S. Department of Energy
Chris Nolan, Duke Energy
Michelle Chang, Google

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

Bringing Advanced Nuclear to Market

NARUC Nuclear Issues – Waste Disposal Subcommittee

Dr. Michael Goff, Acting Assistant Secretary of Nuclear Energy
U.S. Department of Energy

July 14, 2024

STATE of NUCLEAR

94
commercial reactors

18%
of U.S. electricity generation

47%
of U.S. clean power production

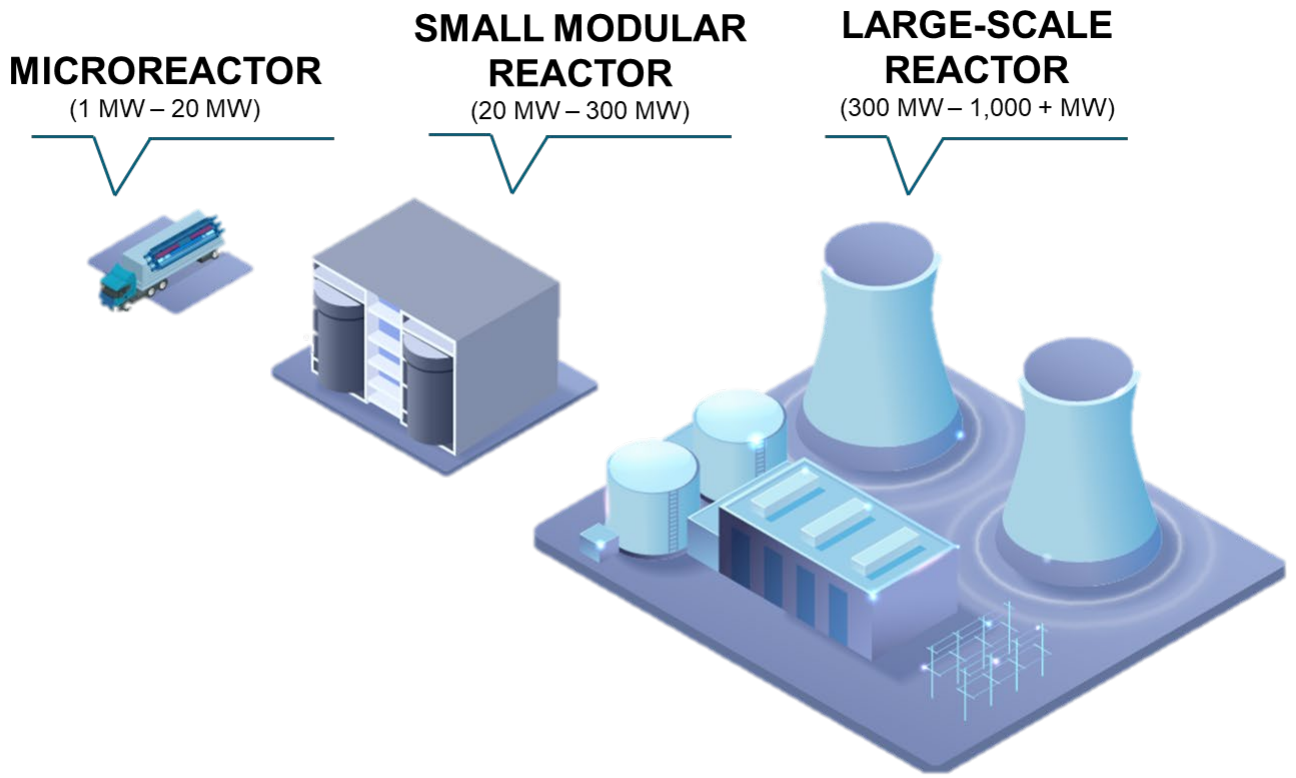
475,000
U.S. jobs supported

1
SMR certified

energy.gov/ne

Advanced Reactors Provide Flexible Nuclear Options

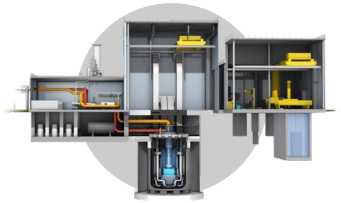
- Flexible deployment options
- Right-sized for community or industrial needs
- Fuel: oxide, metal, TRISO particle, molten salt
- Coolant: water, helium, liquid metal, molten salt, heat-pipe



Current Department of Energy Projects

1 DEMONSTRATION

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

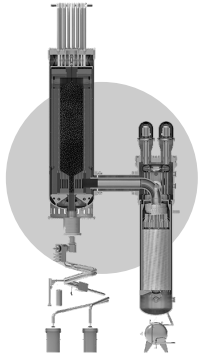


Natrium Reactor

Sodium-cooled fast reactor + molten salt energy storage system

TERRAPOWER

Kemmerer, WY



Xe-100

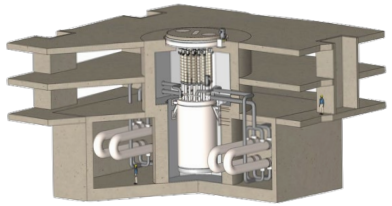
High-temperature gas reactor

X-ENERGY

Seadrift, TX

2 RISK REDUCTION

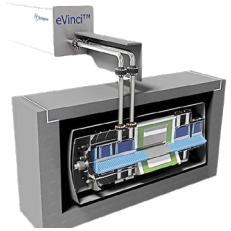
Solve technical, operational and regulatory challenges to support demos within 10-14 years



KP-FHR

Fluoride salt-cooled high-temperature reactor

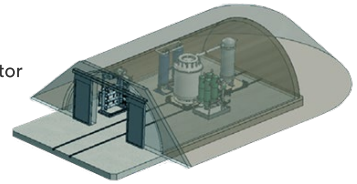
KAIROS POWER

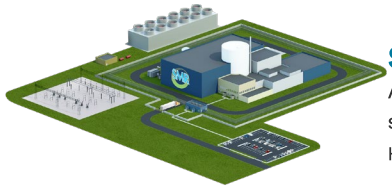


eVinci

Heat pipe-cooled microreactor

WESTINGHOUSE NUCLEAR

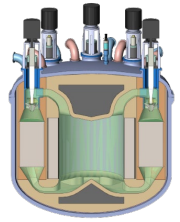




SMR-160

Advanced light-water small modular reactor

HOLTEC INTERNATIONAL



BWXT Advanced Nuclear Reactor (BANR)

High-temperature gas-cooled microreactor

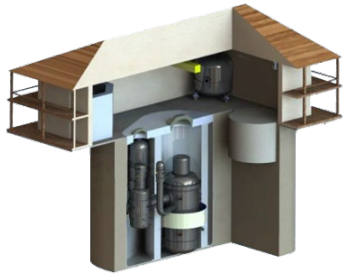
BWX TECHNOLOGIES

Molten Chloride Fast Reactor

SOUTHERN COMPANY

3 CONCEPT DEVELOPMENT

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

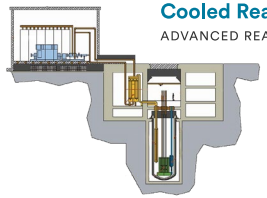


Fast Modular Reactor

GENERAL ATOMICS

Horizontal Compact High-Temperature Gas Reactor

MASSACHUSETTS INSTITUTE OF TECHNOLOGY



Advanced Sodium-Cooled Reactor Facility

ADVANCED REACTOR CONCEPTS

ADVANCED NUCLEAR

Current Advanced Nuclear Applications

Advanced Nuclear sector financing applications through 30 June 2024

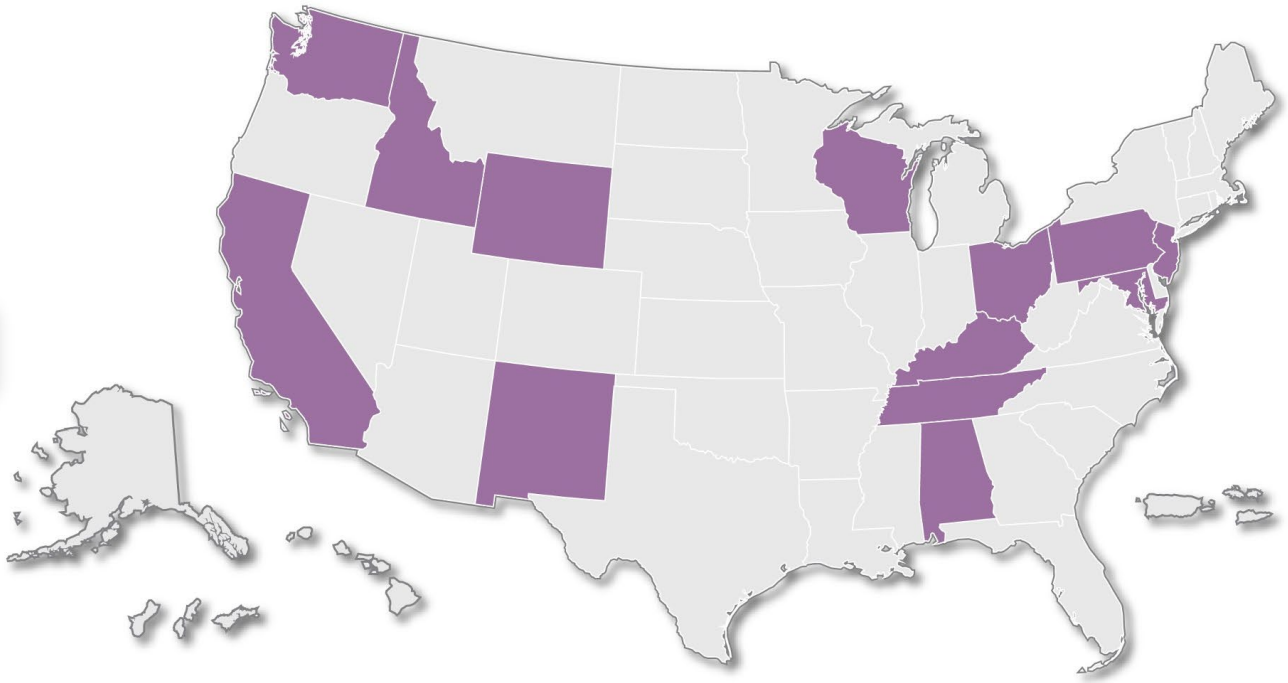
Through June 30, 2024, $64.89 B in Advanced Nuclear projects have submitted applications or are expected to submit applications in the next 120 days.

Title 17 nuclear applications or projects submitting applications in the next 120 days include:

Section 1703: $12.093 B | Section 1706: $52.8 B

Title 17 can finance a variety of projects across the nuclear supply chain, including:

- Nuclear reactor supply chain and manufacturing
- Small and micro nuclear reactor deployment
- Large Gen III+ nuclear reactor deployment
- Existing / shuttered nuclear reactor restarts, upgrades, uprates
- Nuclear fuel cycle, including uranium processing and fuel enrichment, and other technologies



Notes

All data updated through June 30, 2024. For more details and a list of technology areas of interest within each LPO tech sector, see: Energy.gov/LPO/MAAR

1) Proposed project locations are represented by the U.S. state/territory location of the physical facilities or service areas for which LPO financing is being requested, or lacking that, the headquarters state(s) of the sponsor(s).

LPO Loan Programs Office

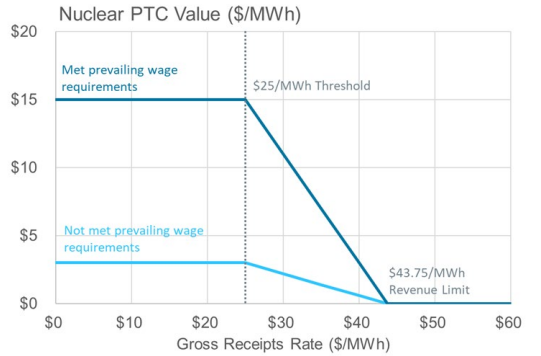
Highlights of Nuclear Energy-Related IRA Tax Provisions

Administered by the Department of Treasury.

The Department of Energy provides technical assistance to support implementation.

45U – Zero Emission Nuclear Power Production Tax Credit (PTC)

- Existing fleet, including uprates
- 2024-3032
- Wage/labor provisions
- Sliding credit based on gross receipts
- Can be monetized



Cents per kWh in the IRA have been converted to dollars per MWh. Calculations beyond 2023 will account for inflation (IRA §45U (c)(1)).

45Y – Clean Energy Production Tax Credit (PTC)

- Technology neutral clean energy, placed in service post 2024
- 10 yrs from operation; phases out later of 2032/GHG target reached
- 10% bonus each for domestic content and energy community
- Wage/labor provision
- Can be monetized

45E – Clean Energy Investment Tax Credit (ITC)

- Technology neutral, clean energy
- Wage/labor provision
- 10% bonus each for domestic content and energy community
- Can be monetized
- Starts to phase out in 2033

48C – Advanced Energy Project Credit

- Manufacturing-focused
- 2024 Award to X-energy for TRISO Fuel Fabrication

Also – 45 V Clean Hydrogen Production Tax Credit

$1 billion

in university support

44 | states, DC, and Puerto Rico

U.S. universities/ colleges | **139**

- **NE currently manages 10 Funding Opportunity Announcements and Requests for Applications**
- **2,568 total awards to universities**
- **833 undergraduate scholarships and 435 fellowships totaling more than $73 million**

  => 92% of our concluded graduate fellows are now employed in nuclear energy-related fields

- **More than $25 million to minority-serving institutions (MSIs) over the last 3 years and looking to engage further**
- **2,400+ students supported by Nuclear Energy University Programs (NEUP) R&D**

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The Value of Nuclear in a Clean Energy Future

Chris Nolan, vice president, New Nuclear Generation Strategy & Regulatory Engagement

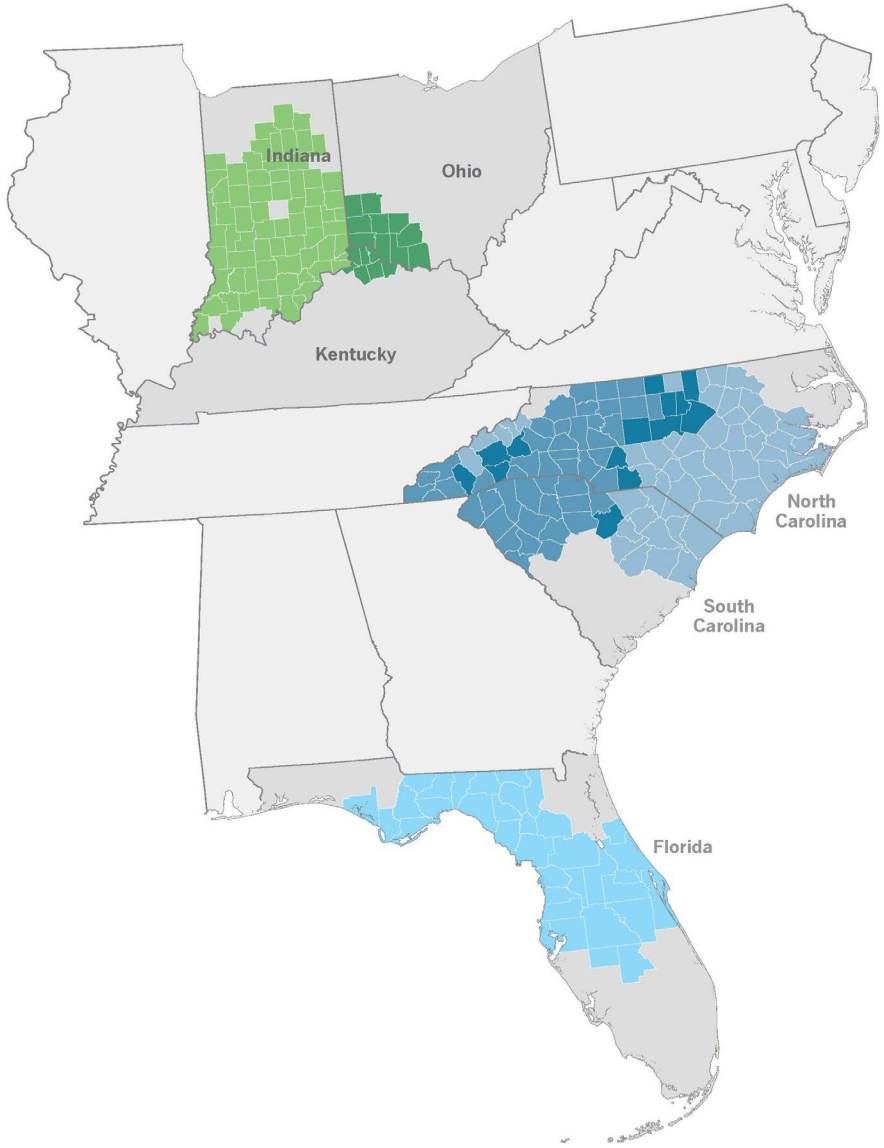
JULY 14, 2024

DUKE ENERGY®

BUILDING A SMARTER ENERGY FUTURE®

Duke Energy Overview

- 8.4 million customers
- Carolinas, Florida, Midwest
- Energy capacity: 54,800 MW
- 27,600 employees
- Clean energy transition
  - 2030: 50% reduction in carbon emissions
  - 2050: Net-zero carbon emissions
- “All of the above” new generation strategy
- Balancing reliability, affordability and environmental sustainability



THREE NUCLEAR STRATEGIES
FOR A CLEAN ENERGY TRANSFORMATION

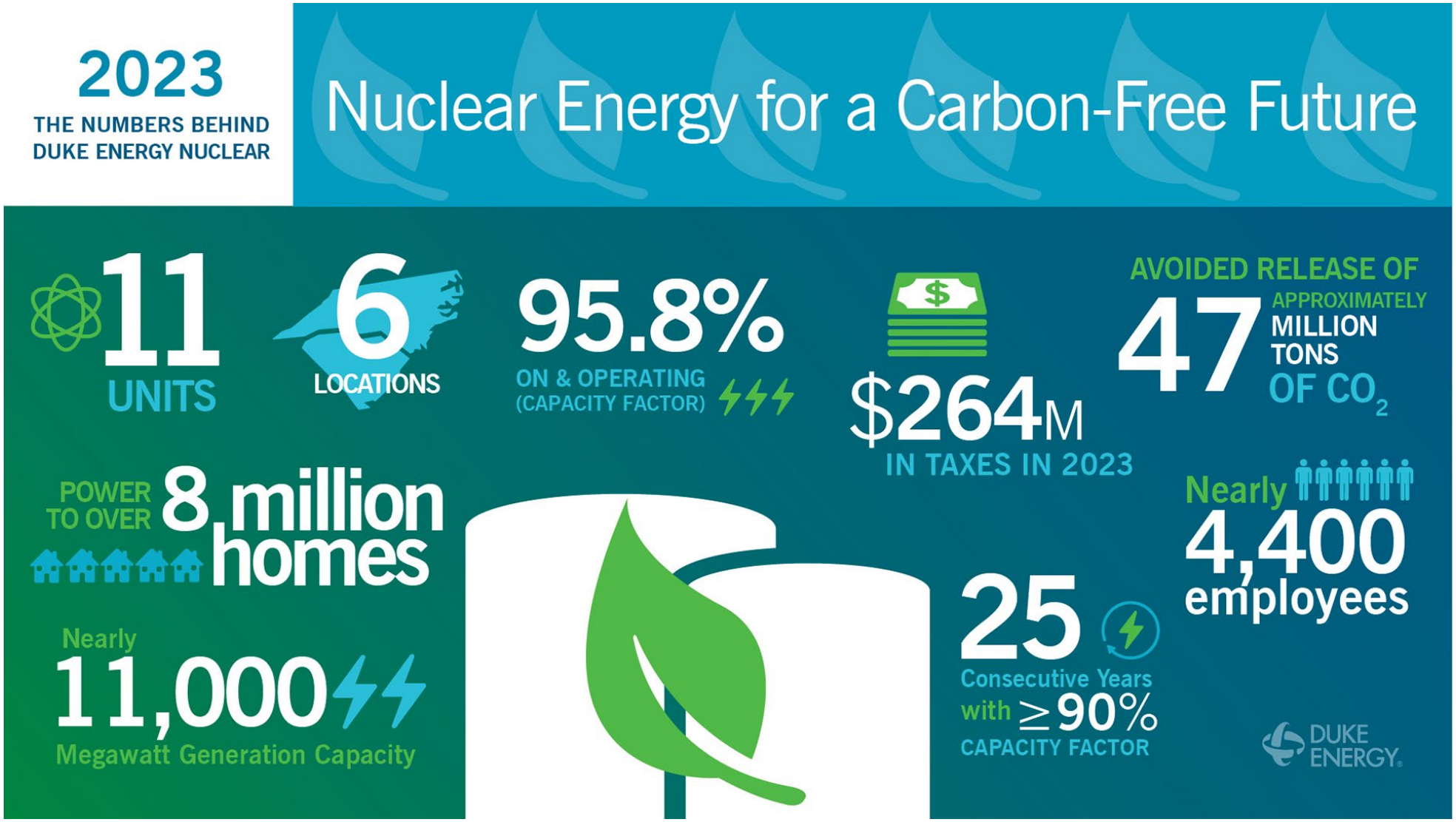
- **TODAY**, continue safe, reliable, innovative and efficient operations
- **TOMORROW**, renew current operating licenses and produce more energy by upgrading components and gaining efficiencies
- For the **FUTURE**, invest in new nuclear technologies and build advanced nuclear plants

Nuclear generation is the only carbon-free energy source that is always on and available 24 hours a day, complementing renewables like solar and wind power.

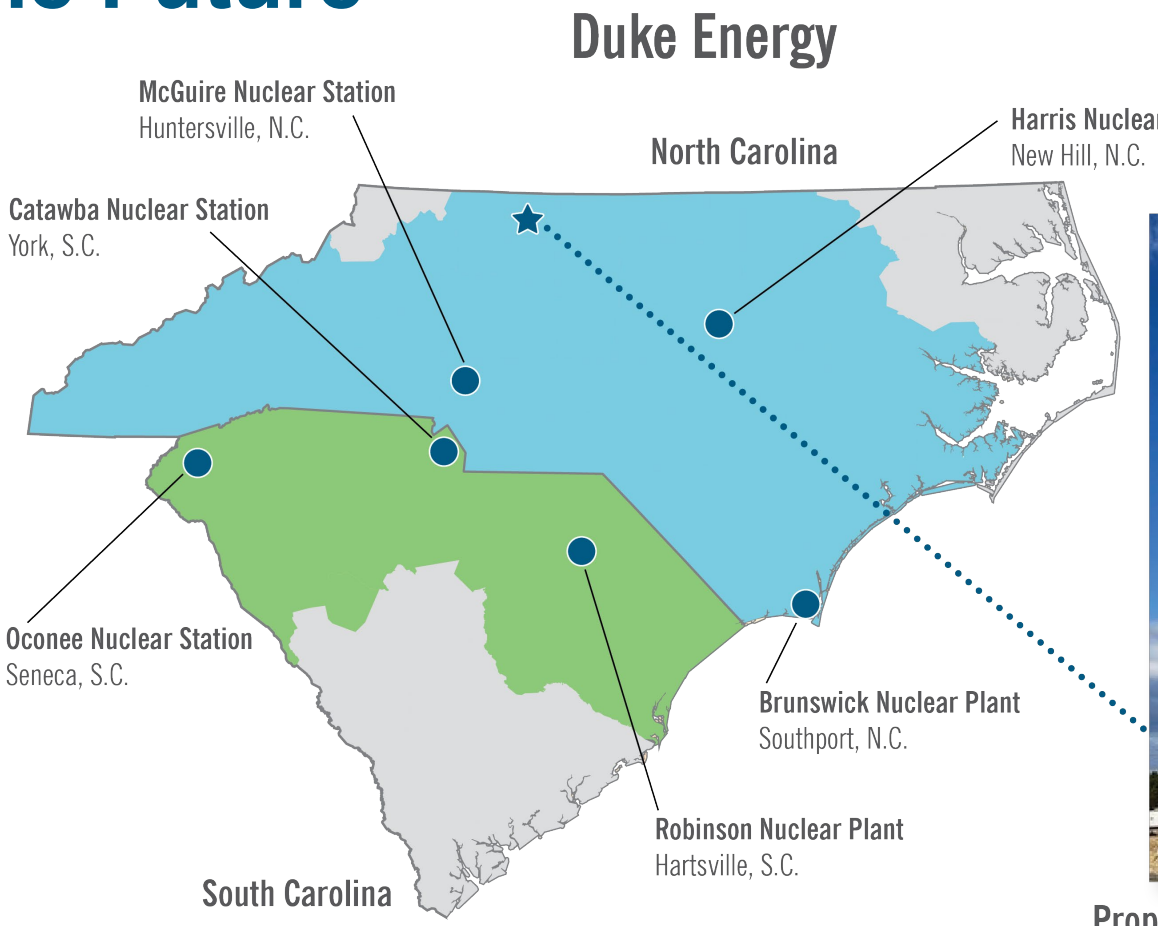
DUKE ENERGY®

*BUILDING A **SMARTER** ENERGY FUTURE®*

The Value of Nuclear



Nuclear Empowers Us Today, Tomorrow and for the Future



Proposed advanced nuclear site near Belews Creek Steam Station
Stokes County, N.C.

Proposed Accelerating Clean Energy Tariffs

Memorandum of Understanding

- Amazon
- Google
- Microsoft
- Nucor

Accelerating Clean Energy Tariffs

- Proposes new, voluntary pricing structures
- Encourages early commitments
- Addresses project risk, lowers costs
- Allows large customers to directly support investment in carbon-free energy

Large Customer Benefits

- On-site generation at their facilities
- Load flexibility programs
- Investments in large-scale clean energy assets

Duke Energy Benefits

- Clean Transition Tariff
  - Provides individualized carbon-free portfolios
  - Matches clean energy and customer load to accelerate grid decarbonization
  - Allows large customers to advance their clean energy goals
  - Protects nonparticipating customers

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Google

Bringing Advanced Nuclear to Market

Michelle Chang, Program Manager, Advanced Clean Electricity Technologies, Google

Google

Google's energy journey

In 2010

Google Signs First Power Purchase Agreement (PPA)

Begin buying renewable energy

Since 2017

100% Renewable Energy

Reducing emissions

By 2030

24/7 Carbon-Free Energy

Eliminating electricity emissions

Net-Zero Emissions

Across all operations and value chain

Google

Google's Approach

24/7 Carbon-Free Energy

Purchasing

Buy more and different types of clean energy deployed locally

Technology

Accelerate technology innovation

Policy

Advocating for policy changes to decarbonize electricity grids

Google

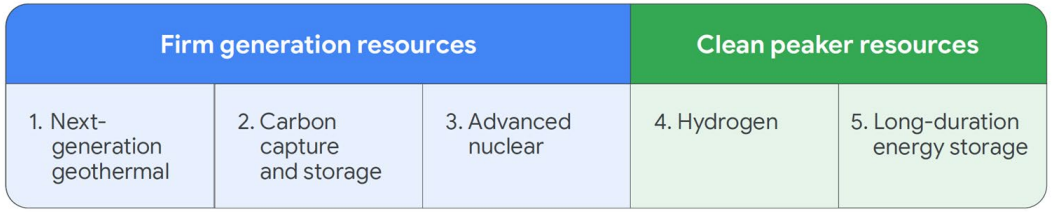
The Corporate Role in Accelerating Advanced Clean Electricity Technologies

September 2023

goo.gle/AdvancedCleanTech

Our recent white paper discusses:

- The importance of advanced clean electricity technologies to creating secure, reliable carbon-free electricity systems
- Five technologies we believe will play a critical role in decarbonization by 2030 and beyond



- Why and how companies can play a catalytic role in the commercialization of these technologies

Our modeling shows that advanced technologies can significantly reduce 24/7 CFE costs and risks

Key insights from our modeling:

1. Advanced CFE technologies are essential to reducing costs of 24/7 CFE portfolios

1. They can reduce market risks in clean energy portfolios, in particular shape risk and cannibalization risk

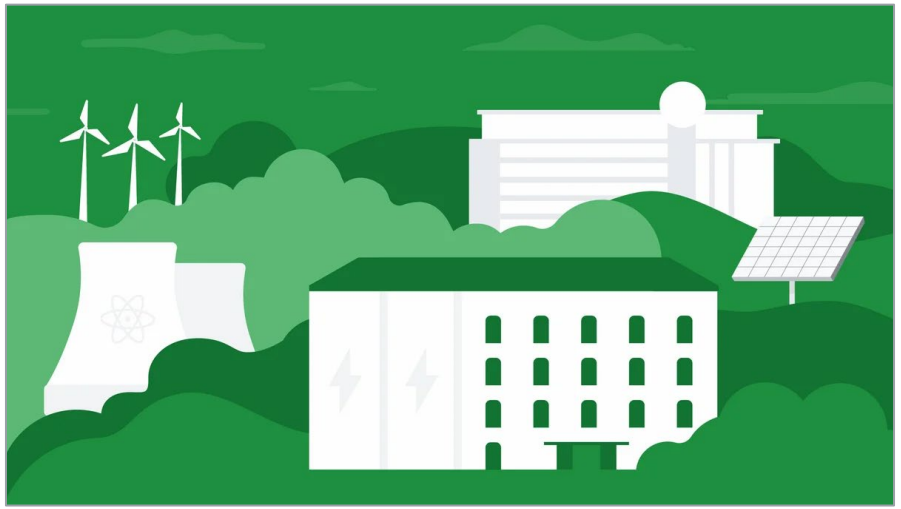
1. Some regions cannot reach high CFE concentrations without advanced technologies (e.g. poor RE resources, land use restrictions).

The inclusion of advanced technologies reduces the cost of achieving 90% hourly CFE across global portfolio by 40%.

Advanced Clean Electricity Technologies RFI

- RFI announced in March 2024 for advanced clean electricity technologies in the US
- Over 200 RFI submissions received across many different technologies
- Intention to sign contracts in Q1 of 2025
- More information: advancedcleanelectricity.com

Google, Microsoft, and Nucor announce a new initiative to aggregate demand to scale the adoption of advanced clean electricity technologies (March 18, 2024)



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This session has concluded.

Check the app for today’s schedule.