

# Advanced Nuclear's Role as a ZELFR\*

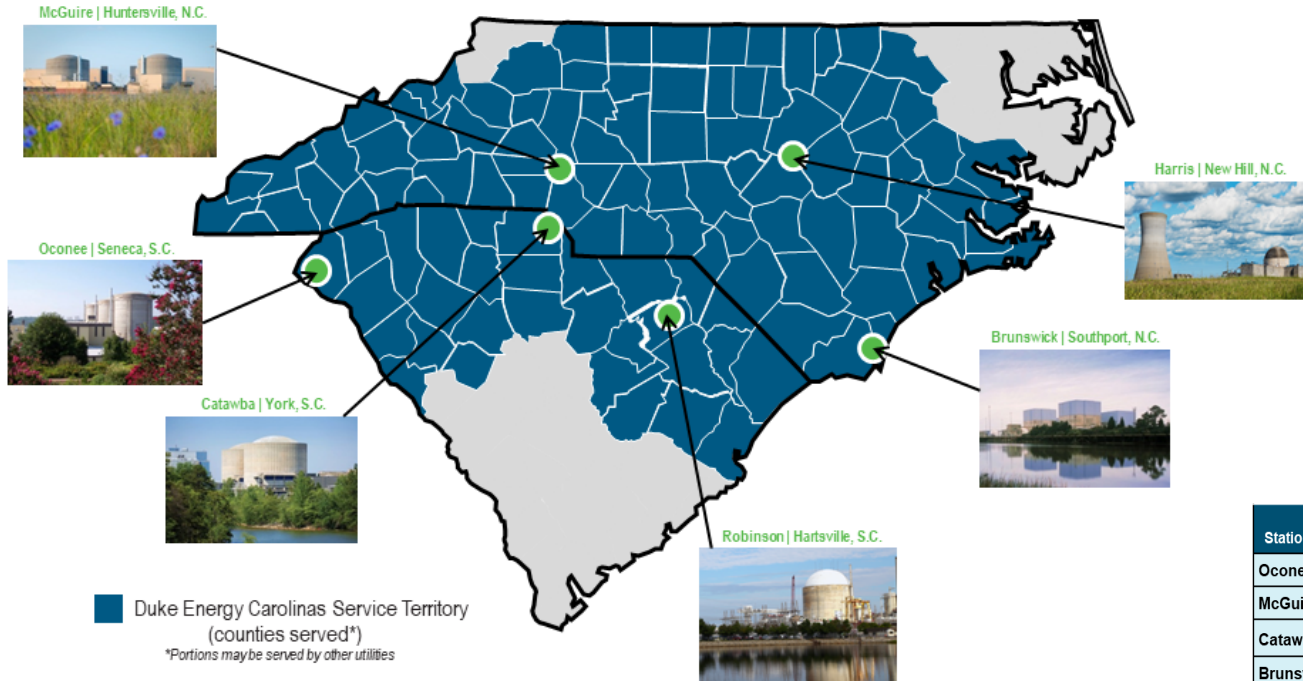
*\*Zero-Emitting Load Following Resource*



**Chris Nolan, Vice President Nuclear Regulatory Affairs, Policy and Emergency Planning**  
South Carolina Governor's Nuclear Advisory Committee – Oct. 18, 2021

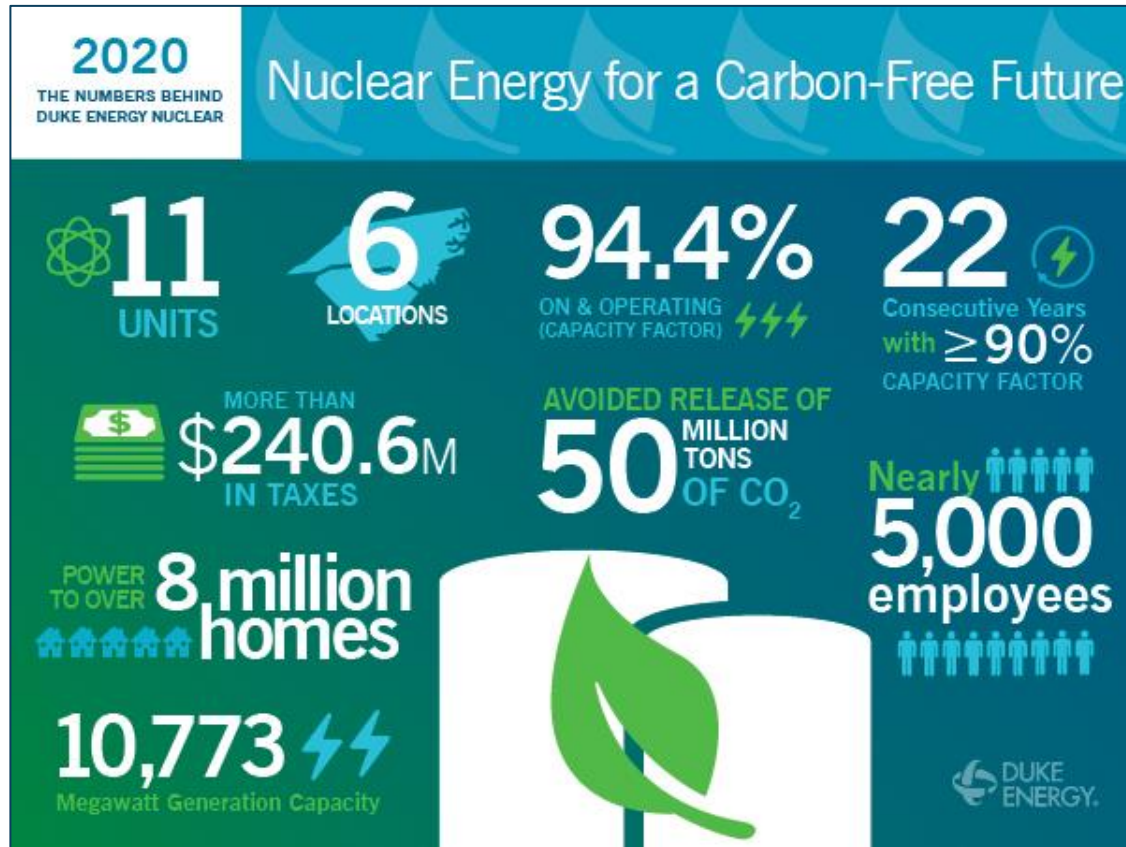


# Duke Energy Nuclear – 11 Generating Units at 6 Sites in the Carolinas



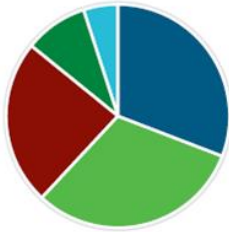
Station	Capacity (MW)	Units	Commercial Operation	License Extension
Oconee	2,554	3 PWRs	1973	2033, 2034
McGuire	2,316	2 PWRs	1981	2041, 2043
Catawba*	2,310	2 PWRs	1985	2043
Brunswick	1,870	2 BWRs	1975	2034, 2036
Harris	964	1 PWR	1987	2046
Robinson	759	1 PWR	1971	2030
<b>Total</b>	<b>10,773</b>	<b>11</b>		

# Duke Energy Nuclear



# Duke Energy Projected Generation Mix

2019



↓ 39% CO<sub>2</sub> Reduction

31% Gas  
31% Existing Nuclear  
24% Coal  
9% Purchase/Sales  
5% Renewables\*

2030



↓ 52% CO<sub>2</sub> Reduction

42% Gas  
30% Existing Nuclear  
14% Renewables\*  
11% Coal  
3% Purchase/Sales

2040



↓ 78% CO<sub>2</sub> Reduction

29% Renewables\*  
29% Existing Nuclear  
25% Gas  
16% ZELFRs  
1% Coal

2050



↓ 95% CO<sub>2</sub> Reduction

36% Renewables\*  
30% ZELFRs  
28% Existing Nuclear  
6% Gas

\*Renewables include hydro, wind, solar, landfill gas, biomass, etc.

# Department Of Energy's (DOE) Advanced Reactor Demonstration Program (ARDP)

## TerraPower/GE-Hitachi Sodium Reactor

- Duke Energy is partnering with TerraPower and Team Sodium, which was chosen as one of the demonstration awards
  - TerraPower and GE-Hitachi (Reactor Design/Licensing)
  - Bechtel Power (Procure/Construction)
  - Duke Energy, Energy Northwest, & PacifiCorp (Utilities)
  - Global Nuclear Fuels, Centrus Energy, and Orano (Fuels)
  - NC State, Oregon State, University of Wisconsin, and Idaho and Argonne national labs
- Must be designed, sited, licensed, constructed, and operational within 7 years (i.e., by end of 2027)
- Provides initial \$80 million to the project from DOE for first year (up to \$2 billion total through completion)
- The Sodium reactor is a 345-500 megawatt Liquid Sodium-Cooled Fast Reactor w/ Thermal Storage
  - Operates at high temperature and atmospheric pressure (approximately)
  - Utilizes a molten salt storage system, can load follow while reactor maintains 100% power
  - High efficiency steam for flexible operations; industrial process heat applications, hydrogen production
  - Uses high-assay, low-enriched uranium (HALEU) in fuel assemblies

# Department Of Energy's Advanced Reactor Demonstration Program (ARDP)

---

## X-energy Xe-100 Reactor

- X-energy's Xe-100 was the other reactor design chosen for a demonstration award under ARDP
  - 80-megawatt High Temperature Gas-Cooled Reactor (HTGR) – Standard design is a four-pack of reactors (320 megawatts)
  - Uses TRISO fuel with pebble bed technology – Uses Helium for cooling
  - Energy Northwest also partnered with X-energy in the ARDP
  - In April 2021, X-energy and Energy Northwest signed an MOU with Grant County, Washington., Public Utility to design, build, and operate the Xe-100 HTGR plant, to be located adjacent to the Columbia Nuclear Generating Station

# Department Of Energy's Advanced Reactor Demonstration Program (ARDP)

## Risk Reduction Awards under ARDP

- **Kairos Power – For reduced-scale Fluoride Salt-Cooled High Temperature Reactor (KP-FHR) [\$303 million over 7 years]**
  - 140-megawatts; TRISO fuel with pebble bed technology
  - Will build the prototype Hermes reactor in Oak Ridge, Tenn., at former DOE site
  - Agreement in May 2021 for TVA to provide Licensing, Engineering, and Operations support for the prototype
  
- **Holtec LLC – For early-stage design, engineering, and licensing of SMR-160 Light Water-Cooled SMR [\$116 million]**
  - 160 MWe, Plan to demonstrate the reactor at the Oyster Creek site in New Jersey
  - Started pre-application process with submittal of Topical Reports to the NRC
  
- **Southern Co. – To build and operate reduced-scale of TerraPower's Molten Chloride Fast Reactor (MCFR) [\$90 million]**
  - The MCFR can be sized up to 1,200 megawatts
  - Liquid core utilizes molten salts as both fuel and coolant
  
- **BWXT Advanced Technologies – BWXT Advanced Nuclear Reactor [\$85 million]**
  - 1 – 5 megawatts; transportable micro-reactor
  - Will use TRISO fuel in pellet form
  - Separately, BWXT and X-Energy selected to develop Project Pele mobile microreactor for Department of Defense
  
- **Westinghouse Electric – eVinci Micro-reactor [\$7 million]**
  - 1 – 5 megawatts; transportable micro-reactor, uses heat pipe cooling
  - Will use TRISO fuel in pellet form

# Duke Energy Industry Engagement

---

## **Technical Advisory Boards**

- Natrium Utility Advisory Committee
- Kairos Power Advisory Board
- NuScale Advisory Board
- Terrestrial Corp. Industrial Advisory Board
- Molten Chloride Fast Reactor (MCFR) Utility Advisory Committee
- Versatile Test Reactor (VTR) Utilities Advisory Board
- Advanced Reactors Technical Advisory Group (ARTAG)
- General Fusion Market Development Advisory Committee (MDAC)

## **Working Groups and Task Forces**

- New Plant Advisory Committee (NPAC)
- Advanced Reactor Regulatory Task Force (ARRTF)
- Advanced Nuclear End Users Task Force
- Advanced Nuclear Technology (ANT) Program
- Advanced Reactor Fuels Task Force
- Advanced Reactor Forum
- Molten Salt Reactor Technology Working Group
- New Plant Working Group (NPWG)
- Part 53 Rulemaking Working Group
- New and Advanced Reactor Steering Committee
- SMR Start



# Plant Siting and Early Site Permits

---

## **Early Site Permit (ESP) with Limited Work Authorization (LWA)**

- Four years and \$50 million to complete
- Available for 20 years and can be renewed for 10 to 20 years
- Permit can be transferred with the property
- Cost Recovery – DOE Cost Share / State Legislative Initiative
- Critical siting factors
  - Water, seismic, need for power, transmission, endangered species, historic
  - Select multiple sites to conduct field studies
  - Two years to complete field work and environmental report
- Opportunities for federal, state, and public engagement



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