

Advanced Nuclear Energy

Oklahoma Senate Energy and
Telecommunications Meeting

October 31, 2023

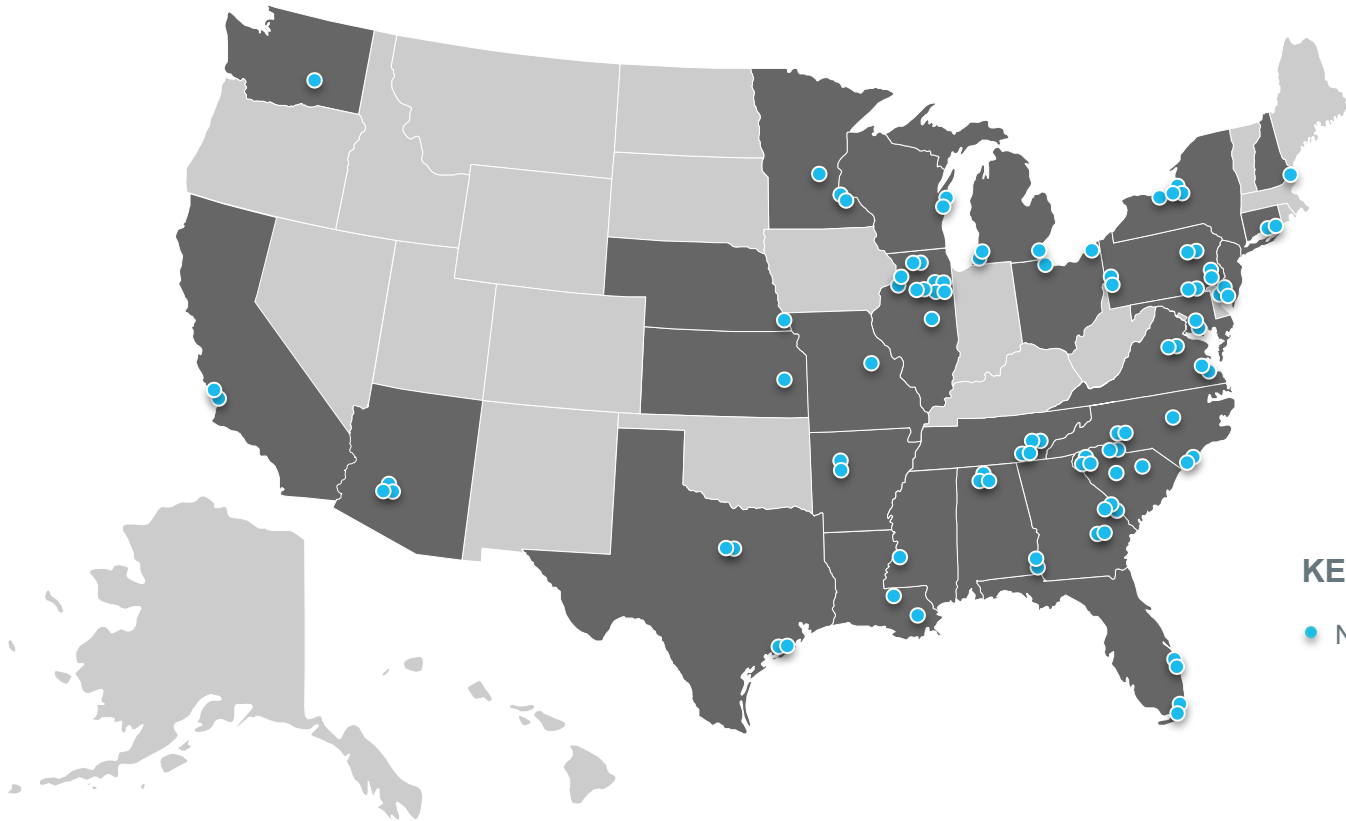


Marc Nichol
Executive Director, New Nuclear

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Nuclear Provides Majority of Emissions-Free Electricity



Nuclear generated 19% of electricity in the U.S.

From 93 reactors at 53 plant sites across the country

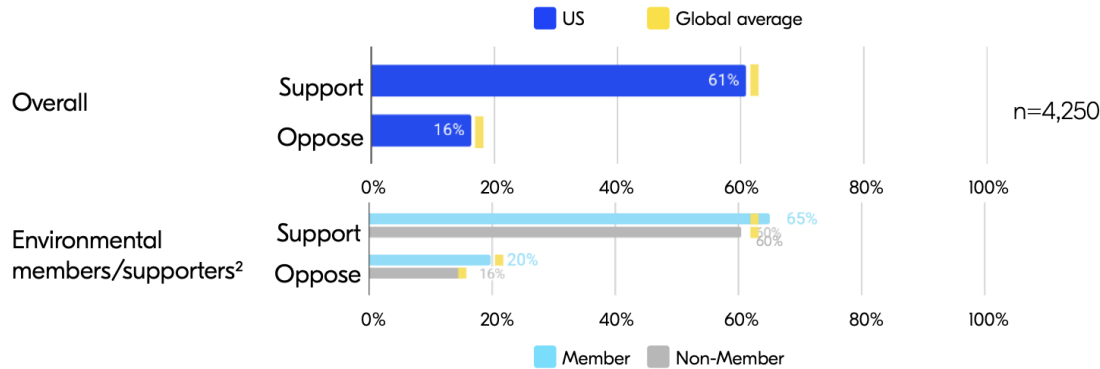
KEY

● Nuclear power reactor

Strong Support for Nuclear Energy



Support vs. opposition¹



Support by...

Gender

Men	73%
Women	50%

Age

18-34	58%
35-54	62%
55+	62%

Income

Low income (under 50k USD)	52%
Medium income (50k-100k USD)	60%
High income (100k+ USD)	70%

Political Affiliation

Democrat	61%
Independent	60%
Republican	66%

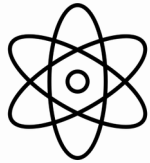
Top 5 nuclear sentiments³

(% agree)

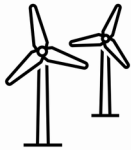
We need a way to produce more and more energy for our economy to keep growing	76%
We need to be building capacity for more energy, not just trying to use less	63%
We need nuclear energy in the mix, along with renewables, if we are to meet our climate goals	60%
Leaving nuclear waste behind is just wrong, however safe it is	59%
We should use advanced nuclear energy to reduce our dependence on other countries	58%

Lowest System Cost Achieved by Enabling Large Scale New Nuclear Deployment

Lowest Cost System

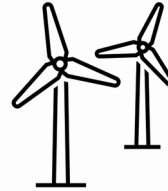


Nuclear is 43% of generation (>300 GW of new nuclear)

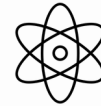


Wind and solar are 50%

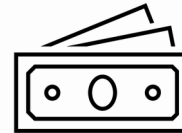
Energy System with Nuclear Constrained



Wind and Solar are 77% of generation



Nuclear is 13% (>60 GW of new nuclear)



Increased cost to customers of \$449 Billion

Both scenarios are successful in reducing electricity grid GHG emissions by over 95% by 2050 and reducing the economy-wide GHG emissions by over 60%

System Benefits of Advanced Reactors

Long term price stability

- Low fuel and operating costs

Reliable dispatchable generation

- 24/7, 365 days per year, years between refueling (Capacity factors >92%)

Efficient use of transmission

- Land utilization <0.1 acre/TWh (Wind =1,125 acre/TWh; Solar 144 acre/TWh)

Environmentally friendly

- Zero-carbon emissions, one of lowest total carbon footprints
- Many SMRs are being designed with ability for dry air cooling

Integration with renewables and storage

- Paired with heat storage and able to quickly change power

Black-start and operate independent from the grid

- Resilience for mission critical activities
- Protect against natural phenomena, cyber threats and EMP

Types of Advanced Reactors

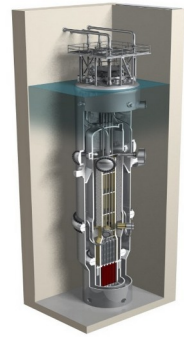
Range of sizes and features to meet diverse market needs

Micro Reactors
< 20MWe



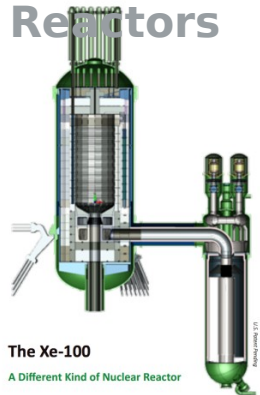
Oklo (shown)
Approximately a dozen
in development

LWR SMRs
<300MWe



NuScale (shown)
GEH BWRX-300
Holtec SMR-160
Westinghouse AP300

High Temp Gas Reactors



X-energy (shown)
Several in development

Liquid Metal



TerraPower Sodium™ (shown)
Several in development

Molten Salt



Terrestrial (shown)
Several in development

Non-Water Cooled
Most <300MWe, some as large as 1,000 MWe



Learn more about innovative technologies with the Nuclear Innovation Alliance.

Strong Federal Support for Advanced Reactors

- DOE funding 12 different designs, >\$5B over 7 years
- Infrastructure Bill
 - \$2.5B funding for two demonstration projects
- Inflation Reduction Act
 - PTC: At least \$30/MWh for 10 years
 - ITC: 30% of investment
 - Both can be monetized, include 10% bonus for siting in certain energy communities
 - Loan Guarantees – up to \$40B in expanded authority
 - HALEU Fuel - \$700M
- CHIPS Act
 - Financial assistance to States, Tribes, local governments and Universities

September 2022

Current Federal Policy Tools to Support New Nuclear

The following is a list of current policy tools that could directly support the deployment of new nuclear, could potentially indirectly support the deployment or planning for new nuclear, and that currently support the deployment of new nuclear.

Programs that Could Directly Support Deployment of New Nuclear

Clean Electricity Production Credit – 45V

The Inflation Reduction Act created a new technology-neutral tax credit for all clean electricity technologies, including advanced nuclear and power uprates that are placed into service in 2023 or after. The bill does not change the existing Advanced Nuclear Production Tax Credit but precludes credits from being claimed under both programs. The value of the credit will be at least \$30 per megawatt-hour, depending on inflation, for the first ten years of plant operation. The credit phases out when carbon emissions from electricity production are 75 percent below the 2022 level. The following is a link to the statutory language.

<https://uscode.house.gov/view.xhtml?req=granuleid:USC-prelim-title26-section45V>

Clean Electricity Investment Credit – 48E

As an alternative to the clean electricity PTC, the Inflation Reduction Act provided the option of claiming a clean electricity investment credit for zero-emissions facilities that is placed into service in 2025 or thereafter. This provides a credit of 30 percent of the investment in a new zero-carbon electricity facility, including nuclear plants. Like the other credits, this investment tax credit can be monetized. The ITC phases out under the same provisions as the clean electricity PTC.

<https://uscode.house.gov/view.xhtml?req=granuleid:USC-prelim-title26-section48E>

Both the clean electricity PTC and ITC include a 10-percentage point bonus for facilities sited in certain energy communities such as those that have hosted coal plants. The following is a link to the statutory language.

Credit for Production from Advanced Nuclear Power Facilities – 45I

The nuclear production tax credit 26 USC 45I provides a credit of 1.8 cents per kilowatt-hour up to a maximum of \$125 million per tax year for 8 years. Only the first 6000 MW of new capacity installed after 2005 for a design approved after 1988 are eligible for the tax credit. The credit does not include a direct pay provision, so the owner will need to have offsetting taxable income to claim the credit or transfer the credit to an eligible project partner. The following is a link to the statutory language.

<https://uscode.house.gov/view.xhtml?req=granuleid:USC-prelim-title26-section45I>

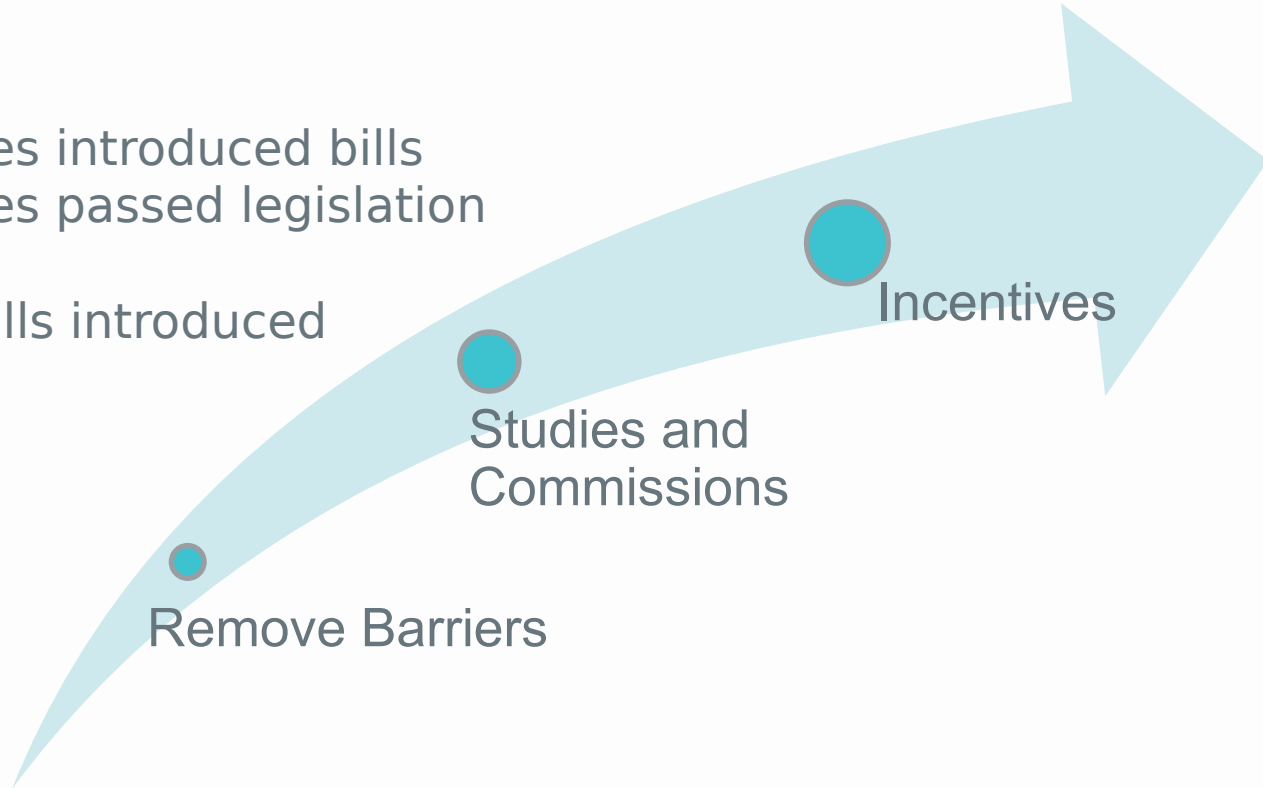
State Action for Advance Reactors

2022

- 19 States introduced bills
- 11 States passed legislation

2023

- 200+ bills introduced



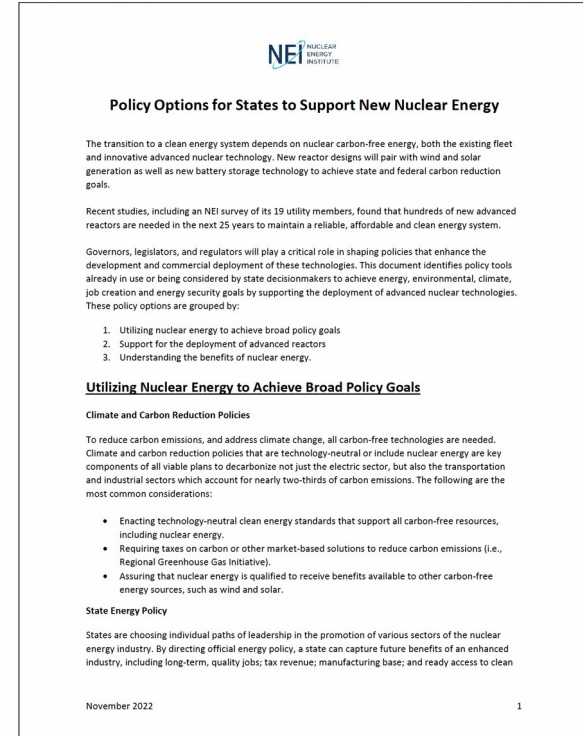
Remove Barriers

Studies and
Commissions

Incentives

State Options to Support Advanced Reactors

- Reliability Portfolio Standards
- Value-based market/regulatory system
- Tax incentives (e.g., property)
- Advanced cost recovery
- Workforce and infrastructure



2023 State Actions for Nuclear Energy

CES and Defining Clean
Minnesota, Idaho, Tennessee,
North Carolina

Workforce Development
Virginia, West Virginia

SMR Incentive
Indiana

SMR Study
North and South Dakotas

Moratorium Repeal
Illinois

Energy Study
Colorado

Hydrogen/Nuclear
Nebraska

Nuclear Working Group or Authority
Kentucky, Connecticut, Ohio

Coal to Nuclear
Texas

Fuel Recycling
Arkansas

Interim SMR Study
Oklahoma, West Virginia

Nuclear Energy Caucus
Washington, Texas, Michigan

2023 Governor Actions

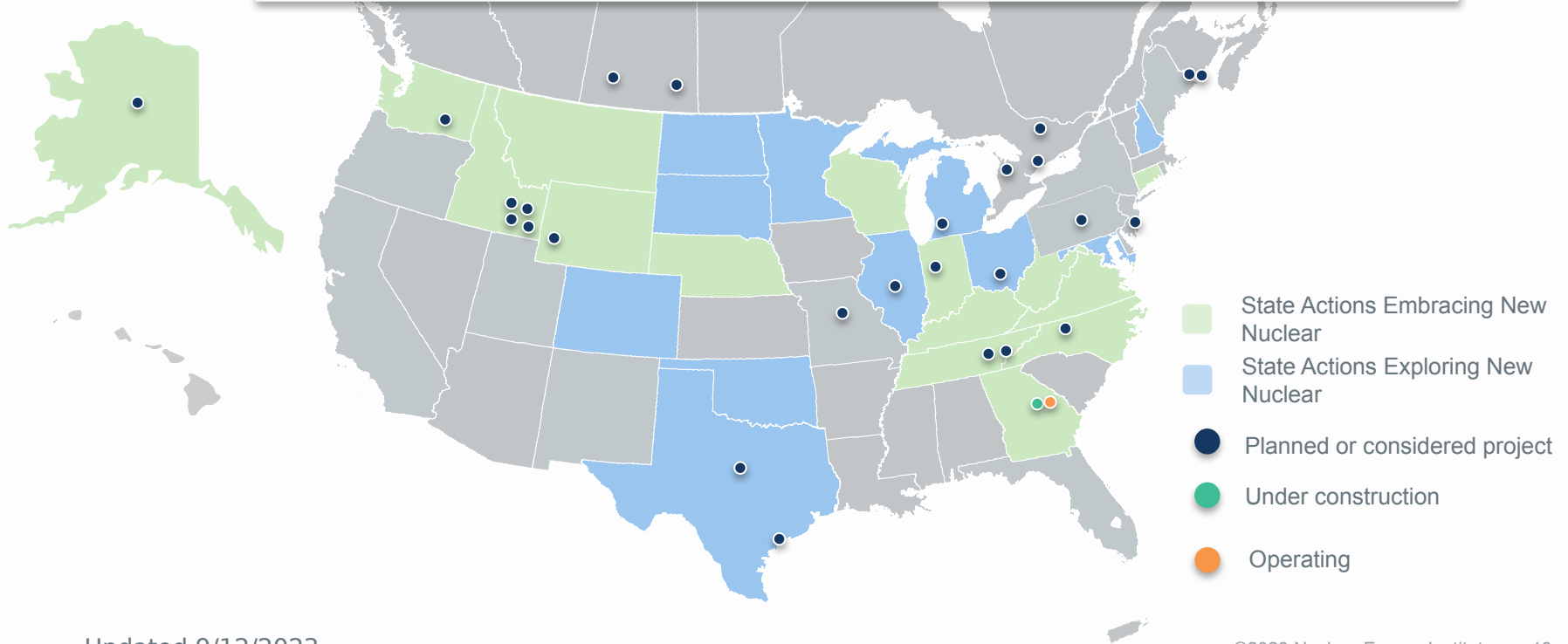
- Tennessee's Governor Lee's **\$50 Million** for Incentives and Nuclear Energy Advisory Council
- Michigan's Governor Whitmer **\$150 Million** for re-activating Palisades in state budget
- Governor Abbott directing the PUCT to create a working group to develop rules for advanced nuclear

State Regulatory Activities

State	Activity (2022-2023 action or impact to the commission related to existing and new nuclear)
California	<ul style="list-style-type: none"> The commission currently has an open rulemaking to consider extending operations at Diablo Canyon nuclear plant.
Indiana	<ul style="list-style-type: none"> 2022 legislation requires the commission to adopt rules by July 1, 2023 granting the certificates for the construction and purchase or lease of SMRs.
Louisiana	<ul style="list-style-type: none"> Commissioner Eric Skrmetta has put forward a directive for the PSC to study new nuclear.
Michigan	<ul style="list-style-type: none"> Following 2022 legislation, the commission has selected a firm to conduct a study examining existing and new nuclear generation in the state. The study is due back to the PSC in March 2024.
Montana	<ul style="list-style-type: none"> In 2022, the commission opened an investigative docket to address issues of resource adequacy and risk surrounding Montana's energy future. Discussions are ongoing and include nuclear's role to address the state's energy needs.
New Jersey	<ul style="list-style-type: none"> Several pending bills would require the commission to consider the use and development of diverse energy sources such as nuclear when preparing the state's Energy Master plan. Pending legislation would establish a new Clean Energy Advocate position within the BPU. The position will facilitate coordination among various state agencies on clean energy projects, including nuclear.
North Carolina	<ul style="list-style-type: none"> The commission approved a carbon plan in Dec. 2022 requiring Duke Energy Carolinas to pursue the license extensions for its existing nuclear fleet and authorizes the utility to incur project development costs associated with new nuclear generation. Duke Energy filed its combined carbon plan and IRP in NC on Aug. 17. The IRP includes 600 MW of new nuclear by 2035, with the first SMR operating in 2034. It also names the Belews Creek coal site for the SMR. A bill (vetoed by the governor) is back with the legislature (with a likely override and litigation) that would change the composition of the commission (from 7 members to 5), and how they are appointed (from all governor appointed to several House and Senate appointments).
South Carolina	<ul style="list-style-type: none"> Duke Energy filed its IRP on Aug. 15, 2023, which includes developments from NC's carbon plan, such as support for existing reactors and studying new nuclear.
South Dakota	<ul style="list-style-type: none"> The commission approved a 2023 order allowing deferred accounting treatment for costs to Northwestern Energy to study new nuclear. The utility identified nuclear in its most recent IRP submitted in 2022.
Texas	<ul style="list-style-type: none"> Governor's Executive Order establishes a new nuclear working group through the PUCT. Commissioner Jimmy Glodfelty will be leading the group, with recommendations due back to the Governor in 2024.
Virginia	<ul style="list-style-type: none"> Legislation considered this session would have required the commission to establish an SMR pilot program. Dominion Energy submitted its 2023 IRP to the commission, which includes 5 scenarios. All but one, a least-cost plan the company was required to model but said it doesn't consider a true "path forward," include the development of SMRs.
West Virginia	<ul style="list-style-type: none"> Legislation considered this session would have directed the commission to create advanced reactor regulations.

Advanced Nuclear Deployment Plans

Projects in planning or under consideration in U.S. and Canada for Operation ~2030



QUESTIONS?

