

Advanced Nuclear Energy

AES Indiana: IRP Meeting

September 19, 2022

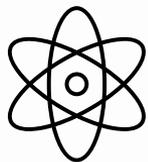


Technology Developers - NEI Members

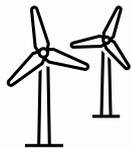


Lowest System Cost Achieved by Enabling Large Scale New Nuclear Deployment

Lowest Cost System

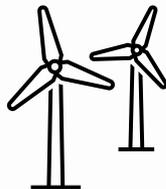


Nuclear is 43% of generation (>300 GW of new nuclear)

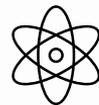


Wind and solar are 50%

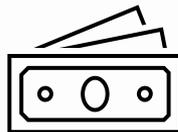
Energy System with Nuclear Constrained



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%

Expanding Versatility through Advanced Technology

Micro Reactors
($< 20\text{MW}$)



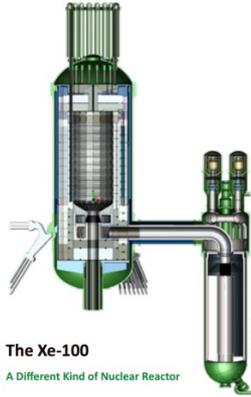
Oklo (shown)
Approximately a dozen in
development

LWR SMRs
 $< 300\text{MW}$



NuScale (shown)
GEH X-300
Holtec SMR-160

High Temp
Gas Reactors



The Xe-100
A Different Kind of Nuclear Reactor

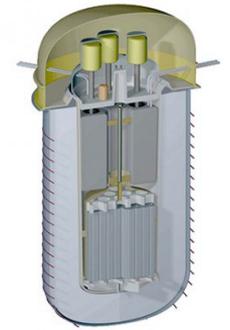
X-energy (shown)
Several in development

Liquid Metal Reactors



TerraPower Sodium (shown)
Several in development

Molten Salt Reactors



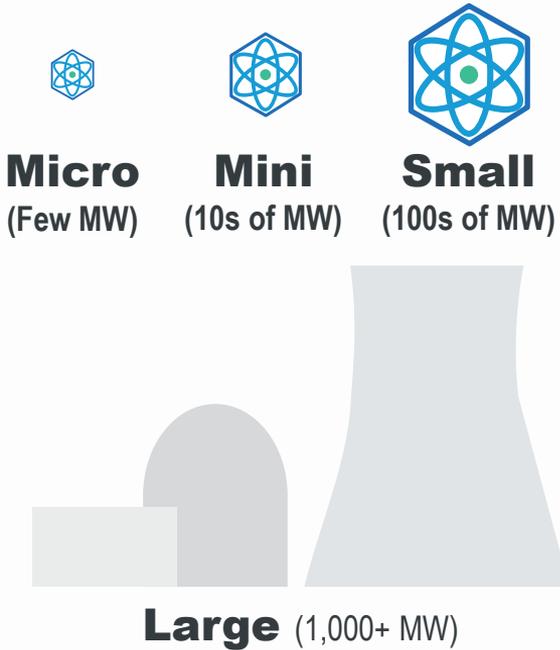
Terrestrial (shown)
Several in development

Non-Water Cooled

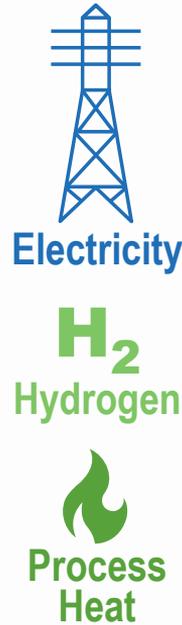
Most $< 300\text{MW}$, some as large as $1,000\text{ MW}$

Expanded Versatility Meets a Diverse Set of Market Needs

Spectrum of Sizes/Options



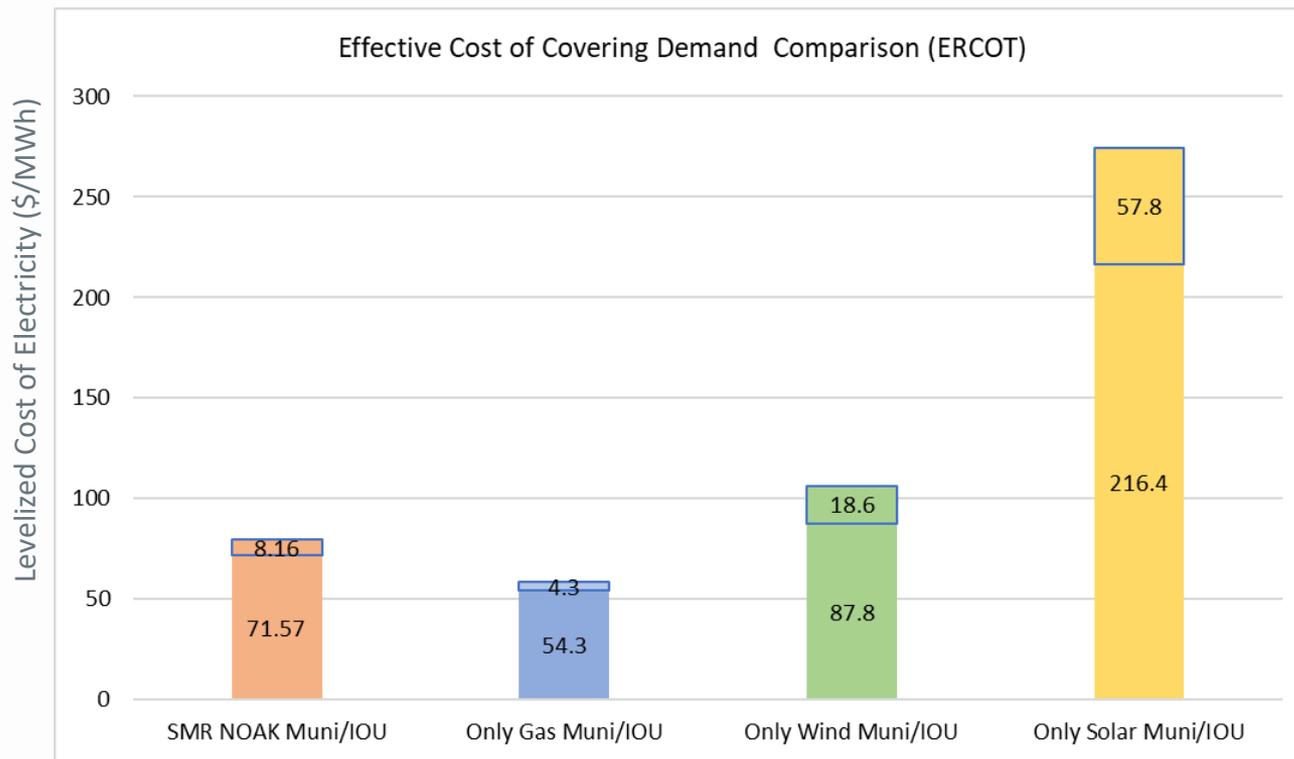
Variety of Outputs



Multitude of Uses



Nuclear Affordability is Clear when Considering Reliability



SMR Start Report: <http://smrstart.org/wp-content/uploads/2021/03/SMR-Start-Economic-Analysis-2021-APPROVED-2021-03-22.pdf>

Federal Support for Advanced Reactors

■ 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

■ Other Federal Programs

- DOE funding 12 different designs, >\$5B over 7 years

July 2022

Current Policy Tools to Support New Nuclear

The following is a list 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

Production Tax Credit

The current 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 MWh of new capacity installed after 2005 for a design approved after 1993 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=production-tax-credit&f=&qt=true&num=&h=true&e=0&num=0&page=0&size=100&sk=0&sort=asc>

Loan Program Office

The DOE Loan Program Office (LPO) has \$10.9 billion in loan guarantees available for advanced nuclear projects. The loan guarantees can be for advanced nuclear reactors including small modular reactors, upgrades and upgrades at existing facilities and front end of the fuel cycle projects (conversion, enrichment and fuel fabrication). LPO can offer 100% guarantee of U.S. Treasury's Federal Finance Bank (FFB) loans or partial guarantees of commercial loans.

The following are links to a slide deck providing an overview of LPO and a fact sheet on the advanced nuclear energy loan guarantees.
https://www.energy.gov/sites/default/files/2022-05/DOE-LPO22-PP1v02_LPO-Overview-Slides.pdf
<https://www.energy.gov/sites/default/files/2020/01/17/DOE-LPO-Nuclear-Energy-Jan2020.pdf>

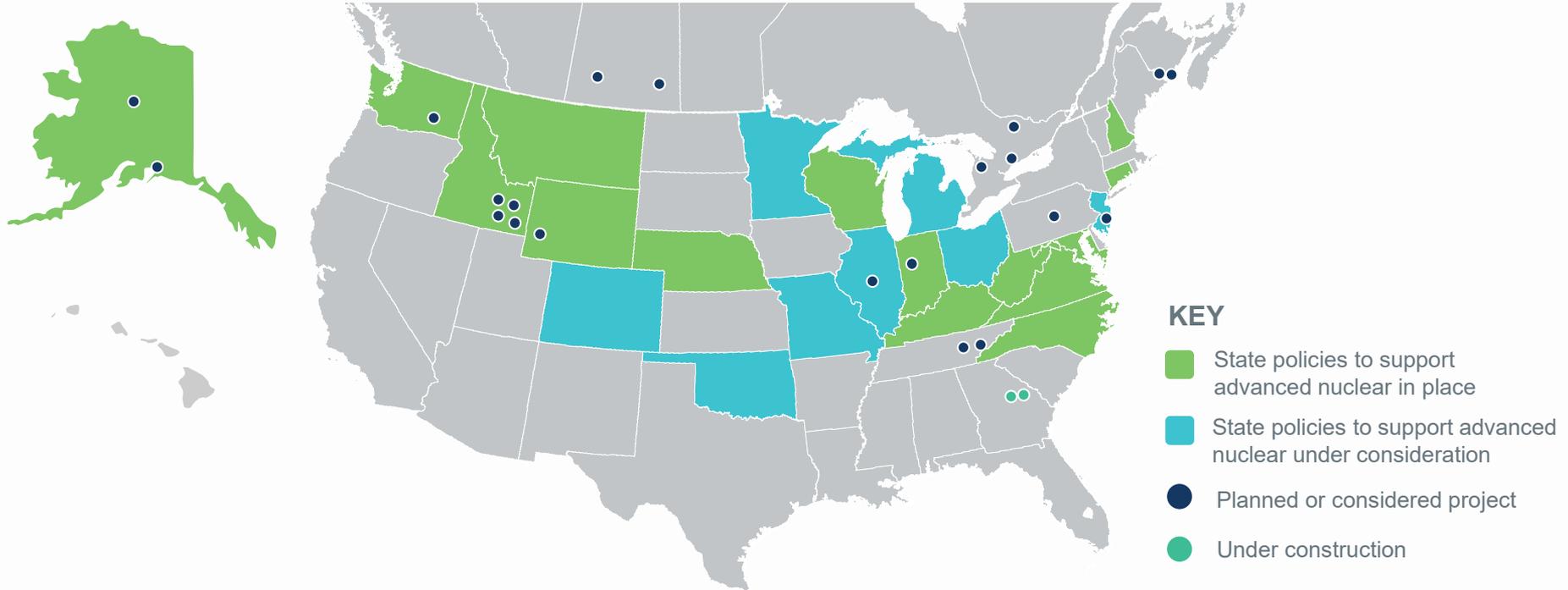
Power Purchase Agreements

Federal power purchase agreements (PPAs) could be, under the right circumstances, a meaningful method to spur the siting and deployment of nuclear power projects. However, PPAs have been difficult to implement in practice. Generally, federal agencies can enter into PPAs to obtain power from a reactor under the United States General Services Administration's ("GSA") authority set forth in 40 USC 501 (subject to applicable federal and state requirements relating to the provision of electricity). However, this GSA authority is currently limited to a maximum of ten years. Legislation has been introduced various times to increase the duration of PPAs but has not been enacted. The following is a link to the statutory language.
<https://uscode.house.gov/view.xhtml?req=granuleid&USC-prelim=true&num=0&page=0&size=100&sk=0&sort=asc>

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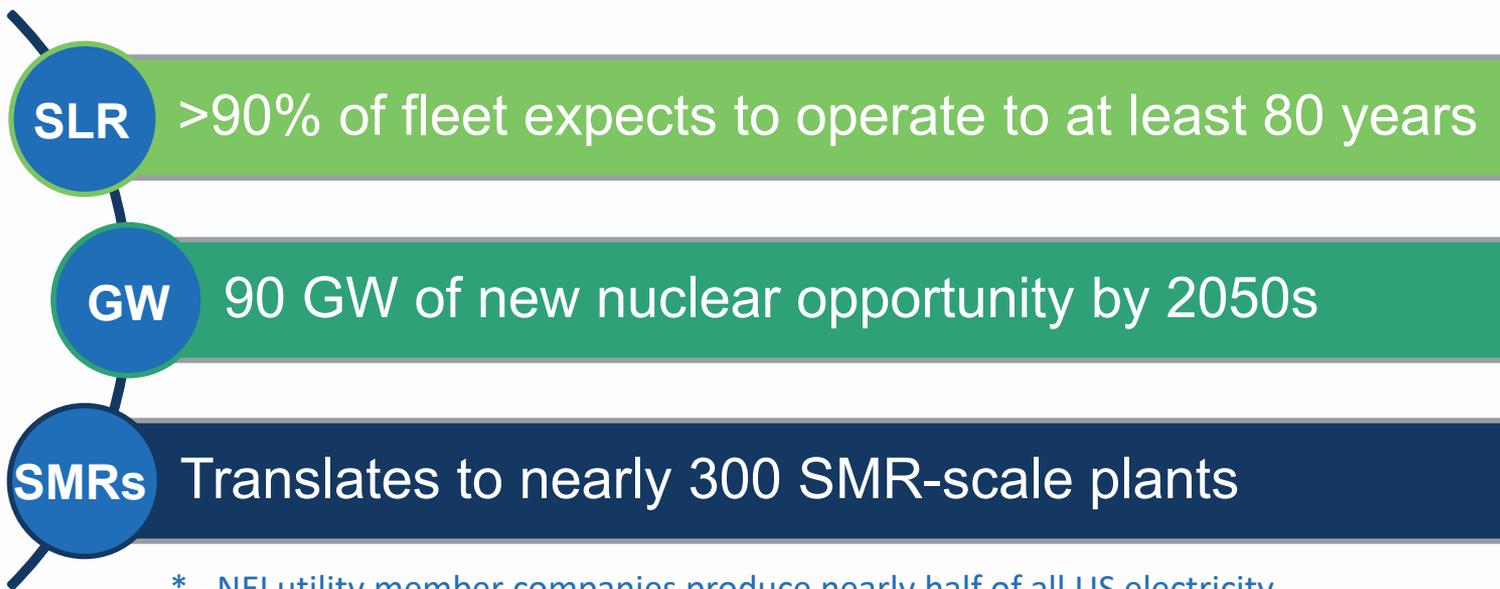
Plans for Advanced Nuclear Deployment are Growing

Projects in planning or under consideration in U.S. and Canada >20; Globally >30



Electric Utilities are Planning for New Nuclear

Nuclear power's potential role in meeting their company's decarbonization goals:



* - NEI utility member companies produce nearly half of all US electricity

System Benefits of SMRs

- Long term price stability
 - Low fuel and operating costs
- Reliable dispatchable generation
 - 24/7, 365 days per year, years between refueling (Capacity factors >92%)
- Integration with renewables and storage
 - Paired with heat storage and able to quickly change power
- Efficient use of transmission
 - Land utilization <0.1 acre/TWh (Wind =1,125; Solar 144 acre/TWh)
- Environmentally friendly
 - Zero-carbon emissions, one of the lowest total carbon footprints
 - Many SMRs are being designed with ability for dry air cooling
- Black-start capability and able to operate independent from the grid
 - Resilience for mission critical activities
 - Protect against natural phenomena, cyber threats and electro-magnetic pulses

QUESTIONS?

