ADVANCED ENERGY TECHNOLOGIES

Legal and Environmental Considerations for Small Modular Reactors

Webinar | 11:00 AM - 12:30 PM MDT


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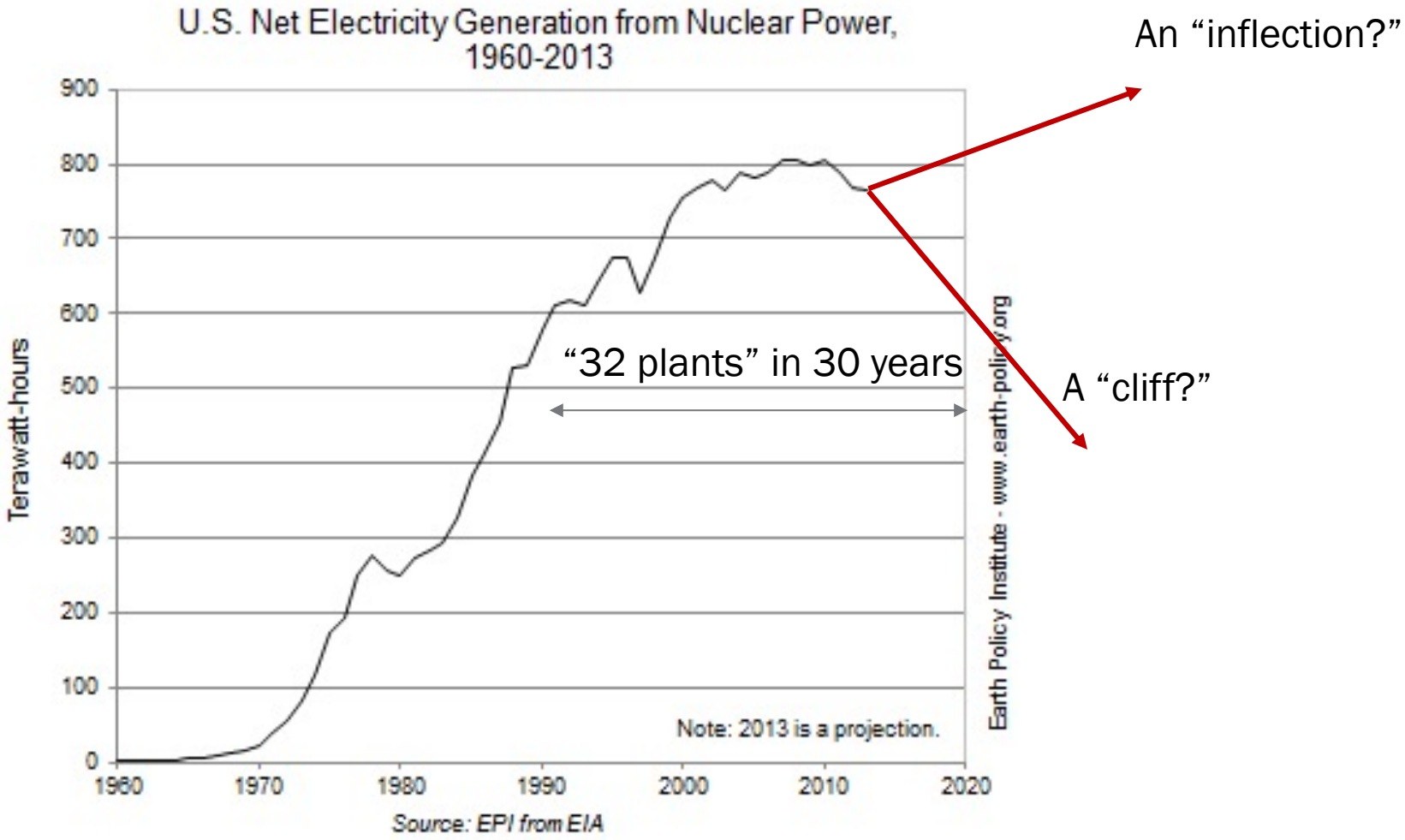
21ST CENTURY NUCLEAR ENERGY

JUNE 2021, TODD ALLEN, PROFESSOR & SENIOR FELLOW

FASTEST PATH TO ZERO
UNIVERSITY OF MICHIGAN

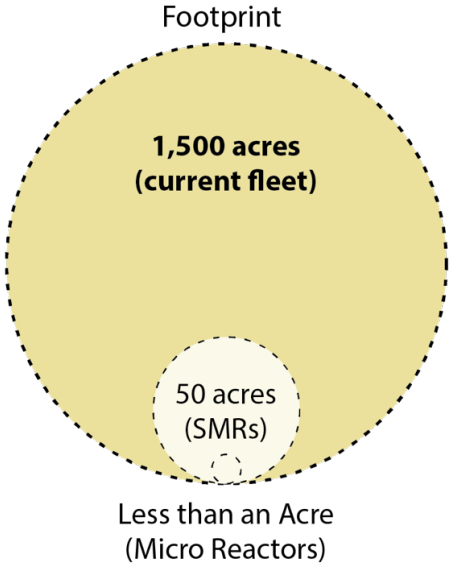
TRAJECTORY OF ATOMS FOR PEACE GENERATION



http://www.earth-policy.org/plan_b_updates/2013/update116

EXISTING NUCLEAR REACTORS

Number in operation:	**98 in U.S.**
Timeframe:	**Built in the 1950s-1980s**
Products:	**Electricity**
Megawatts:	**1,000+ megawatts**
Customers:	**Large utilities**
Emergency zone:	**10 miles**
Construction:	**Custom built on site**
Scalability:	**Difficult due to size and cost**



Applications:
Baseload electricity; 24/7

Did you know? In November 2018, the Union of Concerned Scientists recommended federal and state governments adopt policies to preserve the low-carbon electricity the current fleet of nuclear reactors provides.

Courtesy Shannon Bragg-Sitton, Ph.D., Idaho National Laboratory

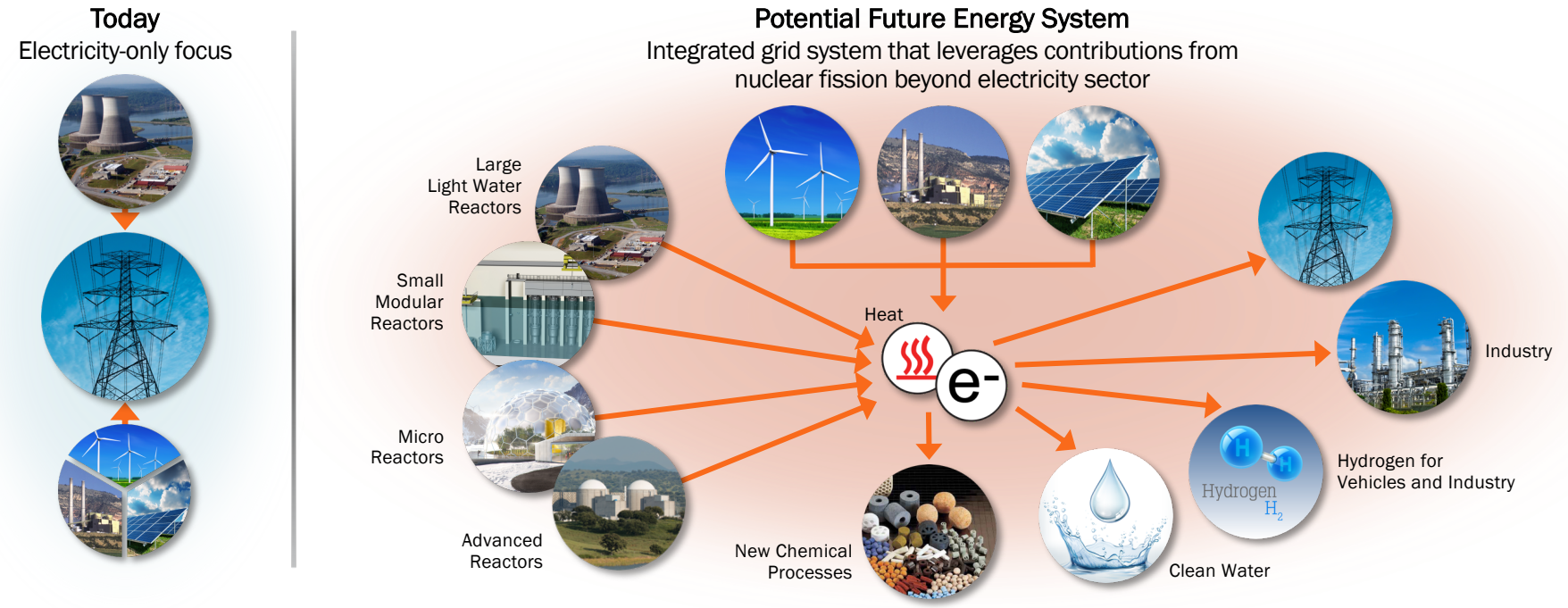
U.S. NUCLEAR

third way
fresh thinking

Advanced Reactor Companies

ENERGY REIMAGINED

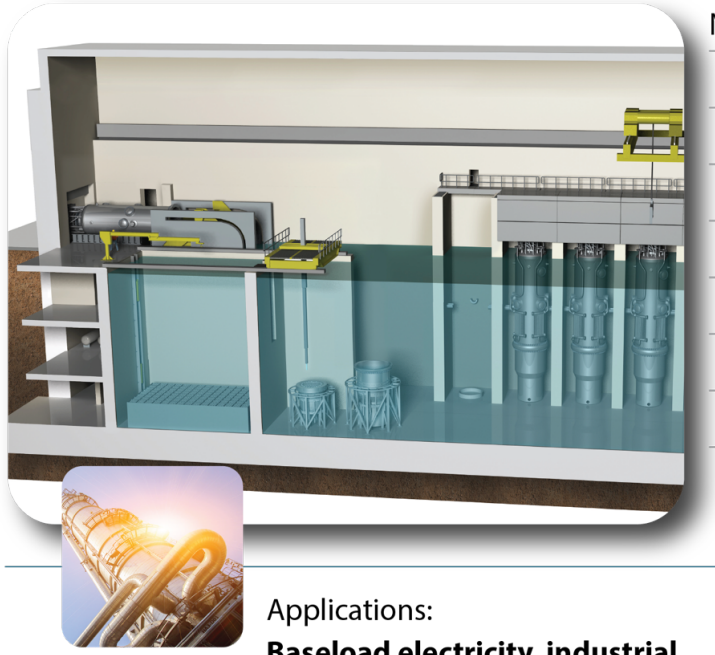
Maximizing energy utilization, generator profitability, and grid reliability and resilience through novel systems integration and process design



Flexible Generators ❖ Advanced Processes ❖ Revolutionary Design

Courtesy Shannon Bragg-Sitton, Ph.D., Idaho National Laboratory

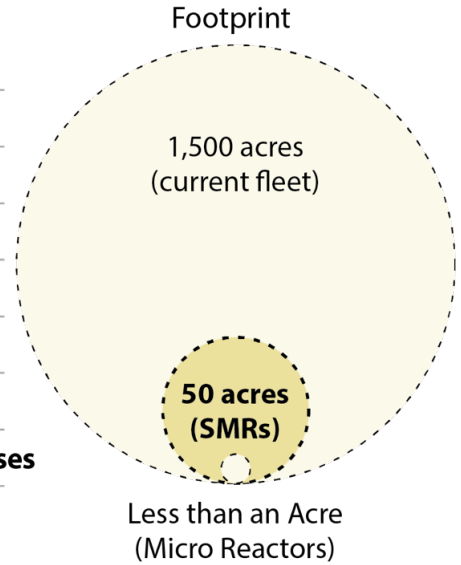
SMALL MODULAR REACTORS



Number in operation:	**None***
Timeframe:	**first reactors expected by 2024**
Products:	**Electricity, heat, and steam**
Megawatts:	**60-300 megawatts per module**
Customers:	**Large utilities; municipalities; industry**
Emergency zone:	**.19 miles**
Construction:	**Factory built; assembled on site**
Scalability:	**Reactor modules added as demand increases**

Applications:

Baseload electricity, industrial electricity, industrial processes such as hydrogen production

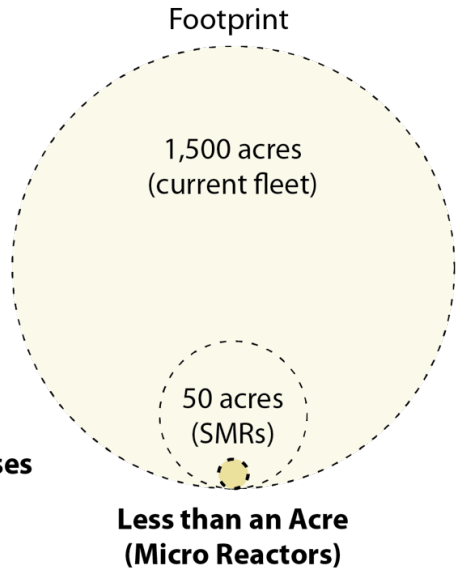


**First SMR in U.S. is currently going through regulatory approval and siting process; UAMPS proposing 12-module SMR in Idaho using NuScale technology.*

Courtesy Shannon Bragg-Sitton, Ph.D., Idaho National Laboratory

MICROREACTORS

Number in operation:	**None in the U.S.**
Timeframe:	**first reactors expected by 2025**
Products:	**Electricity, heat, and steam**
Megawatts:	**20 megawatts or less**
Customers:	**Military; municipalities; industry**
Emergency zone:	**less than .19 miles**
Construction:	**Factory built; assembled on site**
Scalability:	**Reactor modules added as demand increases**



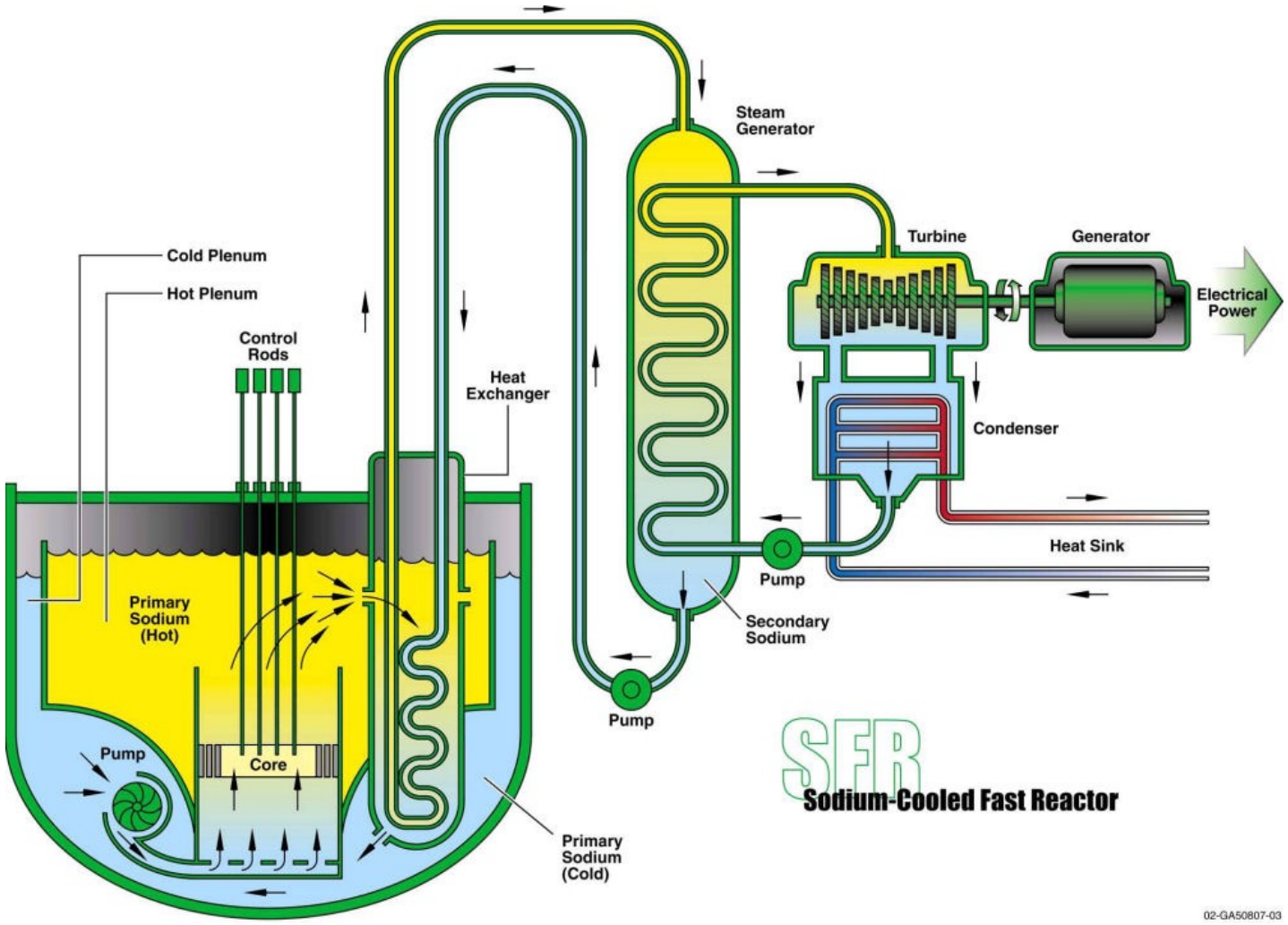
Applications:
Power for remote locations, maritime shipping, military installations, mining, space missions, desalination, disaster relief

Sen. Lisa Murkowski, R-Alaska, April 14, 2019 Op-Ed in the Anchorage Daily News.

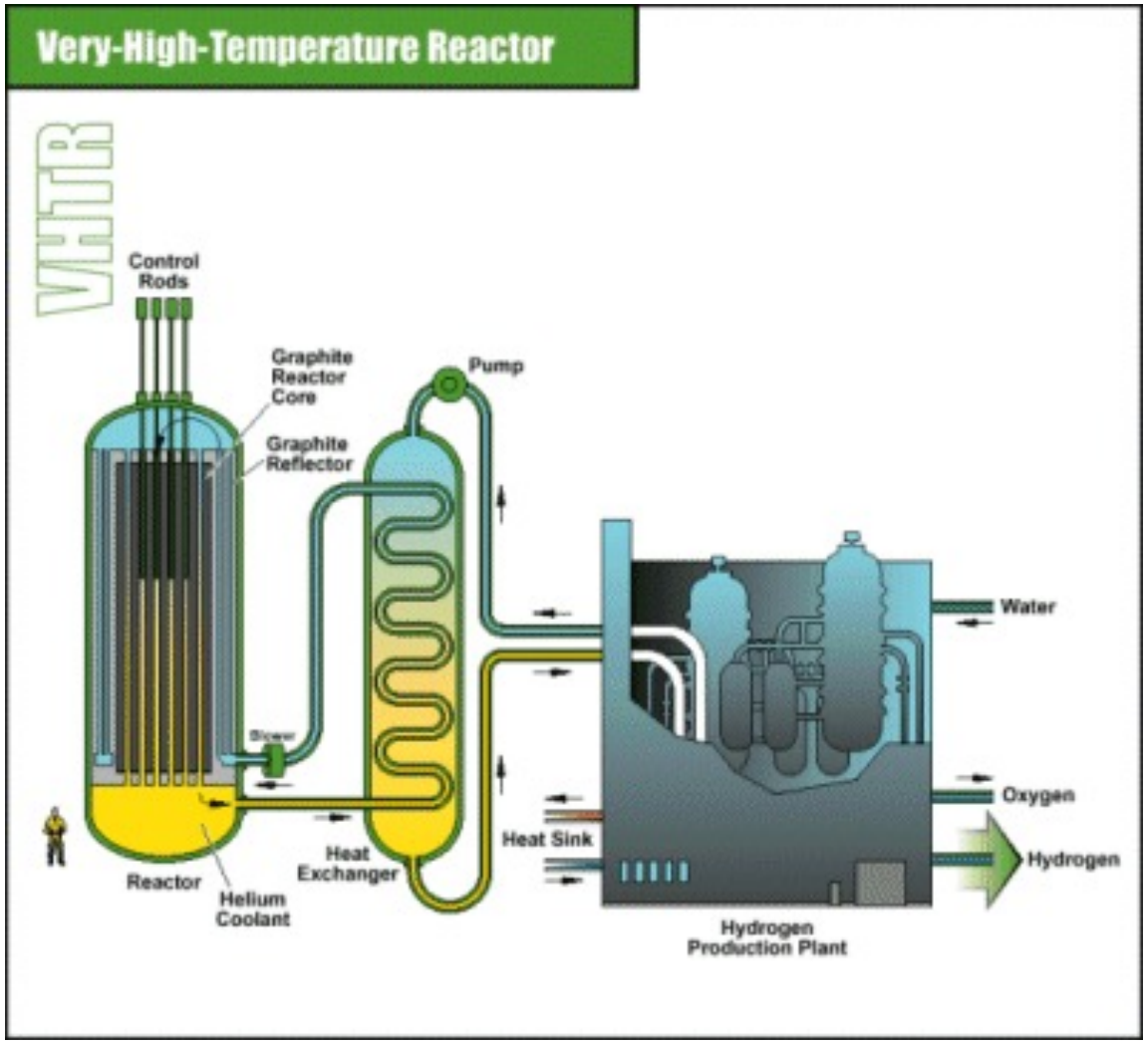
Improvements in nuclear technology "are enabling the emergence of so-called "microreactors" that could be a perfect fit throughout our state. As the name suggests, these smaller reactors can be right-sized for dozens of Alaska communities and will have off-grid capability that could solve the challenge of providing clean, affordable energy in our remote areas."

Courtesy Shannon Bragg-Sitton, Ph.D., Idaho National Laboratory

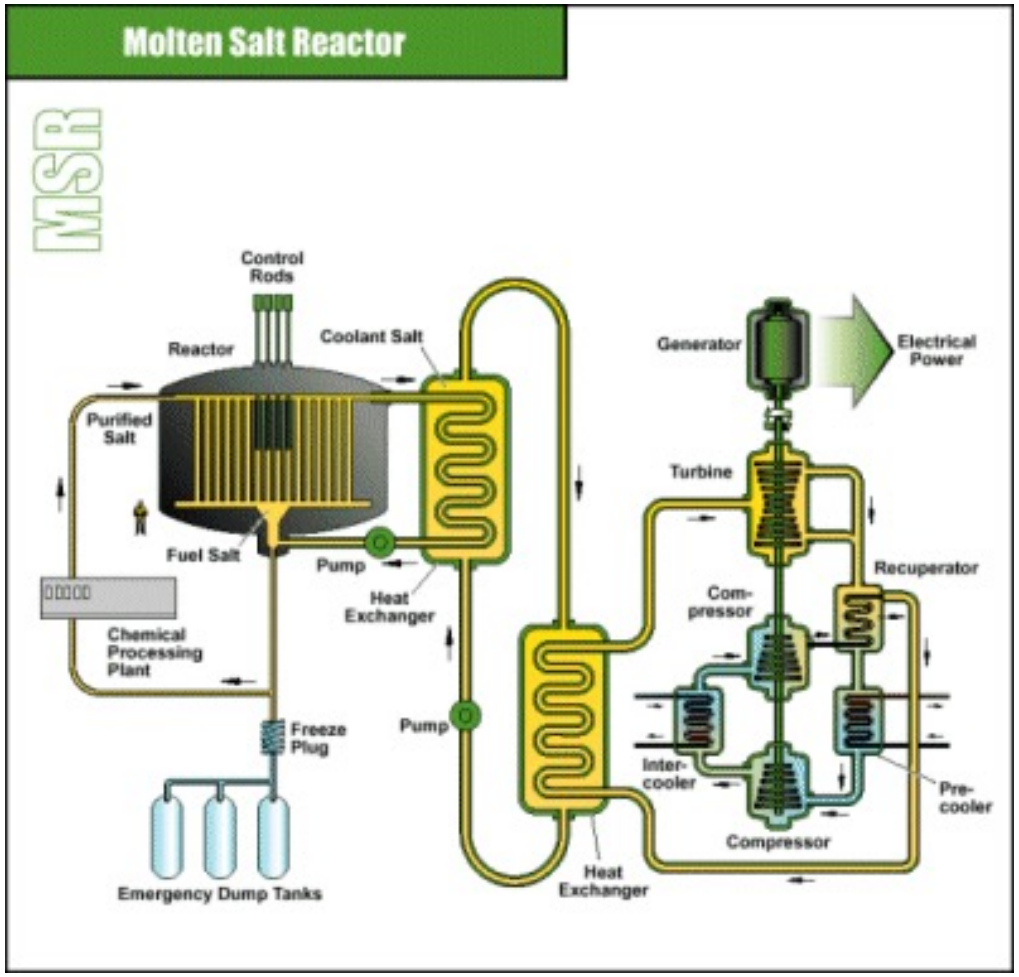
SODIUM COOLED FAST REACTOR



VERY HIGH TEMPERATURE REACTOR



MOLTEN SALT REACTOR



ADVANCED NUCLEAR CAMPAIGN

Todd Allen

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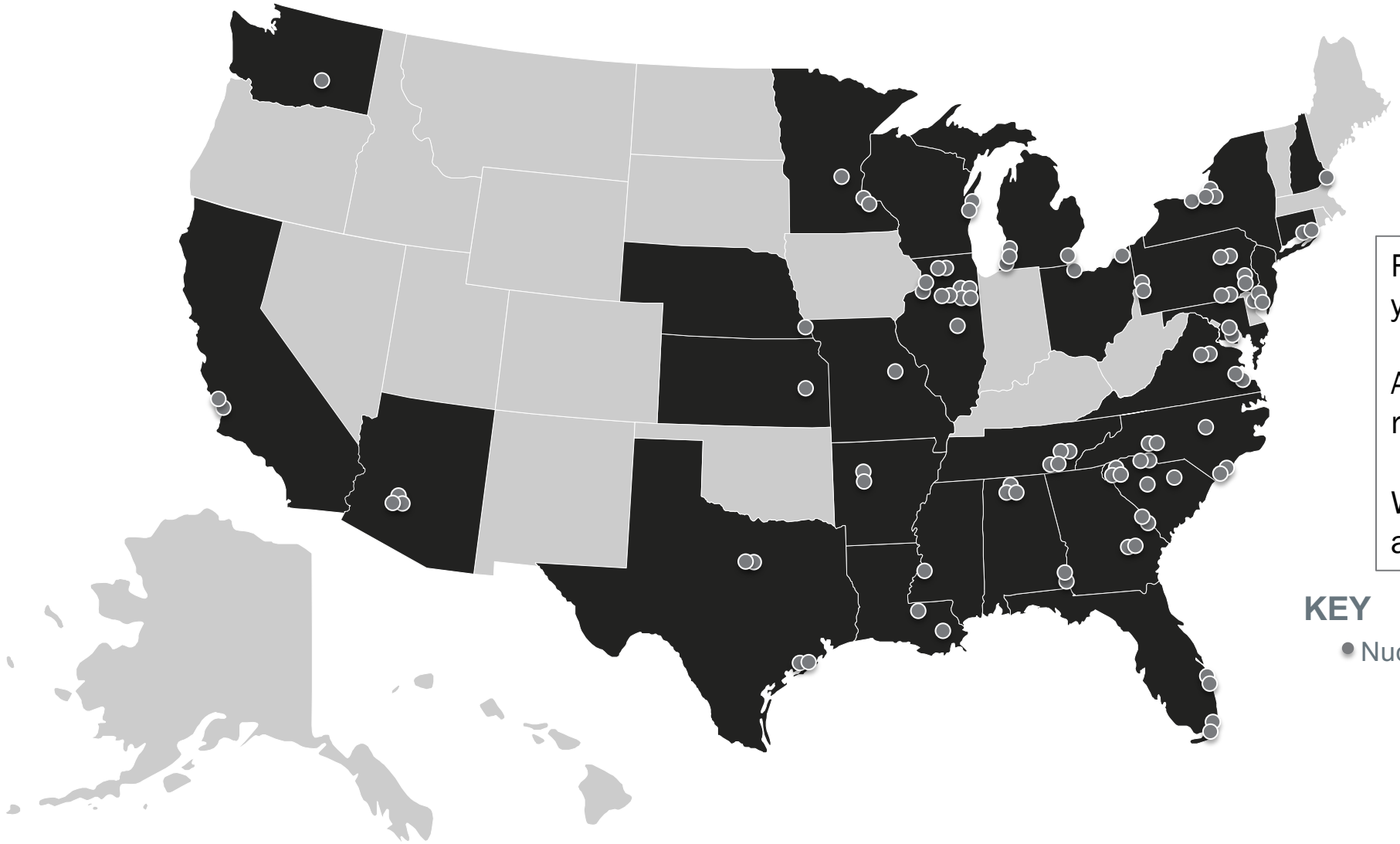
The Role of Nuclear Energy in our Future Energy System

June 2021

NUCLEAR ENERGY INSTITUTE

93 reactors at 54 plant sites across the country



Reactors can operate for 80 years (at least)

About 500 direct jobs per reactor

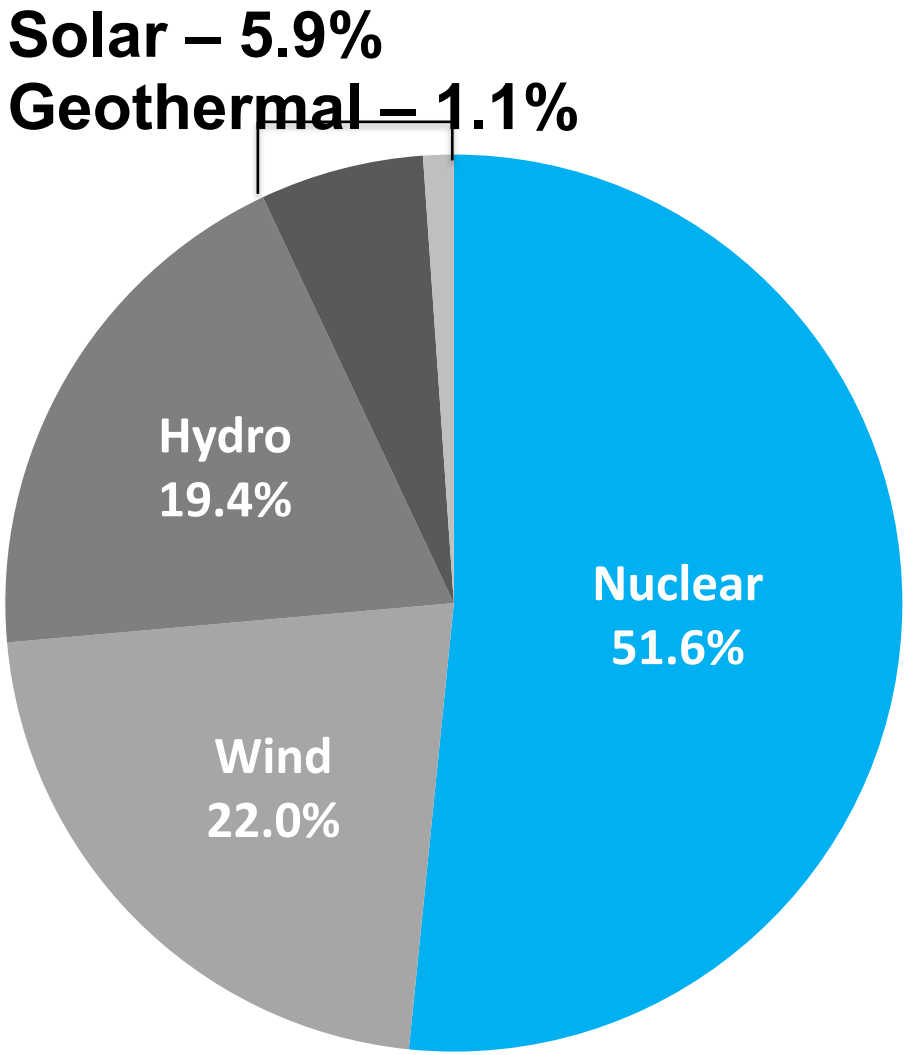
Wages about 1/3 higher than average jobs in local area

KEY

- Nuclear power reactor

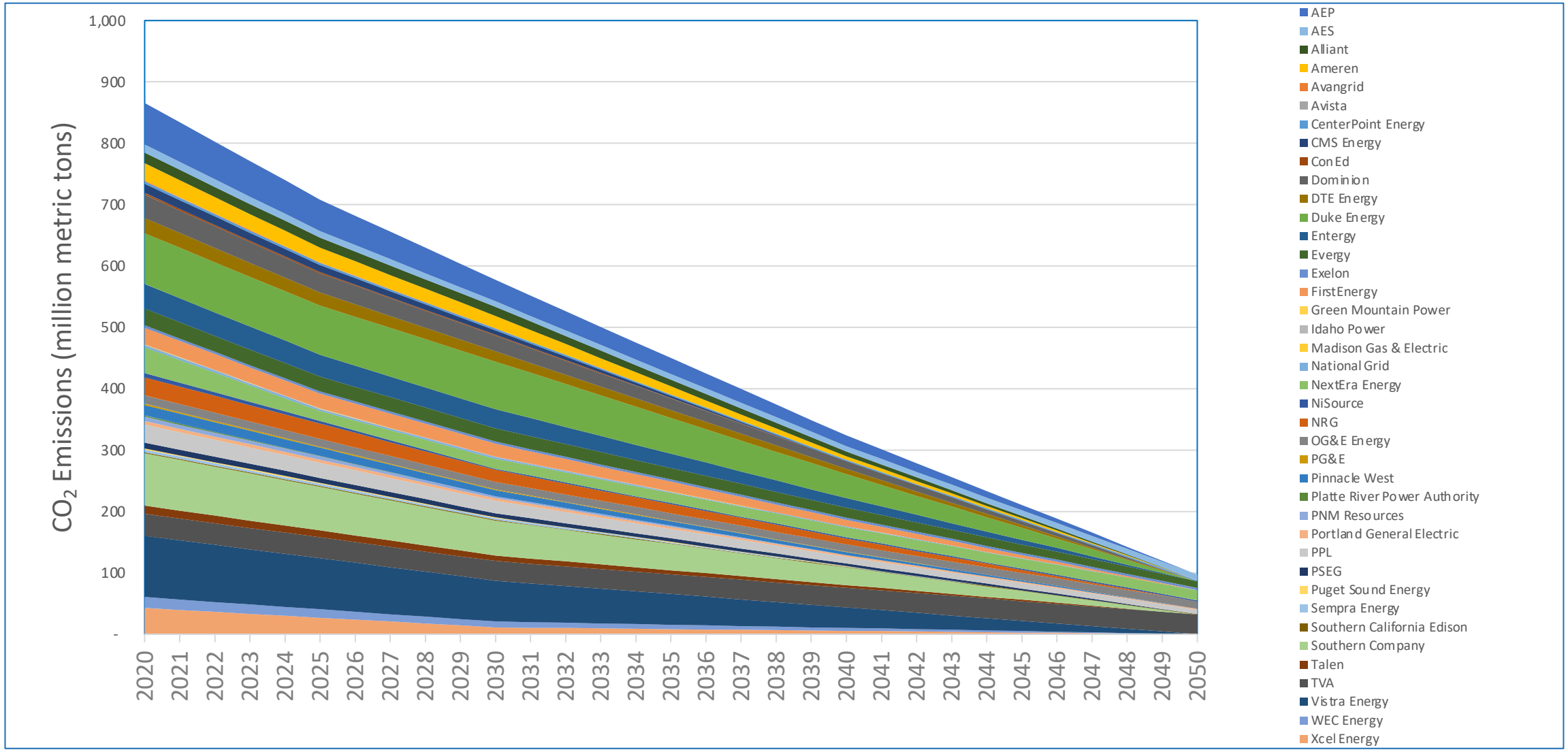
Updated: May 2021

Nuclear power continued to provide more than half of U.S. emissions-free electricity in 2020



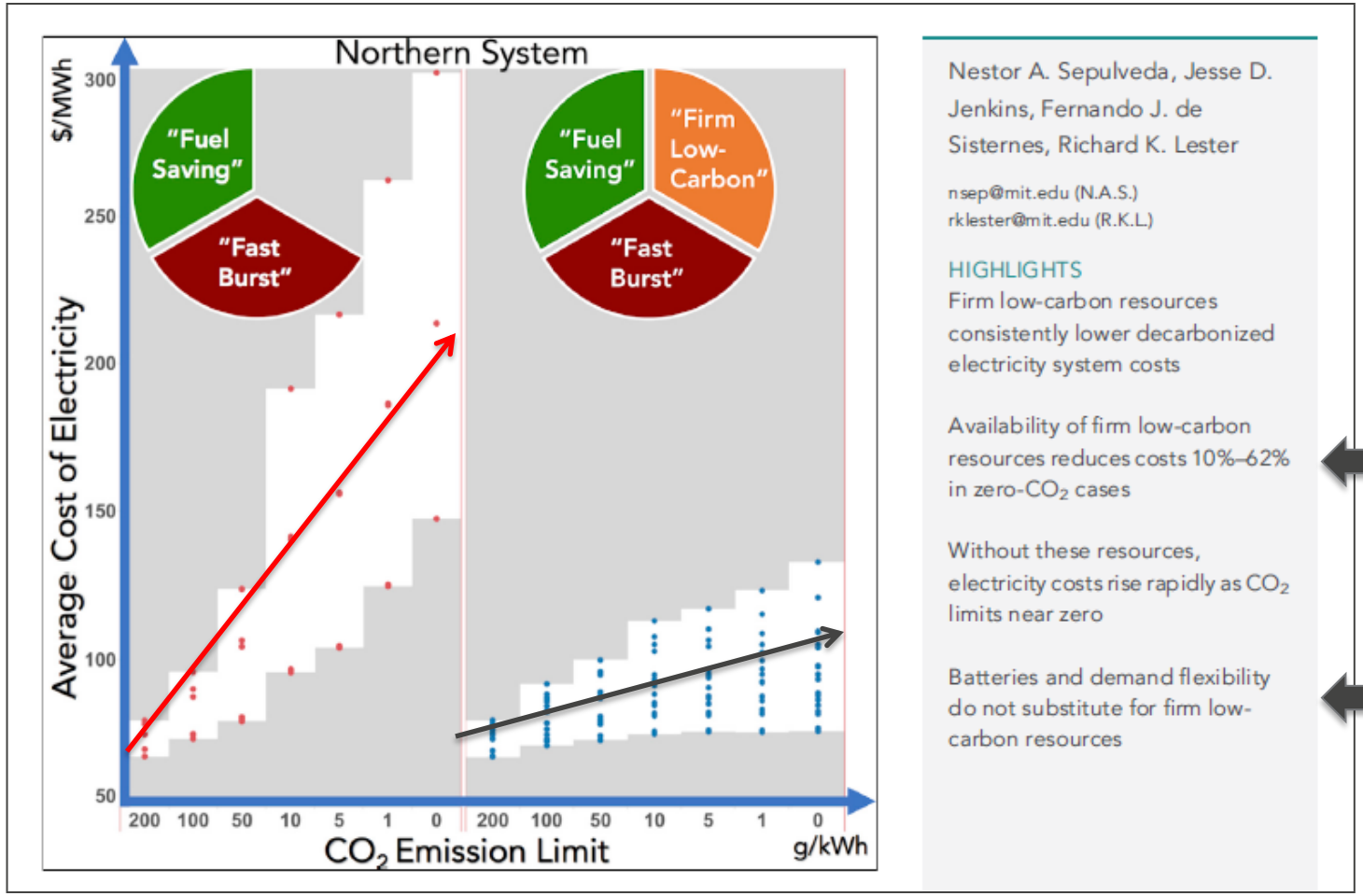
Source: U.S. Energy Information Administration
Updated: March 2021

MOST MAJOR UTILITIES HAVE COMMITTED TO DECARBONIZE 80-100% BY 2050



Source: ABB Velocity Suite, U.S. Environmental Protection Agency, utility press releases.

Firm, Low-carbon Generation (like nuclear) Enables Affordable Decarbonization



Nestor A. Sepulveda, Jesse D. Jenkins, Fernando J. de Sisternes, Richard K. Lester

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HIGHLIGHTS

Firm low-carbon resources consistently lower decarbonized electricity system costs

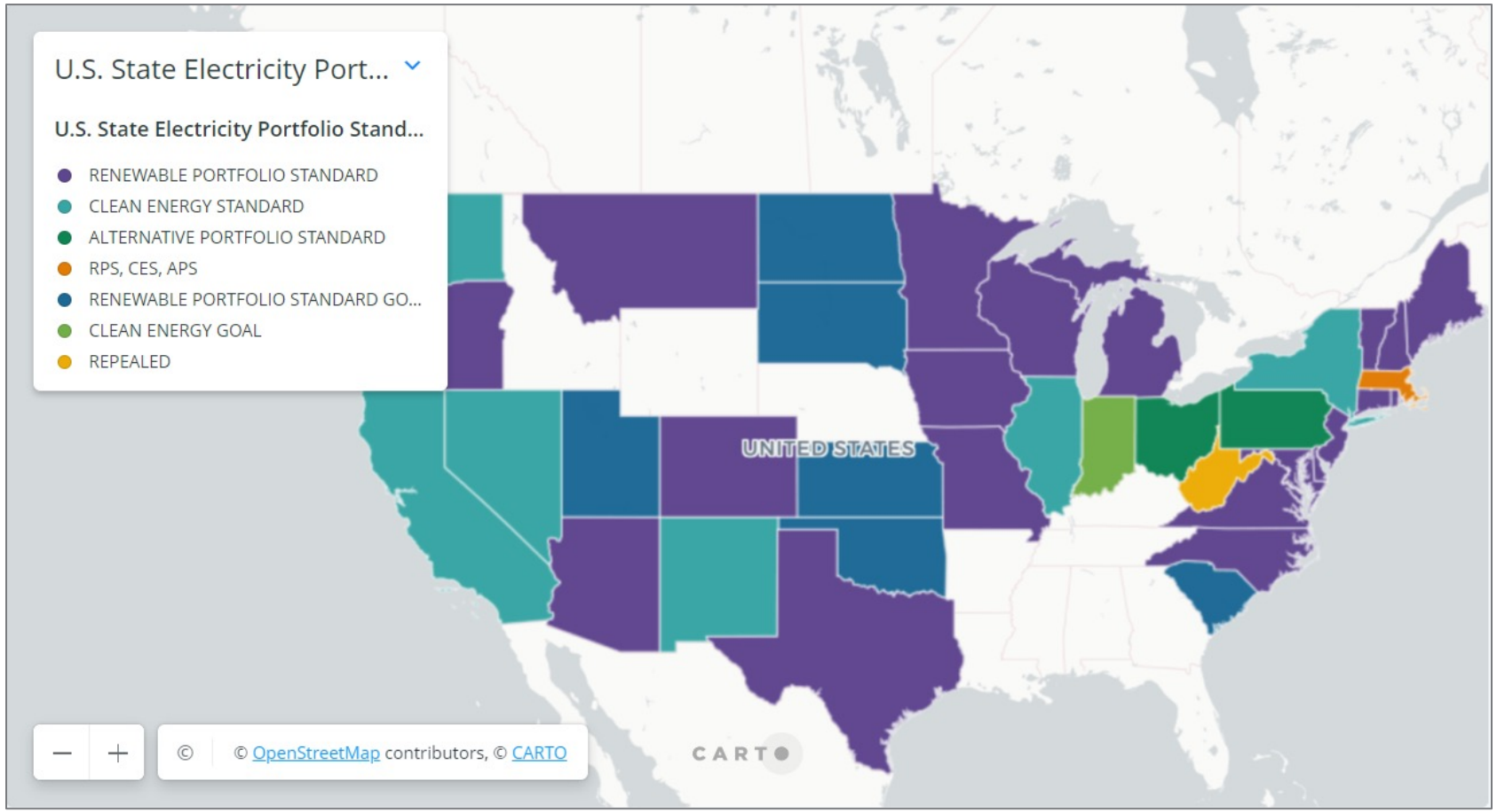
Availability of firm low-carbon resources reduces costs 10%–62% in zero-CO_2 cases

Without these resources, electricity costs rise rapidly as CO_2 limits near zero

Batteries and demand flexibility do not substitute for firm low-carbon resources

Recognizing the Carbon-Free Attribute

STATE EVOLUTION FROM RPS TO CES



MANY STATE CLEAN ENERGY STANDARDS INCLUDE NUCLEAR

Source: https://www.c2es.org/document/renewable-and-alternate-energy-portfolio-standards/

Recognizing the Carbon-Free Attribute

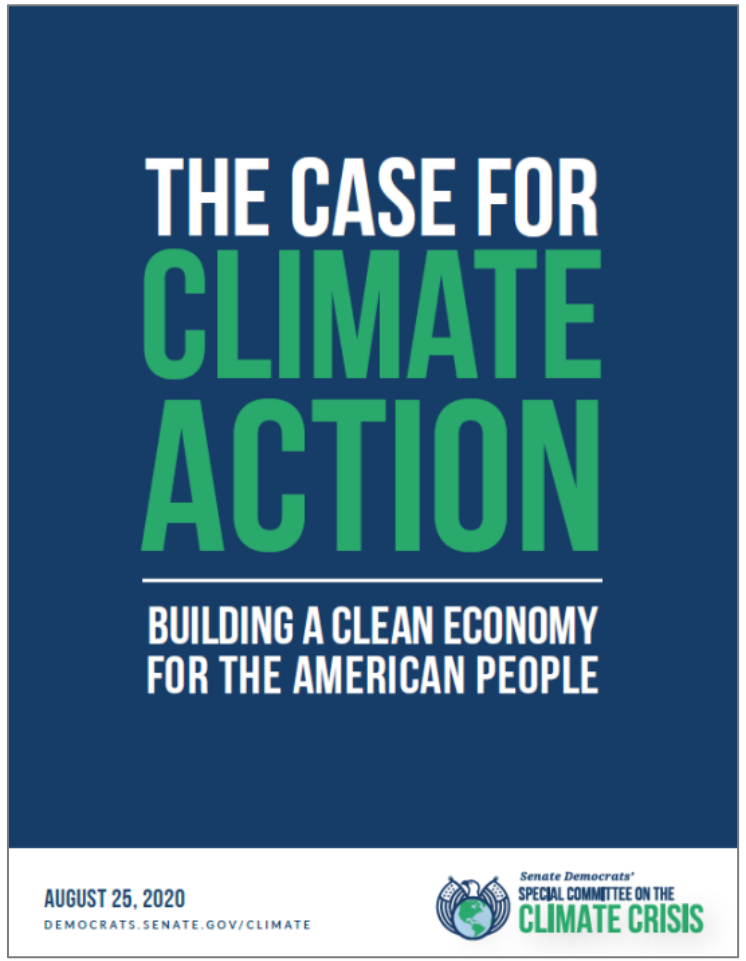
CONGRESSIONAL REPORTS

Senate Democrats – Special Committee on the Climate Crisis:

- "Nuclear energy currently plays an important role in providing reliable zero-carbon power to the grid."
- "Research priorities include advanced nuclear R&D…"

House Select Cmte on the Climate Crisis (D staff):

- "Congress should establish a national clean energy standard to achieve net-zero emissions in the electricity sector by no later than 2040…It should cover zero-emission technologies, including wind, solar, energy storage, nuclear…"



CONGRESSIONAL DEMOCRATS INCREASINGLY EMBRACING NUCLEAR

CLEAN Future Act

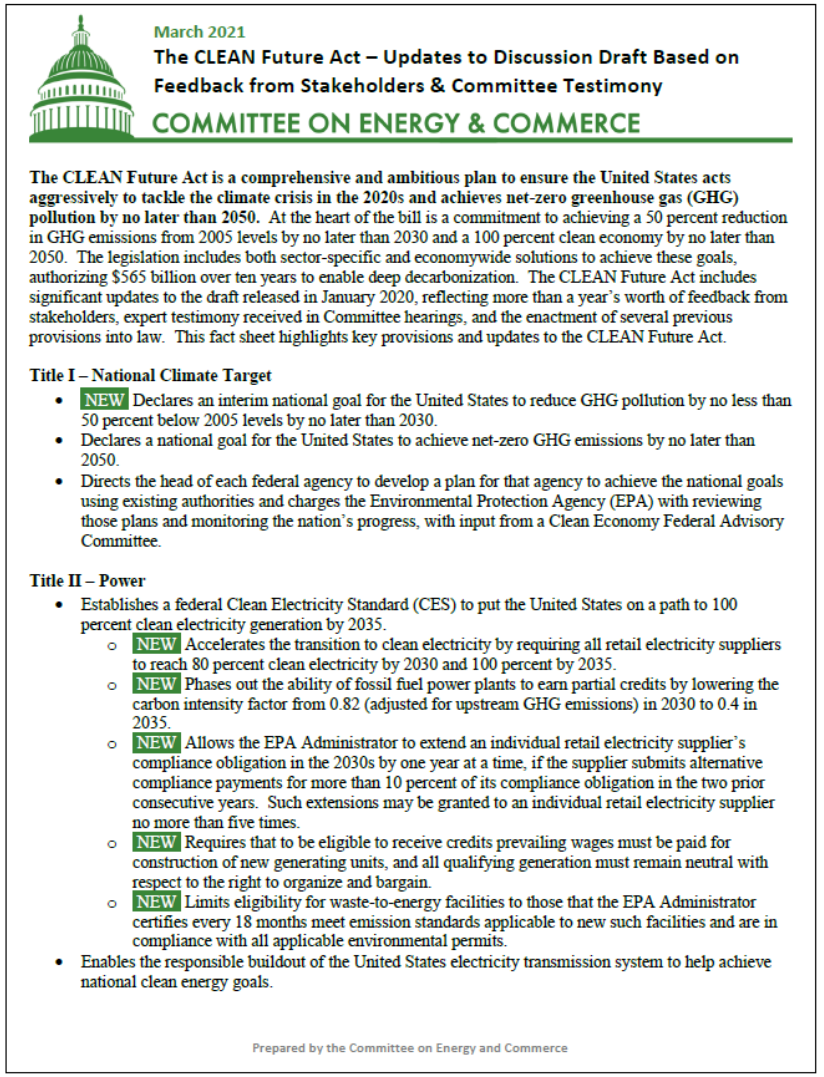
(House Energy & Commerce majority)

Highlights:

- 2050 decarbonization goal – economy-wide
- 100% CES by 2035 (80% by 2030)
  - ZEC program specifically includes nuclear
- Long-term nuclear PPA pilot
- Expands EV infrastructure
- Incentives for decarbonizing other sectors
- Extensive worker & community transition programs

Issues:

- 2035 date – very challenging
- Needs to be coupled with innovation, tax provisions



March 2021

The CLEAN Future Act – Updates to Discussion Draft Based on Feedback from Stakeholders & Committee Testimony

COMMITTEE ON ENERGY & COMMERCE

The CLEAN Future Act is a comprehensive and ambitious plan to ensure the United States acts aggressively to tackle the climate crisis in the 2020s and achieves net-zero greenhouse gas (GHG) pollution by no later than 2050. At the heart of the bill is a commitment to achieving a 50 percent reduction in GHG emissions from 2005 levels by no later than 2030 and a 100 percent clean economy by no later than 2050. The legislation includes both sector-specific and economywide solutions to achieve these goals, authorizing $565 billion over ten years to enable deep decarbonization. The CLEAN Future Act includes significant updates to the draft released in January 2020, reflecting more than a year's worth of feedback from stakeholders, expert testimony received in Committee hearings, and the enactment of several previous provisions into law. This fact sheet highlights key provisions and updates to the CLEAN Future Act.

Title I – National Climate Target

- NEW Declares an interim national goal for the United States to reduce GHG pollution by no less than 50 percent below 2005 levels by no later than 2030.
- Declares a national goal for the United States to achieve net-zero GHG emissions by no later than 2050.
- Directs the head of each federal agency to develop a plan for that agency to achieve the national goals using existing authorities and charges the Environmental Protection Agency (EPA) with reviewing those plans and monitoring the nation's progress, with input from a Clean Economy Federal Advisory Committee.

Title II – Power

- Establishes a federal Clean Electricity Standard (CES) to put the United States on a path to 100 percent clean electricity generation by 2035.
  - NEW Accelerates the transition to clean electricity by requiring all retail electricity suppliers to reach 80 percent clean electricity by 2030 and 100 percent by 2035.
  - NEW Phases out the ability of fossil fuel power plants to earn partial credits by lowering the carbon intensity factor from 0.82 (adjusted for upstream GHG emissions) in 2030 to 0.4 in 2035.
  - NEW Allows the EPA Administrator to extend an individual retail electricity supplier's compliance obligation in the 2030s by one year at a time, if the supplier submits alternative compliance payments for more than 10 percent of its compliance obligation in the two prior consecutive years. Such extensions may be granted to an individual retail electricity supplier no more than five times.
  - NEW Requires that to be eligible to receive credits prevailing wages must be paid for construction of new generating units, and all qualifying generation must remain neutral with respect to the right to organize and bargain.
  - NEW Limits eligibility for waste-to-energy facilities to those that the EPA Administrator certifies every 18 months meet emission standards applicable to new such facilities and are in compliance with all applicable environmental permits.
- Enables the responsible buildout of the United States electricity transmission system to help achieve national clean energy goals.

Prepared by the Committee on Energy and Commerce

Recognizing the Carbon-Free Attribute

BIDEN CAMPAIGN

Biden Plan for Climate Change and Environmental Justice:

- "This initiative will target affordable, game-changing technologies to help America achieve our 100% clean energy target, with a specific focus on the following, as recommended by the founding director of ARPA-E:
  - grid-scale storage at one-tenth the cost of lithium-ion batteries;
  - small modular nuclear reactors at half the construction cost of today's reactors;…"

Biden-Sanders Unity Task Force Recommendations:

- "We will advance innovative technologies that create cost-effective pathways for industries to decarbonize, including…advanced nuclear that eliminates risks associated with conventional nuclear technology…"

BIDEN INCLUDES NUCLEAR IN DECARBONIZATION PLANS

PRESIDENT BIDEN WANTS TO DECARBONIZE WHILE CREATING LONG-TERM, WELL-PAYING JOBS

AMERICAN JOBS PLAN GOAL – DECARBONIZE THE ELECTRIC GRID BY 2035

Source: ABB Velocity Suite, U.S. Environmental Protection Agency, utility press releases.

Recognizing the Carbon-Free Attribute

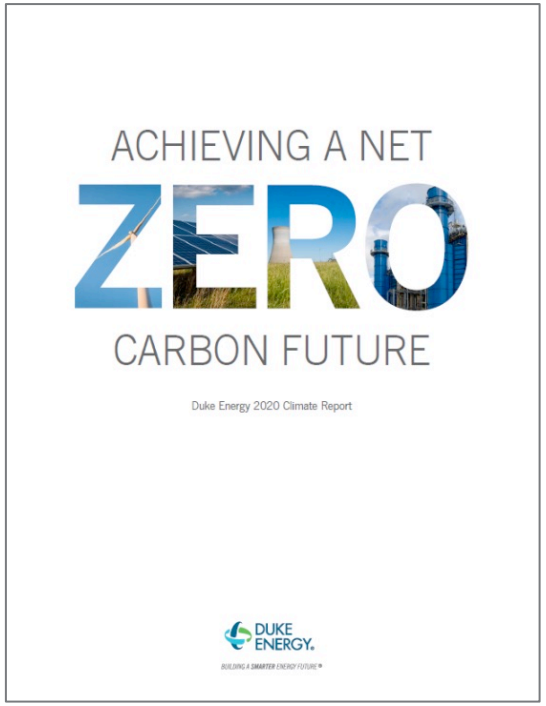
UTILITY PLANS

Duke Energy

- SLR planned for all 11 reactors
- SMRs, Advanced Reactors an option in IRP

Dominion Energy

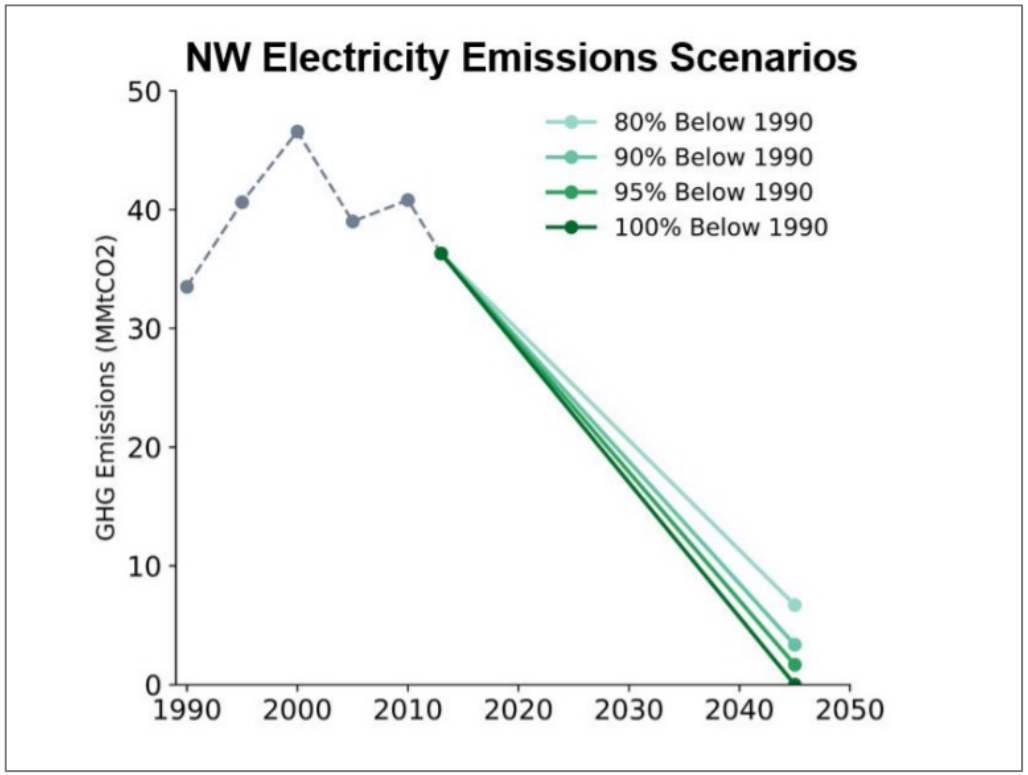
- SLR applications under review for all 4 reactors
- SMRs, Advanced Reactors an option in IRP

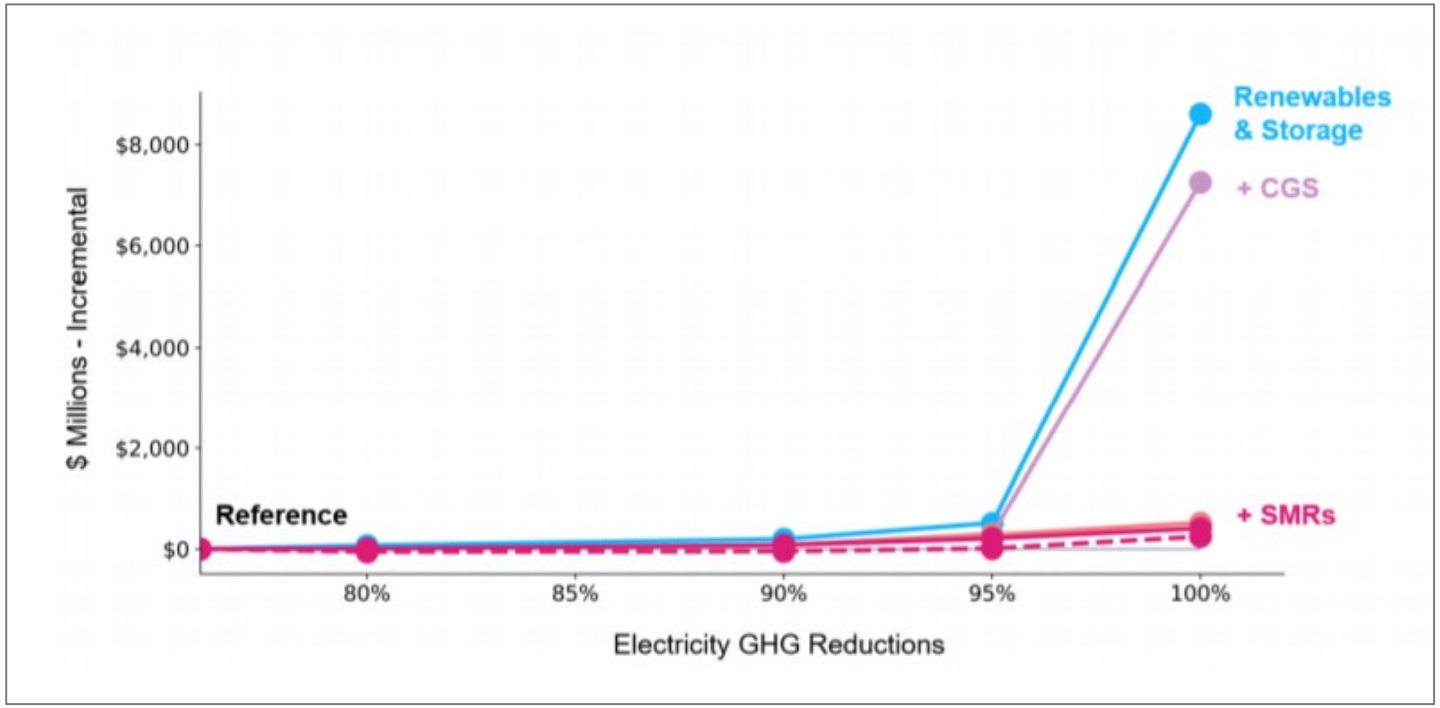


Multiple generating companies teamed with developers for DOE Advanced Reactor Demonstration Program awards

UTILITY DECARB PLANS INCLUDE SLR, ROLE FOR NEW NUCLEAR

Existing + New Nuclear is a Solution Pathway to Achieving Emissions Goals





Source: Energy + Environmental Economics (E3), see https://www.energy-northwest.com/Documents/E3%20Study%20Executive%20Summary%20final.pdf.

Increasing Utility Interest in SMR/ARs

"The grid can't be 100 percent renewable…that last 20 percent [from 80 percent to 100 percent] has to be carbon-free, and it has to be dispatchable."

"I think nuclear plays a role in our carbon-free future…I think there's another generation out there that is smaller, less a capital bet for somebody like me sitting in a boardroom…and is safer, and has passive safety controls." – Ben Fowke, CEO, Xcel

The price for storage has come down but is still not low enough to provide the backup needed for intermittent power sources like wind and solar. So Idaho Power will consider buying into a proposed modular nuclear reactor at the Idaho National Laboratory in East Idaho, [CEO Darrel] Anderson said. Idaho Power uses no nuclear power now, but it considers nuclear to be clean, carbon-free energy. – *Idaho Statesman*, March 26, 2019

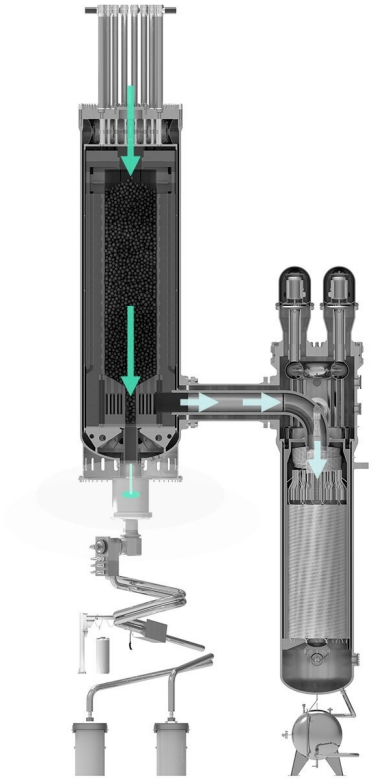
"We believe that nuclear power has a vital role in ensuring a clean, reliable, and cost-effective supply of electricity to meet the needs of a growing economy," – Dan Stoddard, Chief Nuclear Officer, Dominion Energy

Department of Energy Advanced Reactor Demonstration Program

Advanced Reactor Demonstrations

- Technical feasibility that the demonstration can be operational in five to seven years
- 50/50 cost share – awards for 7 years with possible 3 year extension
- DOE share $3.2 billion (combined)
- TerraPower and X-energy
- Reactors and fuel fabrication facilities

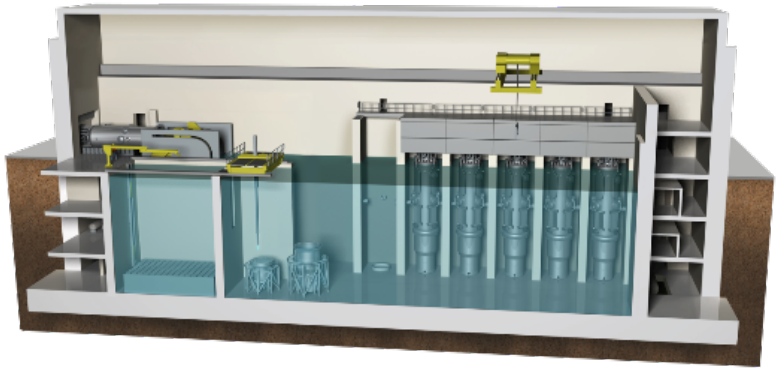
DOE DEMONSTRATING NEXT-GEN TECHNOLOGY THRU ADVANCED REACTOR DEMO & ADVANCED SMR PROGRAMS



X-energy Xe-100 – Energy Northwest/Grant PUD, Hanford

TerraPower Natrium – partner, location ANNOUNCEMENT TODAY

NuScale SMR – UAMPS Carbon-free Power Project, INL



TECHNOLOGY DEMONSTRATIONS REQUIRED THIS DECADE TO BUILD UTILITY CONFIDENCE IN TECHNICAL AND ECONOMIC VIABILITY

Summary of New Commercial Reactor Projects in U.S. With Target Dates Before 2030

- Vogtle 3 and 4
- Oklo Aurora
- UAMPS with NuScale
- TerraPower Natrium
- X-energy Xe-100
- Kairos Power Test Reactor
- Southern Company Molten Chloride Reactor Experiment

Key Takeaways

- Consumers and policymakers (U.S. and abroad) increasingly demanding low-carbon electricity
- Maintaining existing nuclear is the least expensive way to avoid carbon emissions
- States and utilities responding with deep decarbonization goals, conversion from RPS to CES; Biden Admin/Congress - CES
- New nuclear is extremely valuable to deep decarbonization
  - Least-cost, most reliable low-carbon systems include nuclear energy
  - State and federal policy actions needed to overcome FOAK cost barriers
  - Nuclear can help decarbonize non-electric energy uses

Legal & Social License to Operate Small Modular Nuclear Reactors in Wyoming

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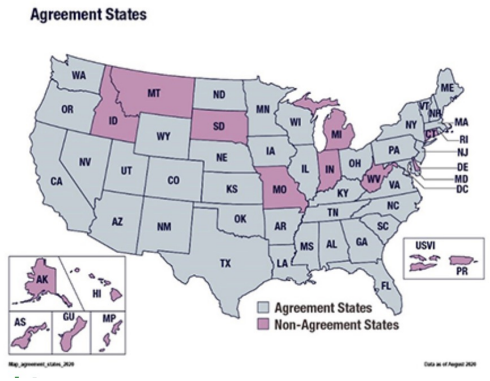
University of Wyoming, College of Law

University of Wyoming | School of Energy Resources

Legal License to Operate SMRs in Wyoming

Division of Authority — Federal & State



- Addressed in 42 USC § 2021:
  - Federal-
    - Commercial nuclear power reactors, research reactors, and nuclear fuel cycle facilities, even in agreement states
  - State-
    - "Non-radiological" matters (subject to case-law interpretation)
    - If an agreement is entered between State governors and the NRC, some or all of:
      - Byproduct materials, source materials, special nuclear materials in quantities not sufficient to form critical mass

https://www.nrc.gov/reading-rm/doc-collections/fact-sheets/agreement-states.html

State Authority Under the Atomic Energy Act of 1954, as Amended

Wyoming's Nuclear Regulatory Commission (NRC) Agreement

- Agreement transferred regulatory authority from NRC to Wyoming over "source material involved in uranium or thorium recovery or milling" and "the tailings or wastes produced by the extraction or concentration of uranium or thorium from any ore processed primarily for its source material content" -42 USC § 2021(e)(2); WS § 35-11-2001(a)

  - Signed September 25, 2018
  - Published in the Federal Register September 28, 2018
  - Effective September 30, 2018

State-Level Permitting for Small Modular Reactors

Wyoming Small Modular Nuclear Reactor Permitting

WS § 35-11-2100

ORIGINAL HOUSE
ENGROSSED
BILL NO. HB0074

ENROLLED ACT NO. 60, HOUSE OF REPRESENTATIVES

SIXTY-FIFTH LEGISLATURE OF THE STATE OF WYOMING
2020 BUDGET SESSION

AN ACT relating to environmental quality and utilities; authorizing permits of small modular nuclear reactors; specifying permit requirements; authorizing the replacement of coal generation capacity with small modular nuclear reactor capacity; making conforming amendments; imposing a tax; requiring rulemaking; and providing for an effective date.

Wyoming Small Modular Nuclear Reactor Permitting

Definitions:

- Small modular nuclear reactor:
  - Has a rated capacity of not more than three hundred (300) megawatts of electricity;
  - Can be constructed and operated in combination with other similar reactors at a single site, if additional reactors are necessary; and
  - Has been licensed by the United States Nuclear Regulatory Commission and is in compliance with all requirements and conditions imposed by the commission

Wyoming Small Modular Nuclear Reactor Permitting

Definitions: *same as under federal Nuclear Waste Policy*

- Spent nuclear fuel:
  - Fuel that has been withdrawn from a nuclear reactor following irradiation, the constituent elements of which have not been separated by reprocessing -42 USC § 10101; WS § 35-11-1501(a)(iv)

- *High-level radioactive waste*:
  - The highly radioactive material resulting from the reprocessing of spent nuclear fuel, including liquid waste produced directly in reprocessing and any solid material derived from such liquid waste that contains fission products in sufficient concentrations; and
  - Other highly radioactive material that the Commission, consistent with existing law, determines by rule requires permanent isolation -42 USC § 10101; WS § 35-11-1501(a)(i)

Wyoming Small Modular Nuclear Reactor Permitting

Wyoming legislature provides parameters for Environmental Quality Council's (EQC's) rules & regulations governing:

- Existing facility replacement;
- Combined rated capacity;
- Licensing and permitting requirements;
- Reporting processes;
- Storage; and
- Siting

Wyoming Industrial Development Information & Siting

- WS § 35-12-101 through WS § 35-12-119
- Industrial facility > $96.9 million must obtain a permit -WS § 35-12-102(a)(vii); WS § 35-12-106
- *Commercial radioactive waste management facilities* required to obtain a permit -WS § 35-12-102(a)(vii)(C)

County-Level Considerations

- Wyoming Counties do not have “home rule” authority
- Counties do have permitting & zoning authority
- Any Small Modular Reactor (SMR) project should check county requirements for permitting and zoning relevant to the project

Federal-Environmental Regulations Possibly Implicated by SMR Projects
(not all-inclusive)

National Environmental Policy Act of 1969 (NEPA)
— 42 USC § 4321 et seq.

Clean Air Act of 1970 (CAA)
— 42 USC § 7401 et seq.

Endangered Species Act of 1973 (ESA)
— 16 USC § 1531 et seq.

Clean Water Act of 1972 (CWA)
— 33 USC § 1251 et seq.

Social License To Operate SMRs in Wyoming

SMR SOCIAL LICENSE OPPORTUNITY

SMR provides an opportunity to increase the number of nuclear reactors = increased number of nuclear sites.

Public concern regarding the use of nuclear energy remains high.

Public engagement strategies to bring the public along with sitting decisions will be critical.

- Legal license v. social license.

Social License to Operate in Wyoming

SOCIAL LICENSE TO OPERATE

A community's acceptance of a company's operations, including a mutual understanding of the demands on and expectations for a business enterprise that emerge from neighborhoods, environmental groups, community members and other elements of the surrounding civil society.

State level regulations are for the most part not yet developed for SMR; providing a unique opportunity to begin to engage the public at the ground level to begin to build a social license to operate for SMR.

PROCESS TO OBTAIN A SOCIAL LICENSE

Early and ongoing communications;

- Significant degree of meaningful dialogue between all involved.

Transparency and engagement in decision-making; and

Establishing effective conflict resolution mechanisms.

The utilization of a purposeful, principled collaborative process presents an opportunity to develop an even stronger social license to operate.

Public Engagement in Wyoming

STATE PUBLIC ENGAGEMENT OPPORTUNITIES

Environmental Quality Council SMR Rule Development

- EQC promulgates rules after receiving a recommendation to do some from the DEQ Director of Wyoming Statute - WS § 35-11-112(a)(i).
- DEQ can initiate preliminary rulemaking, and conduct hearings before Advisory Board - EQC Rule, Chapter 3, §4.
- Wyoming Administrative Procedures Act requires public notice and comment prior to rule adoption - WS § 16-3-103(a)(i).
- EQC Rulemaking Hearings - EQC Rule, Chapter 3, §6.
- Wyoming Administrative Procedures Act legal challenges to final agency actions – WS § 16-3-114

FEDERAL PUBLIC ENGAGEMENT OPPORTUNITIES

NRC NEPA Process

- Federal and State Agencies along with local and tribal governments can request cooperating agency status under the CEQ regulations - 40 CFR § 1501.8 (2020).
- NEPA public engagement and comment requirements (40 CFR § 1503.1 & §1503.3 (2020)).
- Admirative Procedures Act § 706(2)(a) challenges on the final agency action.

Public comments/appeals and challenges on ESA, CWA, CAA permits.

OPPORTUNITY FOR INTEGRATION OF LEGAL LICENSE TO OPERATE WITH A SOCIAL LICENSE TO OPERATE

A social license to operate is critical to achieving a legal license to operate.

But achievement of a social license to operate will require thinking about public engagement beyond the required notice and comment opportunities.

- It will require the utilization of a purposeful, principled public engagement strategy, likely a cooperative one.

QUESTIONS?

By Third Way, GENSLER

Upcoming Event!

CENTER FOR ENERGY REGULATION & POLICY ANALYSIS (CERPA)

OVERVIEW OF A POSSIBLE NEW FEDERAL CLEAN ELECTRICITY STANDARD: THE VIEW FROM WYOMING

June 16, 2021
2:00 - 3:00 PM MT/ (4:00 - 5:00 PM ET)

Register at www.http://www.uwyo.edu/ser/events/index.html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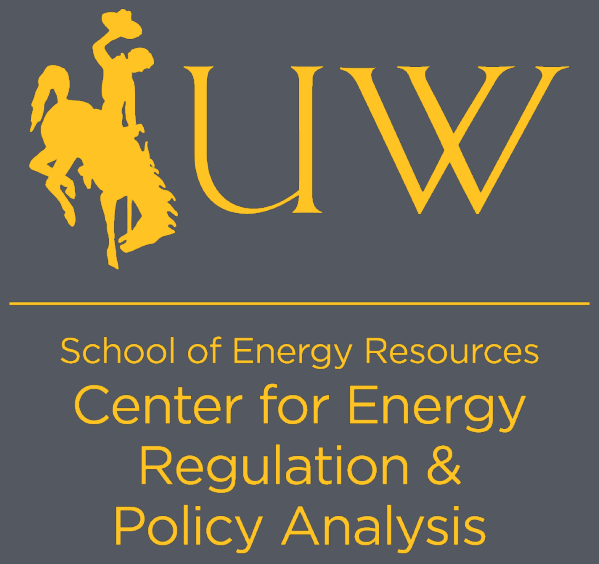
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