

# Next-Generation Nuclear Energy in a Decarbonized Energy System

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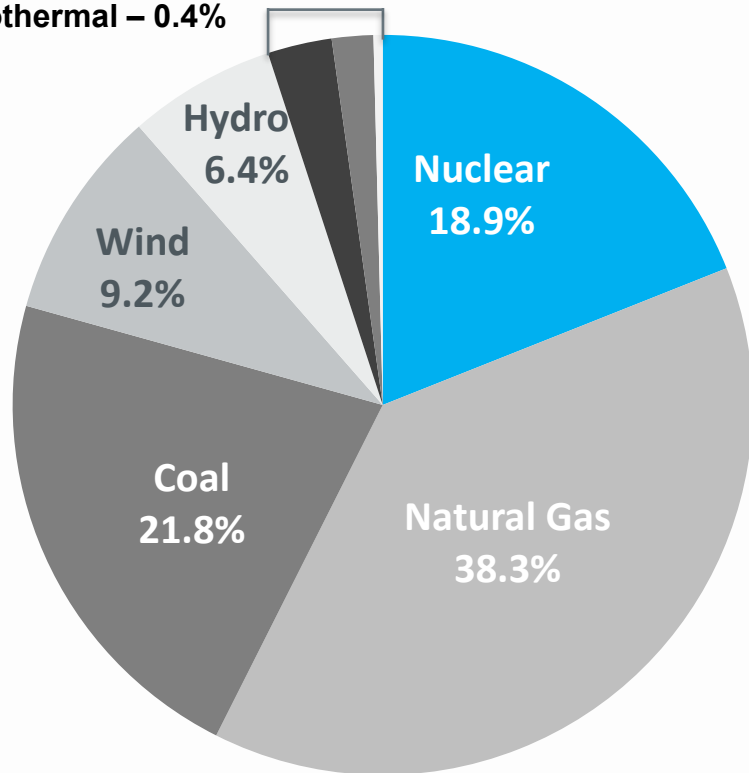
April 2022



# Nuclear generated 19% of U.S. electricity in 2021

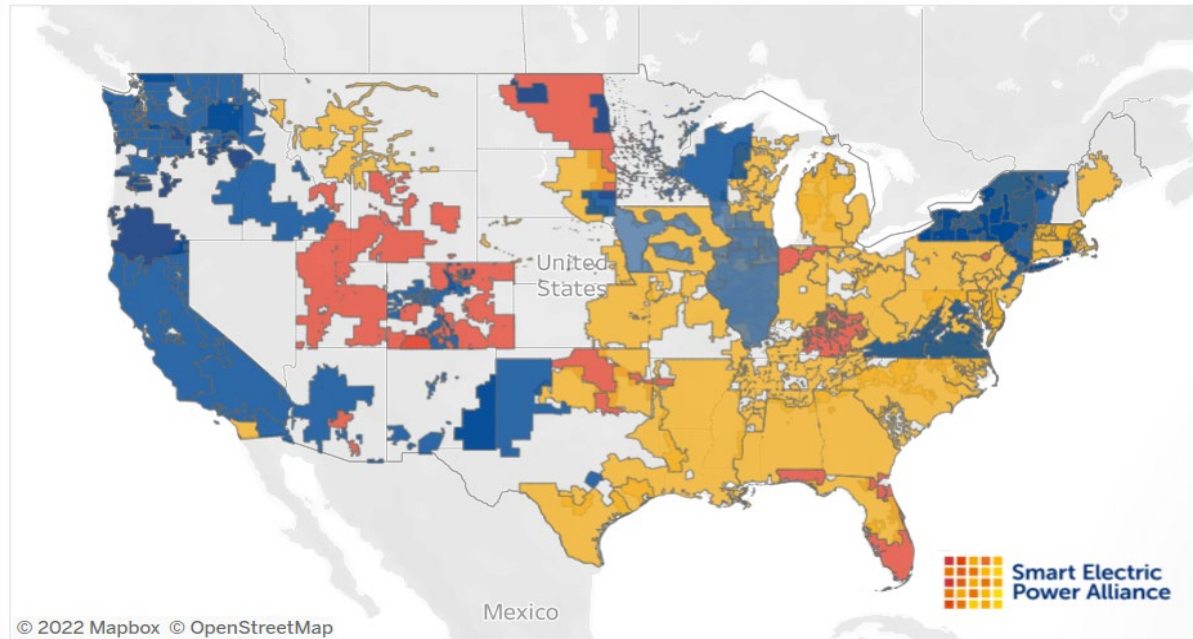


**Solar – 2.8%**  
**Biomass & Petroleum – 1.8%**  
**Geothermal – 0.4%**



# UTILITIES WITH EMISSIONS REDUCTION PLEDGES

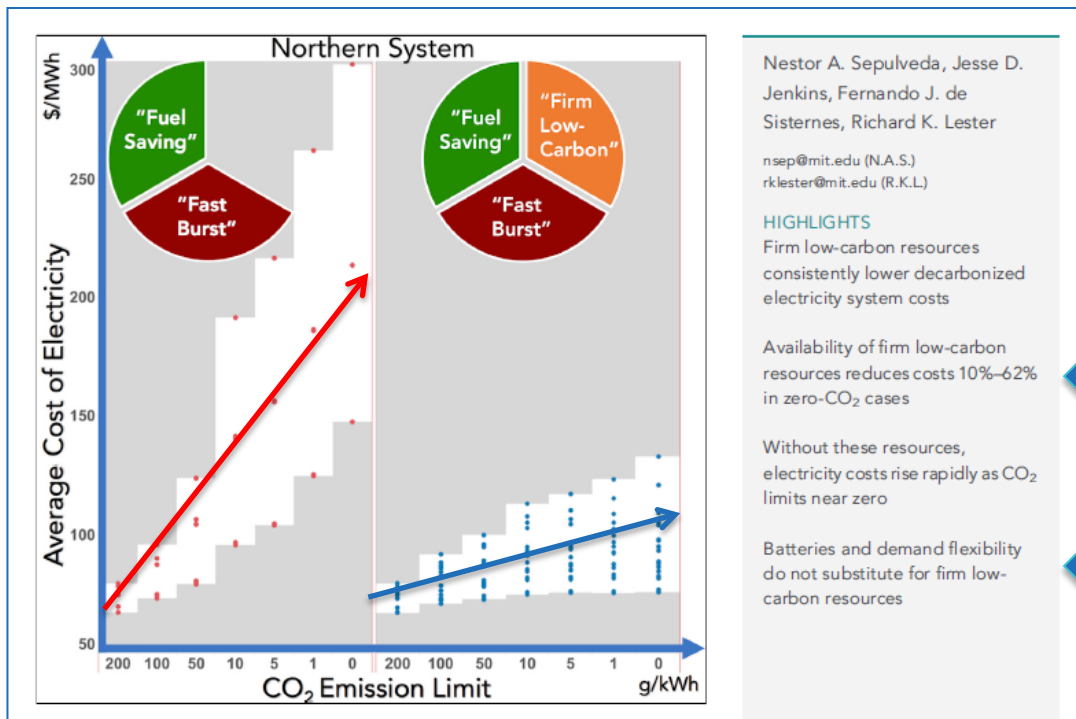
This map displays carbon-reduction targets adopted by individual electric utilities, as well as individual electric utilities that are subject to a state-level 100% requirement. It also displays carbon-reduction targets adopted voluntarily by parent companies of utilities that provide retail electric distribution service. A target adopted by a utility parent does not necessarily require individual utilities owned by the parent to comply with the overarching target.



Source:

<https://sepapower.org/utility-transformation-challenge/utility-carbon-reduction-tracker/>

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





# PRESIDENT BIDEN, U.S CONGRESS EMBRACE NUCLEAR ENERGY

## Biden American Jobs Plan:

- Recognizes important role of existing nuclear
- Pledges support for demonstration projects, manufacturing infrastructure investments

## Bipartisan Infrastructure Bill:

- Operating nuclear plant credit program
- Advanced reactor demonstration funding
- Large-scale H2 demos

## Build Back Better Bill:

- Tax credits for existing reactors
- Tax credits for all new clean generation
- Expanded federal loan guarantees



# Types of Advanced Reactors

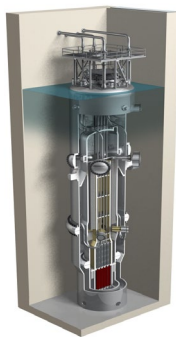
Range of sizes and features to meet diverse market needs

**Micro Reactors**  
( < 20MW)



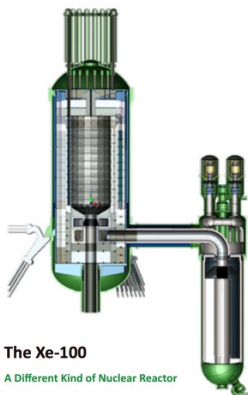
**Oklo (shown)**  
Approximately a dozen in development

**LWR SMRs**  
<300MW



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

**High Temp Gas Reactors**



**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 <300MW, some as large as 1,000 MW**

# ARDP Demonstration Awards

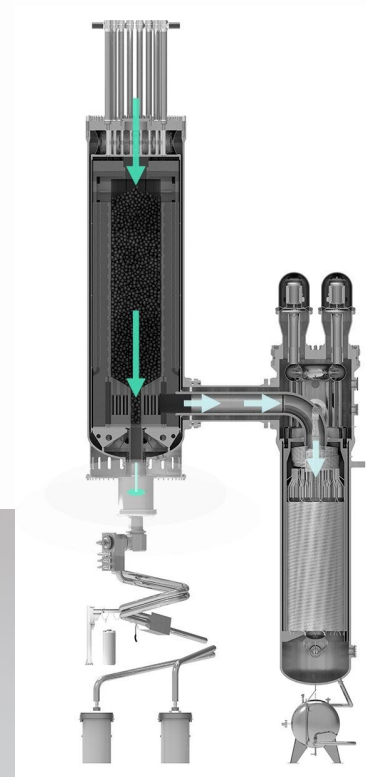
-  **TerraPower™**  
Natrium Reactor
  - Liquid sodium fast reactor - 345 MWe
  - Metallic fuel
  - Molten salt thermal storage for peaking to 500 MWe



# ARDP Demonstration Awards

- **energy**<sup>®</sup> Xe-100
  - Pebble bed Helium cooled gas reactor – 80 MWe
  - Four reactors
  - TRISO fuel

TRISO Fuel Pebble Cutaway





# NuScale Reactor

- Four, Six or Twelve water cooled small modular reactor modules
- Up to 77 MWe each, 924 MWe gross
- Ability to rapidly adjust total power output by adjusting individual modules
- Air cooling for condensers is an option
- NRC approval of Design Certification – 2020



## *NuScale Reactor*

First Commercial Deployment Planned  
by UAMPS at INL site in 2029

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

- Vogtle 3 and 4 - Georgia
- Oklo Aurora - Idaho
- UAMPS with NuScale - Idaho
- TerraPower Sodium - Wyoming
- X-energy Xe-100 - Washington
- Kairos Power Test Reactor - Tennessee
- Southern Company Molten Chloride Reactor Experiment - Idaho

Also – GE-Hitachi with OPG, USNC with Chalk River Lab in Canada

# MOVING BEYOND ELECTRICITY

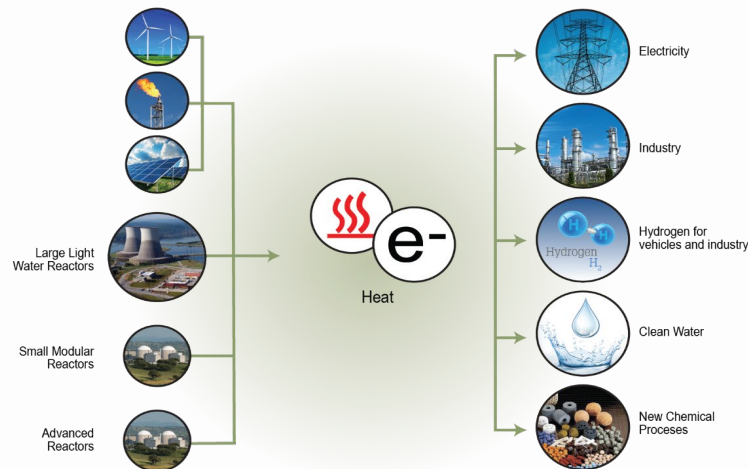
**TODAY**

Electricity focused



**FUTURE**

Integrated grid system that leverages contributions from nuclear fission **beyond** electricity sector



*Tomorrow's nuclear will produce more than electricity*

# KEY TAKEAWAYS

- Consumers and policymakers (U.S. and abroad) increasingly demanding low-carbon electricity; states and utilities responding with deep decarb goals
- Growing understanding that new nuclear is extremely valuable to deep decarbonization
  - Least-cost, most reliable low-carbon systems include firm clean generation
  - Nuclear can help decarbonize non-electric energy uses
- Increased attention to energy security creating tremendous opportunities in global markets

**WIND + SOLAR + NUCLEAR + STORAGE IS THE BALANCED MIX  
THAT WILL GET US TO A LOW-CARBON FUTURE**



# QUESTIONS?





# “COMPARED TO WHAT?”

To enact any of the pathways, we need to build infrastructure significantly faster than we ever have before.

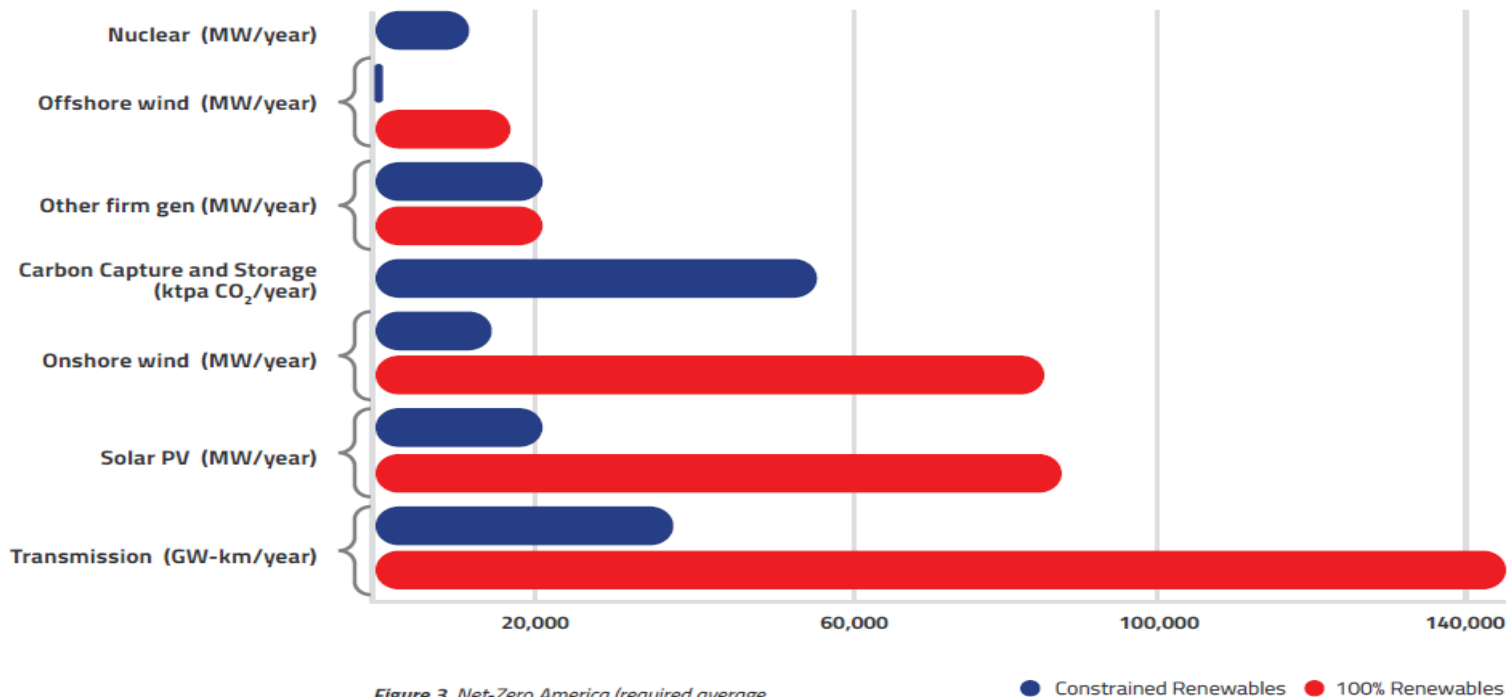


Figure 3 Net-Zero America (required average annual capacity increase in the constrained and 100% renewables pathways)

Source: From Ambition to Reality, Worley/Princeton E-FFILIATES, 2021