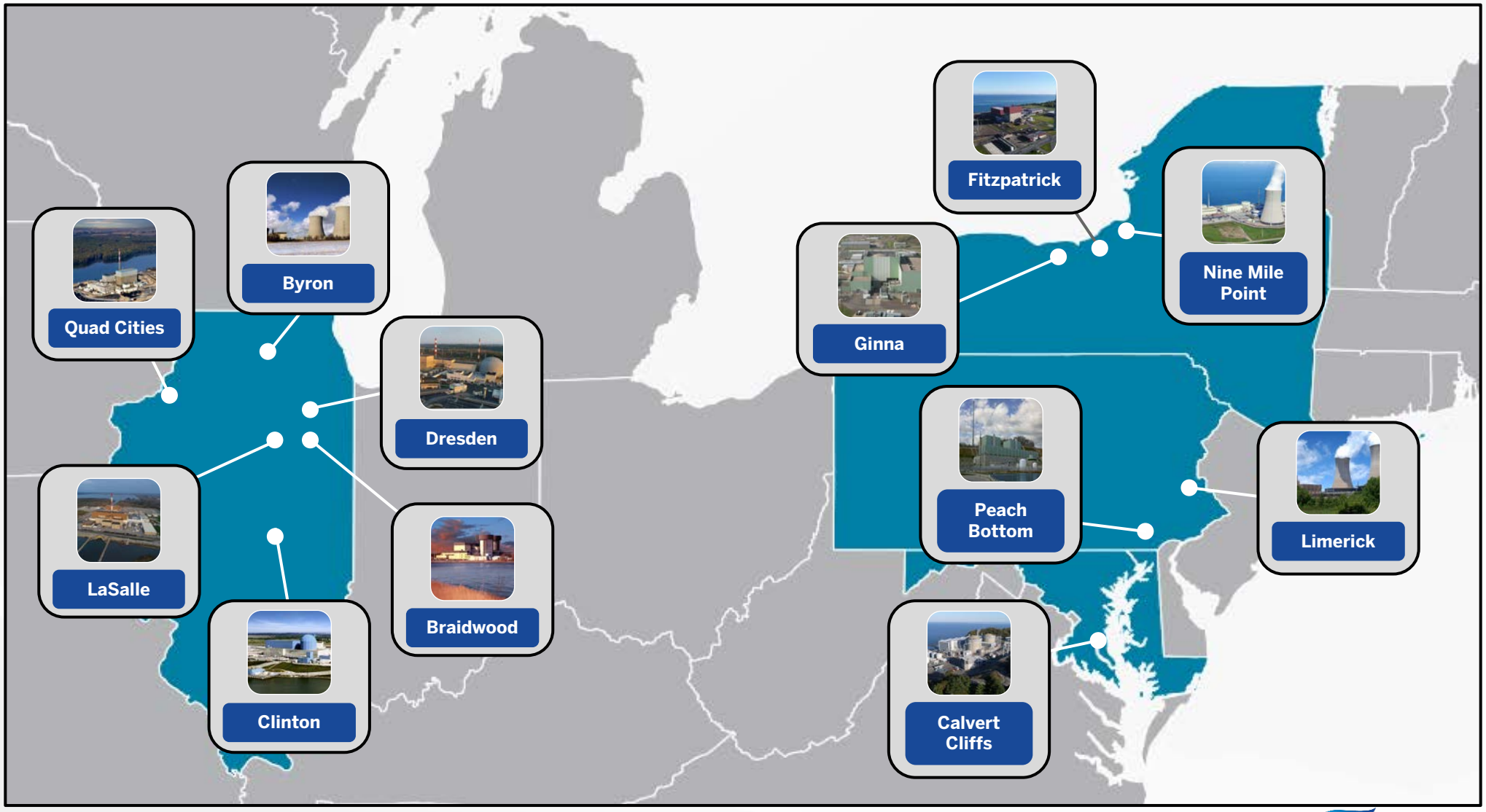
Constellation

Clean Energy Options: Preserving and Expanding Nuclear

December 13, 2024

Constellation's operated nuclear fleet



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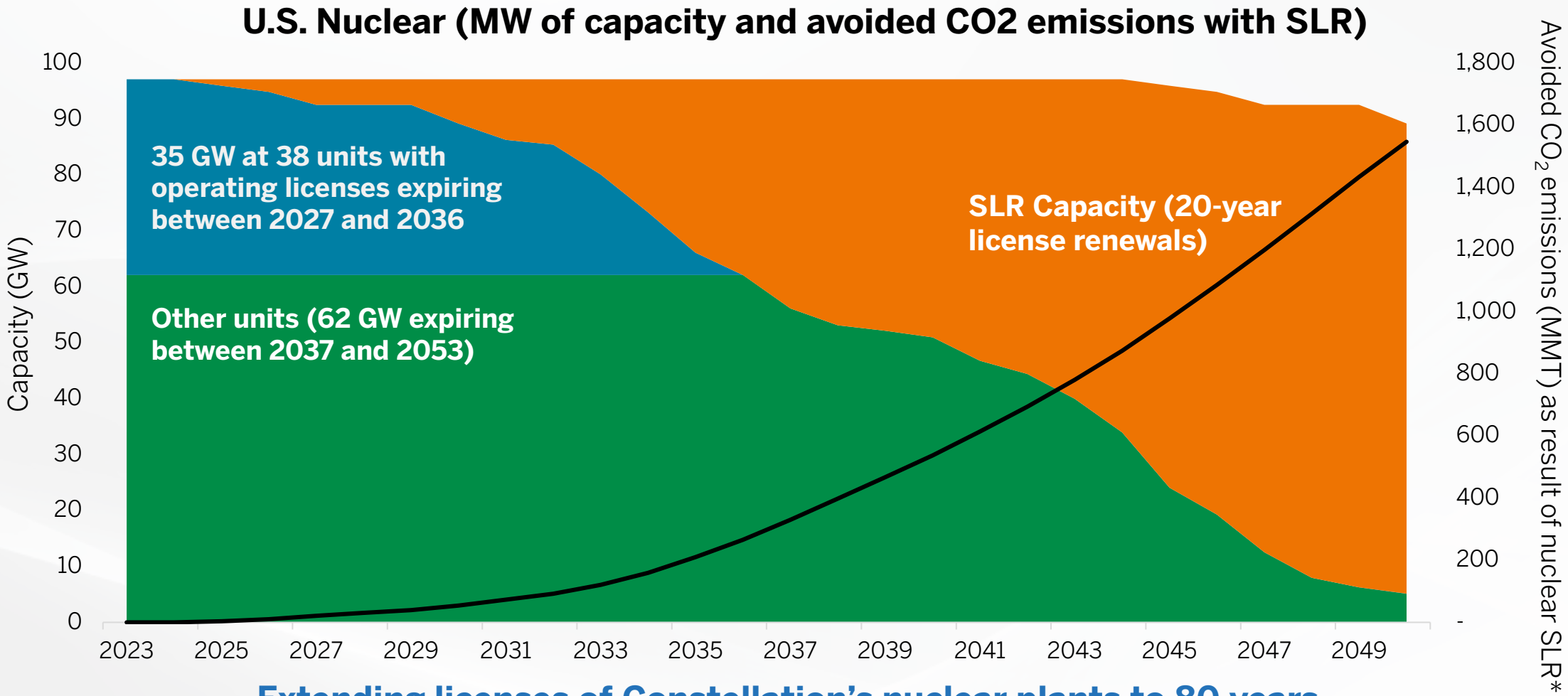
Relicensing the nuclear fleet would create more clean energy than all the renewable energy generated in the US to date



Extending licenses of Constellation's nuclear plants to 80 years will create over 453 million people-hours of work in high-paying jobs

*Emissions estimate based on EIA forecasts; will vary with pace of clean energy transformation

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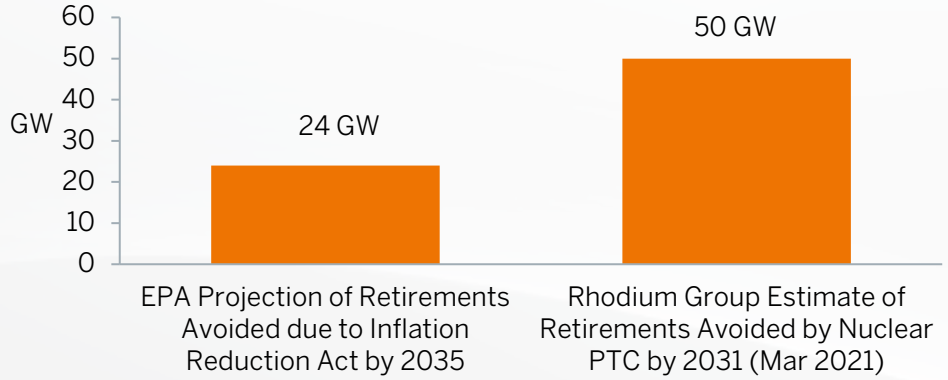
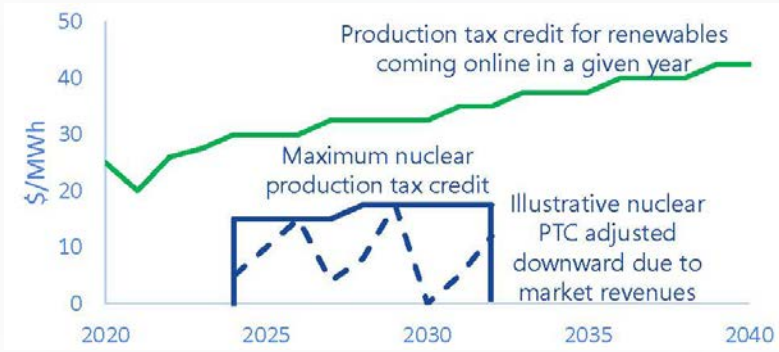
Nuclear faces long-term challenges complicating re-licensing decisions

(1) EPA and Rhodium Group analysis confirm that the nuclear production tax credit avoids significant near-term retirements

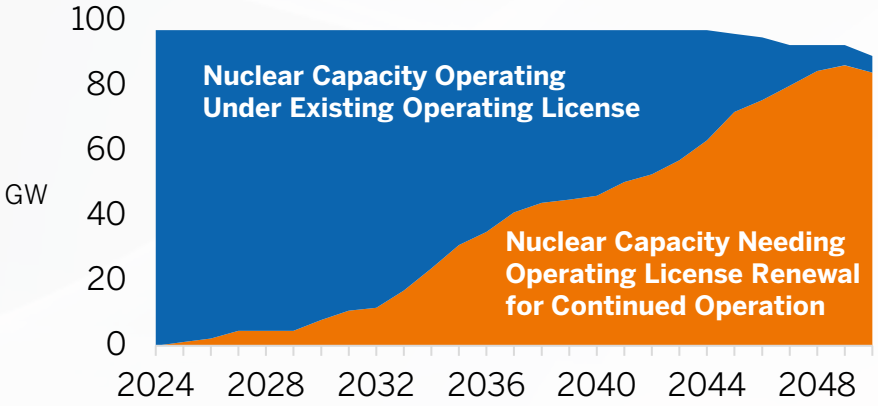


(2) But both EIA and EPA project that nuclear retirements will greatly accelerate once the nuclear PTC expires

(3) While zero-marginal cost renewables continue to benefit from long-term subsidies



(4) Which challenges nuclear economics as increasing numbers of units face expiring licenses in the early 2030s



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Uprates allow increased output from an existing nuclear plant

Nuclear Uprates

Nuclear uprating is the process of increasing the maximum power level of a unit, producing more carbon-free power with no additional use of land

- **Measurement Uncertainty Recapture Uprates (MUR)** – Installation of new flow measurement devices to increase thermal power output by ~2 percent
- **Stretch Power Uprates** – Changes to instrumentation setpoints to increase in electrical production capacity by up to 7 percent
- **Extended Power Uprates (EPU)** – Modifications to major pieces of equipment (e.g., turbine) that can increase electrical production capacity by up to 20 percent

45Y Credits

- Section 45Y PTC provides a $27.50 /MWh technology neutral credit, growing with inflation, available for any new zero-carbon emitting power source
- If a Section 45Y PTC is claimed for an uprate, the increased nuclear production from the uprate would not be eligible for the Section 45U nuclear PTC

Constellation Announced Projects

- Increasing nuclear output by ~135 MWs at Byron and Braidwood, phased in starting in 2026 with full implementation by 2029 based on timing of the turbine installations during planned refuel outages
- Estimate 1 GW of total uprate potential across our nuclear fleet, which is equivalent to 1.6 GW of offshore wind, 2.8 GW of onshore wind, or 7.3 GW of utility scale solar.

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Restarts are bringing new, clean, and reliable power back online

Constellation has entered into a 20-year PPA with Microsoft to bring the Crane Clean Energy Center online in 2028

- Adds 835 MWs – 7 million MWhs – of clean, firm reliable energy
- Creates more than 3,400 jobs, including 600 permanent jobs at the plant
- Provides $16B in PA state GDP and $3.6B of estimated tax revenues

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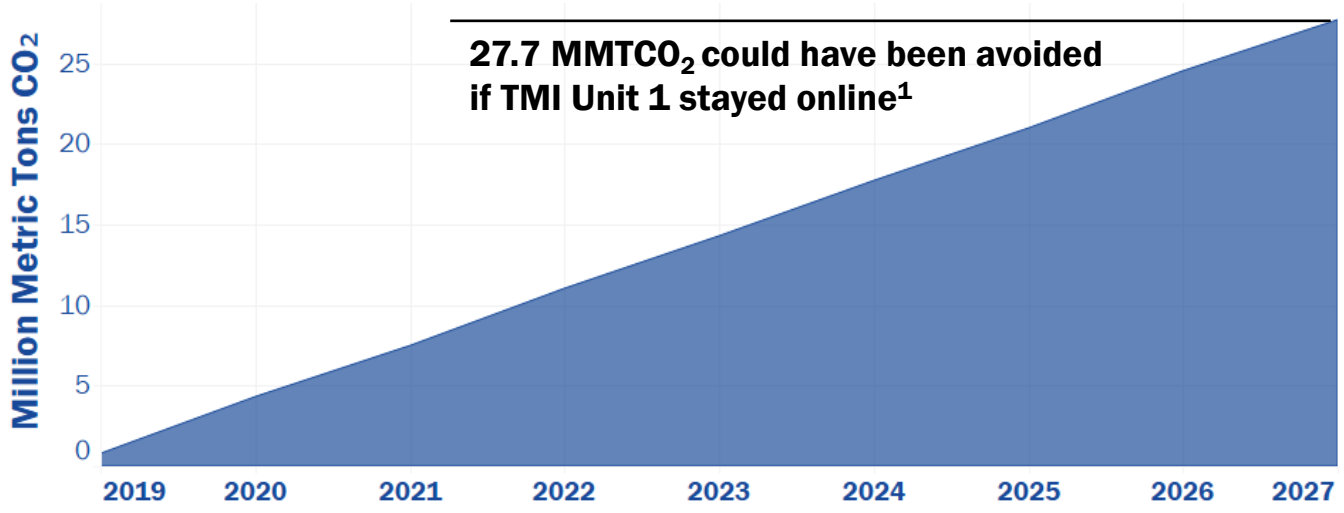
Preventing Nuclear Retirement is Equivalent to Adding Multiples of New Wind or Solar

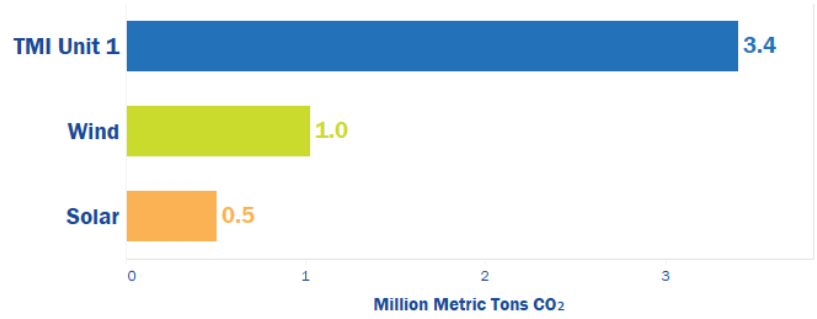
Cumulative Avoided Emissions at TMI Unit 1 in Million Metric Tons CO_2
(September 2019 - December 2027)



Equivalent avoided emissions & net generation to TMI Unit 1 from a renewable PPA would require:

- Wind: 2.8 GW Capacity and >60,000 acres[2]
- Solar: 5.6 GW Capacity and >40,000 acres[3]

Annual Avoided CO_2 from 837 MW Generating Capacity for PPAs by Generation Source



[1] Calculated using 2023 PJM Hourly Marginal Emission Rates at LMP node TMI – 49484. https://dataminer2.pjm.com/feed/hourly_marginal_emissions/definition
[2] NREL 2009. Land-Use Requirements of Modern Wind Power Plants in the United States. https://www.nrel.gov/docs/fy09osti/45834.pdf
[3] NREL 2013. Land-Use Requirements for Solar Power Plants in the United States. https://www.nrel.gov/docs/fy13osti/56290.pdf

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Policy support is needed to drive investment in new nuclear reactors

TEXAS ADVANCED NUCLEAR REACTOR WORKING GROUP

7 LEGISLATIVE RECOMMENDATIONS

The Working Group's recommendations that follow target critical nuclear industry issues in Texas with possible legislative solutions to bring ANR projects to Texas.

1. **Texas Advanced Nuclear Authority**
   A non-regulatory entity to coordinate Texas' strategic nuclear vision, implement ANR policy recommendations, and manage potential funds and oversight of state nuclear incentive programs.
2. **Texas Nuclear Permitting Officer**
   A single point of contact for advanced nuclear reactor developers and associated businesses to navigate permitting.
3. **Workforce Development Program for Community Colleges and Universities**
   Coordination plan between workforce, education, and industry to support a homegrown nuclear workforce in Texas capable of meeting ANR industry and Texas energy demand.
4. **Texas Advanced Manufacturing Institute**
   Designed to develop and foster a nuclear ecosystem in Texas.
5. **Texas Nuclear Public Outreach Program**
   A communications and public engagement plan to inform and educate Texans about the benefits of advanced nuclear power and reactor development.
6. **Texas Nuclear Energy and Supply Chain Fund**
   A direct grant cost-sharing program to incentivize early development and siting, and support supply chain and manufacturing capacity readiness.
7. **Texas Nuclear Energy Fund**
   An appropriation to a fund, modelled after the existing Texas Energy Fund, explicitly for advanced nuclear power to overcome the funding valley project developers face in Texas.

	Gen III+ (Next-Gen LWRs)	Gen IV ("Advanced Reactors")
Large reactors 1,000+ MWe 8+ TWh/yr	Westinghouse AP-1000 Framatome EPR-1400 (non-US) GW ABWR (1,350 Mwe, non-US)	Generally inactive
Small Modular Reactors ~350 MWe ~2 TWh/yr	GE BWRX-300 (2-pack) Westinghouse AP-300 Holtec SMR-300 NuScale VOYGR (77 MWe, 6-pack)	Kairos Power KP-150 (2-pack) Terrapower Natrium (345 MWe) X-energy Xe-100 (4-pack)
Microreactors ~10 Mwe ~0.1 TWh/yr	Generally inactive	Oklo Aurora (15 MWe) BWXT BANR (15 MWe) Westinghouse eVinci (5 MWe)

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