



**Institute for Energy Economics
and Financial Analysis**

Risks & Warning Signs for Investors in Small Modular Reactors

Institute for Private Investors 2023 End of Year Forum

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**Institute for Energy Economics
and Financial Analysis**

www.ieefa.org

What is a small modular reactor (SMR)?

- SMRs are **generally defined as reactors that are 300 megawatts (MWe) or smaller**; this compares to the 600-1135 MWe range for most current U.S. reactors
- Designs can include a **single reactor or multiple units** grouped together
 - *NuScale's reactor modules are 77 MWe each, and can be grouped in plants of up to 12 modules – not necessarily small*
 - *GE-Hitachi's reactor is a single 300 MWe unit – but also not necessarily small if grouped*
- Modular refers to the idea that **plants would be fabricated in factories, then assembled at site**
- Designs include **scaled-down versions of existing boiling and pressurized water reactors**, as well as **other proposals** for technologies that previously have been tried and failed or have never been tried at all

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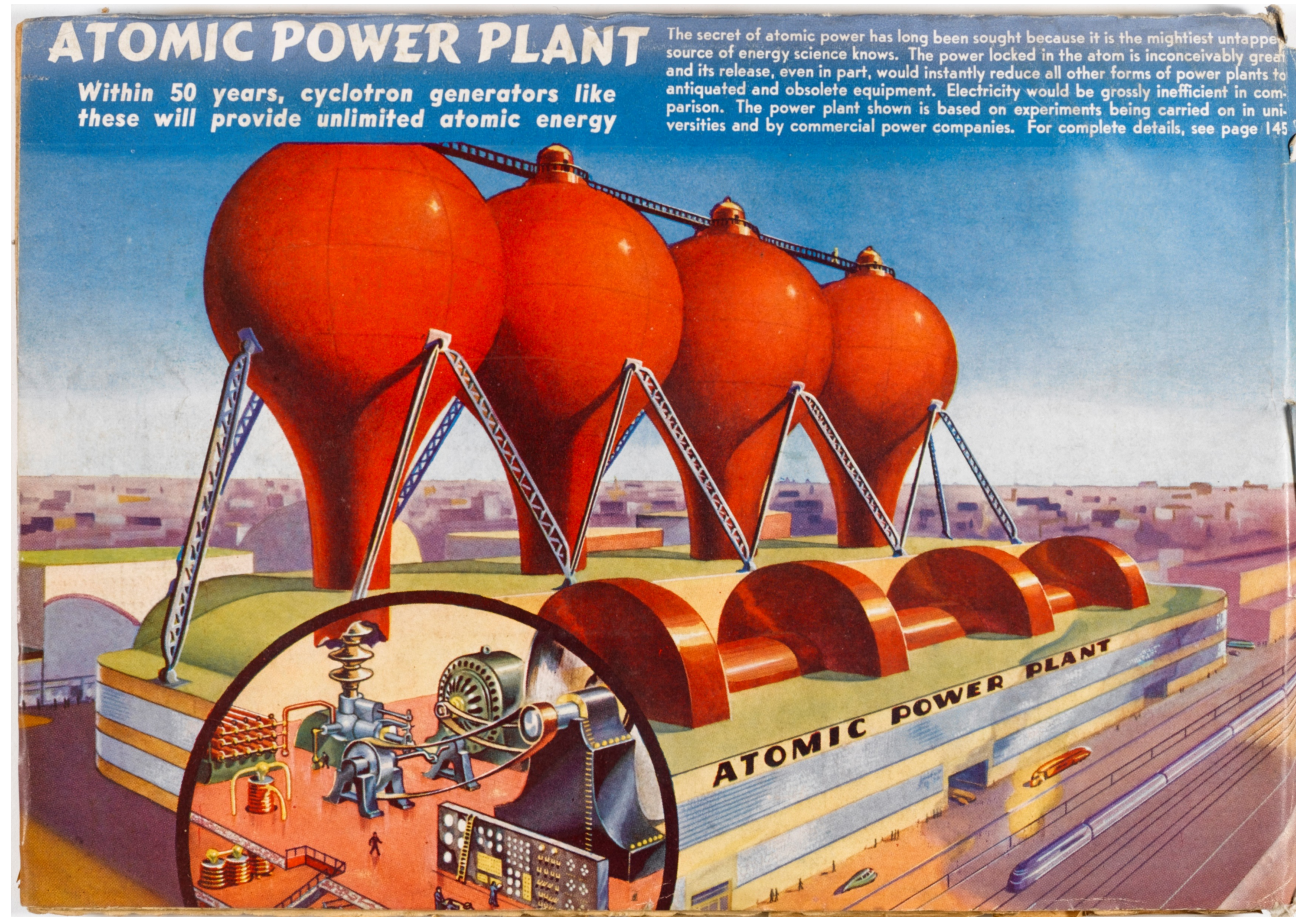
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8. Increasing competition from declining cost renewable sources + storage

How Expensive Can the Power From SMRs Get?

- When the NuScale SMR was cancelled in November, its target price of power was **\$119 per megawatt hour (MWh)**, not including Inflation Reduction Act subsidies, & \$89 per MWh *with* the subsidies
- But that's not as high as the price of power from an SMR can get
- For example, the CEO of Constellation Energy Corporation, which owns the most nuclear plants in the U.S., sees a price **of \$150 to \$160 per MWh for the power from a new SMR**. And wants no piece of one without a guaranteed contract that someone will pay that much for power from the plant
- The CEO of NextEra Energy has similarly expressed **skepticism about SMRs**
- “[SMRs] are **going to be very expensive**, and then you’re going to be taking a bet on the technology”
- “Right now, I look at SMRs as an **opportunity to lose money in smaller batches**”
- But **\$160 is not a cap** - SMR power prices could be even higher, perhaps significantly higher

Initial Government and Industry Claim

Atomic power would be “too cheap to meter”



Reality – After 1970 Reactors Became Too Expensive to Build

Estimated vs Actual Overnight Cost of 75 Reactors that Started Construction in 1966-77 (1982 dollars)



Estimated Construction Schedule at Start of Construction vs Actual



Results of 1986 DOE study understated cost and schedule overruns: (1) overnight costs don't include financing costs or inflation & (2) many of most expensive reactors were not included

Ratepayers Bore Nearly \$100 Billion in Higher Reactor Costs from Overruns just in the 1970s to 1990s

- Over **100 reactors were built. Many more were cancelled** due to lack of power demand or concern over “rate shock,” even some that were finished or close to completion

Zimmer in Ohio was converted to coal despite being 97% complete

\$5 billion Shoreham plant on Long Island sold to state for \$1, never operated

WPPSS disaster in the Northwest

- Owners of many completed or cancelled reactors experienced **severe financial problems** - some went bankrupt due to higher-than-expected construction costs
- **Investors forced to bear ~\$10 billion** in nuclear construction costs disallowed by state utility commissions – but ratepayers bore almost \$100 billion in overruns

What Did the Nuclear Industry Say After the First Wave of Reactors Were so Expensive?

The industry claimed:

New reactor designs would benefit from modular construction in terms of both shorter construction time and lower costs.

- (1) But these **benefits did not materialize** and
- (2) This is nearly identical to what **current SMR vendors are claiming today** for their projects

Did This Lead to Less Expensive Nuclear Units?

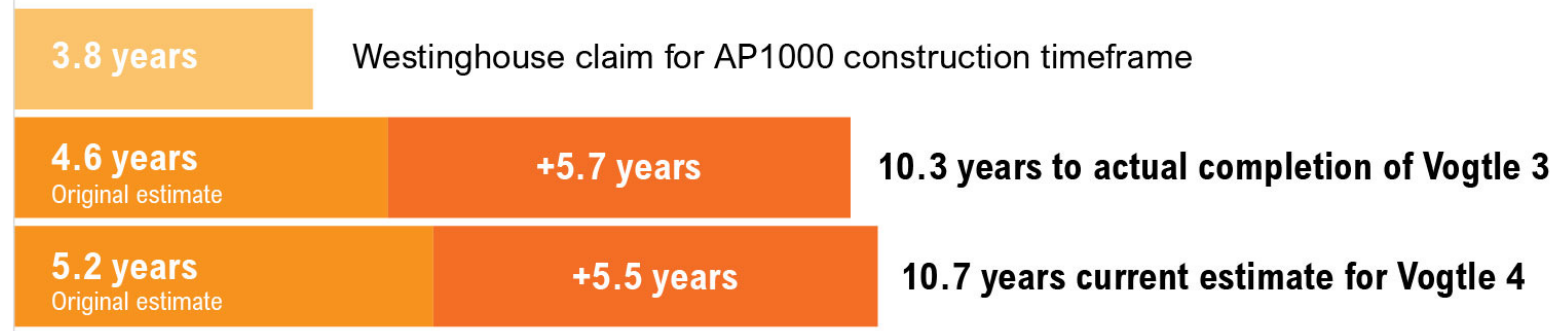
- No.
- Over 20 new reactor projects were proposed in the U.S. by 2010
- Only 4 units began construction, the rest were cancelled
- Two of the four, being built in South Carolina, were cancelled in 2017 due to rapidly rising costs

The Vogtle Experience Much Worse than Projected

Cost



Construction



Have Investors Had to Bear Any of Vogtle's Higher Cost?

- Ratepayers of Vogtle's owners will have to bear the greatest part of the cost overrun
- A proposed settlement before the Georgia Public Service Commission would require **shareholders of Georgia Power Company to absorb \$2.6 billion** of the project's cost
- But this settlement is being **challenged as being too low**

What Claims Does the Nuclear Industry Now Make for SMRs After the Experience at Vogtle?

The industry's **current claims for SMRs** are mostly the same as they were before Vogtle

“Simplified, modular, ultra compact nuclear island (costliest portion of any reactor) reduces construction costs/schedule.” Westinghouse, 2023

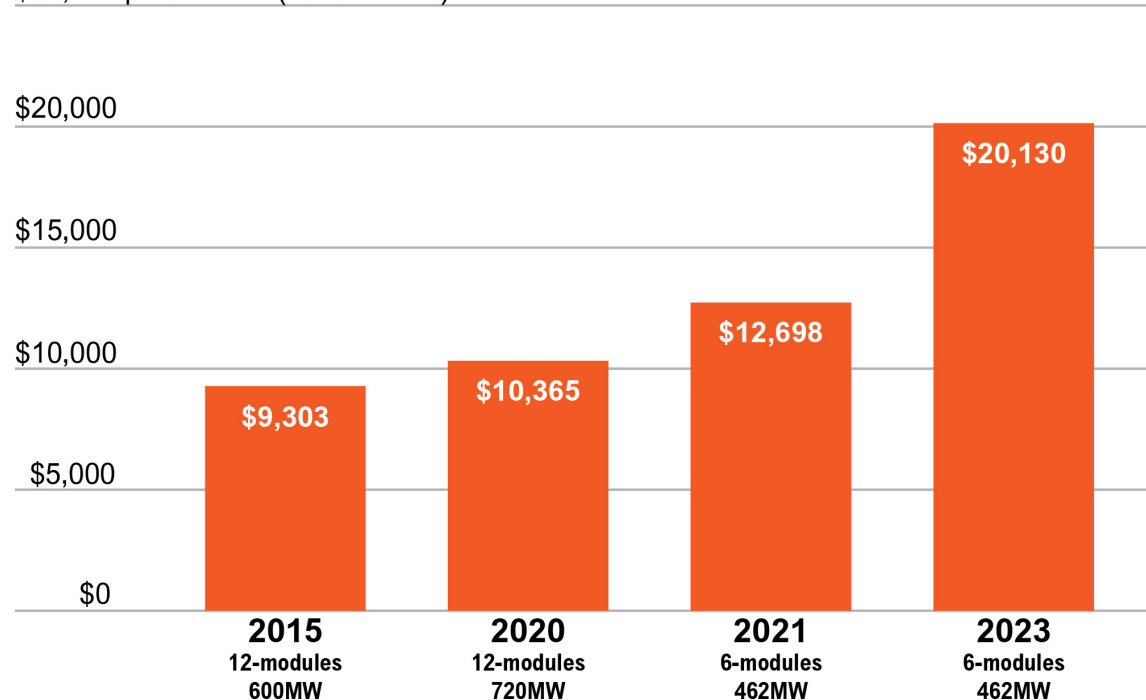
The industry and its supporters also claim that by building lots of SMRs, the cost per MWh will decline – that is, there will be learning curve that will lead to cost reductions

Have the Estimated Costs of Any Proposed SMRs Gone Up?

Yes.

Estimated **cost** has **doubled** for NuScale's proposed SMR for Utah

\$25,000 per kilowatt (2022 dollars)



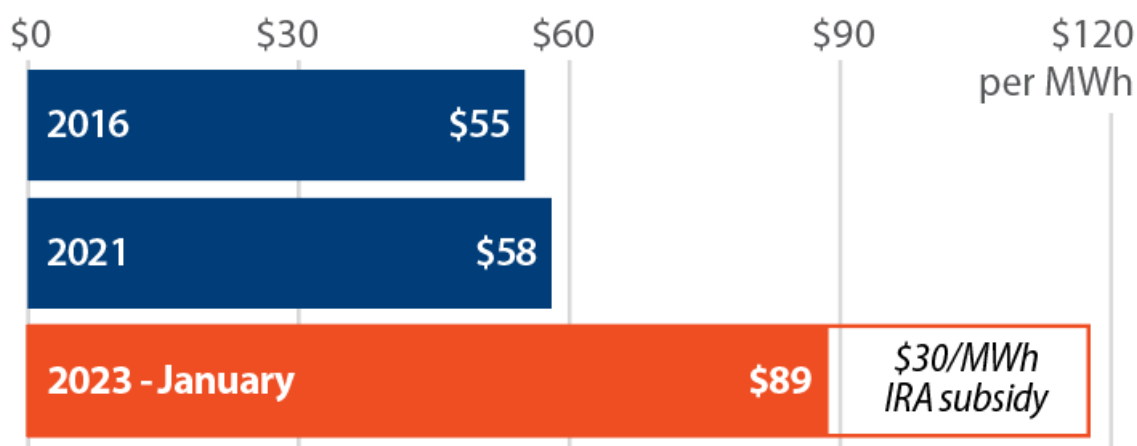
As the Estimated Cost of Building the NuScale SMR Rose So Did Its Projected Price of Power

\$119 per MWh would not have been the final price for the power from the NuScale SMR

The price of power would have continued to go up had the project not been cancelled

Eye-Popping New Cost Estimates for NuScale SMR

UAMPS raises estimated construction costs from \$5.3 to \$9.3 billion; power cost estimates increase by 54%



Sources: UAMPS statements; January 3, 2023 Talking Points

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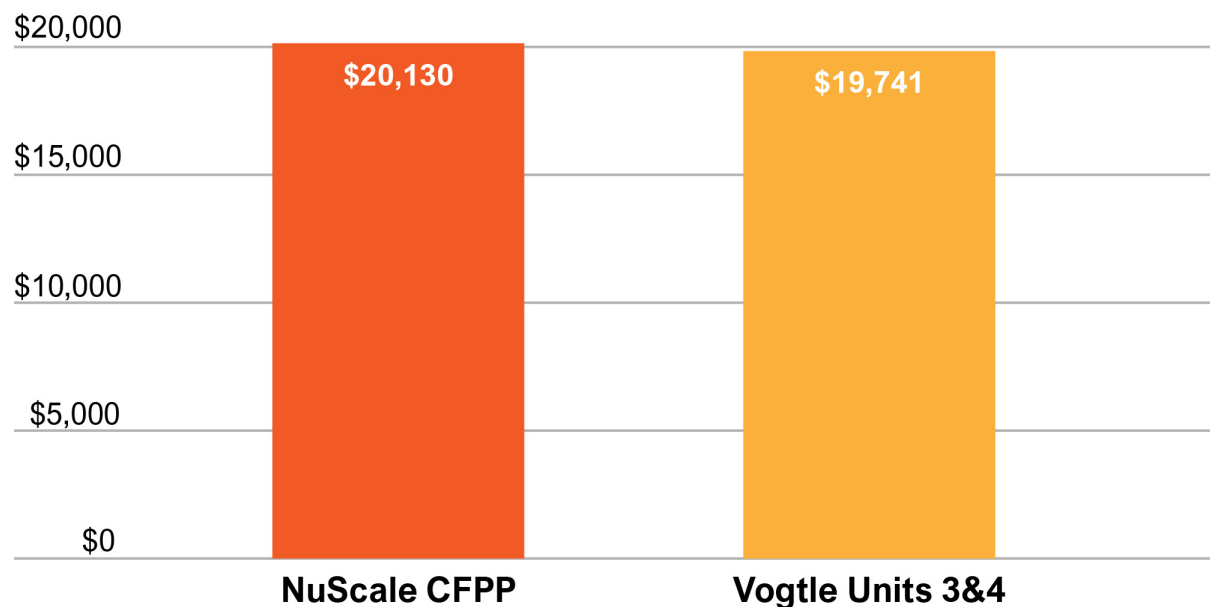
Is There Any Evidence that SMRs Will Be Less expensive than Earlier Reactors?

No.

Despite proponents' claims, the estimated **cost of NuScale's SMR was already as high as the Vogtle project when it was cancelled** with more than 7 years left before construction is scheduled to be completed – plenty of time for the cost to go even higher.

\$25,000 per kilowatt electric (kWe)

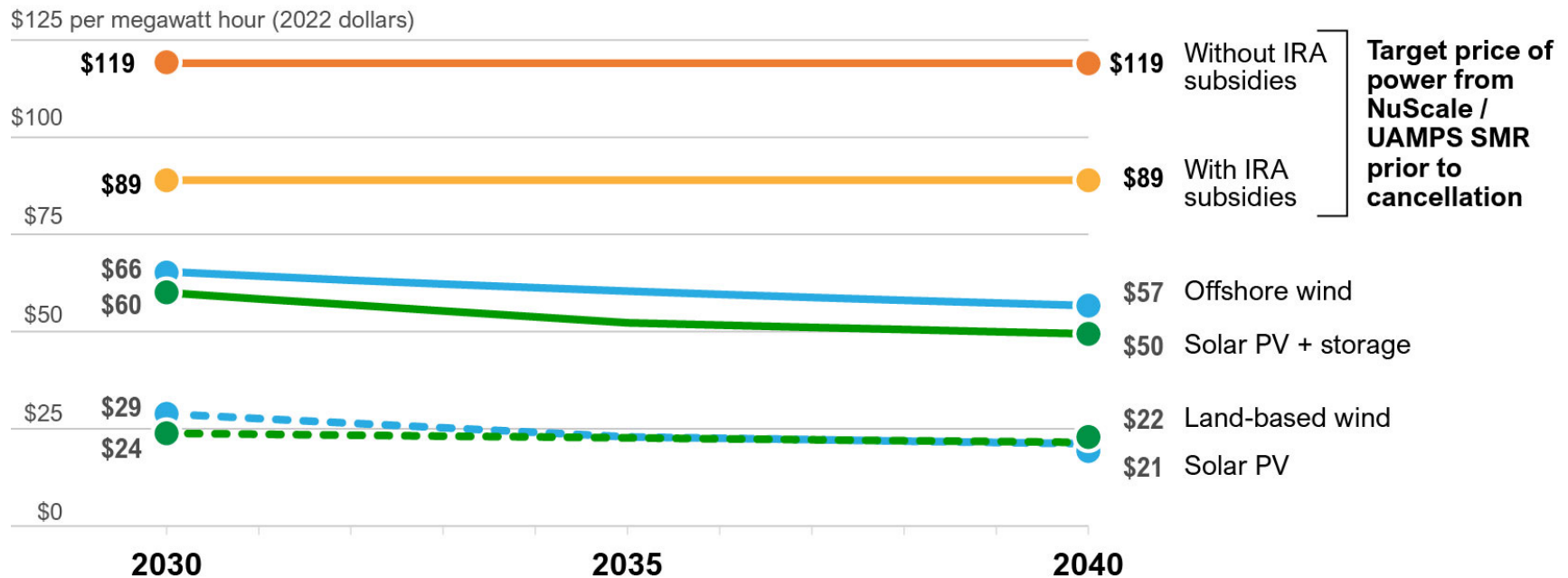
**Construction costs
(2022 dollars)**



Was Concern over Rising Construction Costs and Power Prices Why the SMR Was Cancelled?

- Yes.
- Project was cancelled because NuScale and UAMPS (Utah Associated Municipal Power Systems) were **unable to find enough parties to sign contracts** to pay for the power from the SMR
- The power contract required parties who remained in the project after a license was granted by the Nuclear Regulatory Commission to ***pay all the actual costs of the SMR even if it was not finished, never provided any power, or was damaged or destroyed***
- Public information about the **SMR's rising cost, and the potential for further cost increases certainly contributed to new parties' refusal to sign** the power contract

Power From SMRs Will Be More Expensive than Power from Renewable Resources



Sources: NuScale Power, UAMPS and National Renewable Energy Lab's 2023 Annual Technology Baseline report.

What About the Estimated Costs of Other Proposed SMRs?

- NuScale and UAMPS cited higher interest rates and escalation of construction commodity prices as reasons why the cost of its proposed SMR increased by 75% just between 2021 & January 2023
- Reasonable to expect that the same factors will lead to similar increases in the cost of other SMRs especially those with more exotic designs
- **Warning Sign** - *other SMR marketers have so far been able current project cost and schedule estimates secret from the public and investors*

Is It Reasonable to Expect That the Costs of Building SMRs Will Decline as More Are Built?

- **Proponents of SMRs assume** that there will be a “learning curve” which will make the costs of building SMRs decline over time.
- This is **just an assumption** – it certainly hasn’t happened in the U.S. and credible analyses raise doubt whether it has happened elsewhere
- As noted earlier, the same prediction was made for the Vogtle Nuclear project
- Even if there is such a learning curve, it is unknown how quickly the cost of building SMRs will decline or by how much – **without offering any real evidence, SMR proponents assume steep declines**, e.g., where each successive SMR is 10% cheaper than the last
- Also, if there such a learning curve, it’s slope will depend on how many SMRs of each specific design are built and whether any major flaws in that design are found during construction or operation - these are **currently unknowable especially with so many different designs being marketed**

For More Information

- Contact David Schlissel at dschlissel@IEEFA.org
- IEEFA reports on SMR risks available at www.ieefa.org/smr
 - “SMRs – Too late, too expensive, too risky and too uncertain”
 - “Eye-popping new cost estimates released for NuScale small modular reactor”
 - “NuScale Power, the canary in the small modular reactor market”
- Sign up to get new research from IEEFA when it’s available