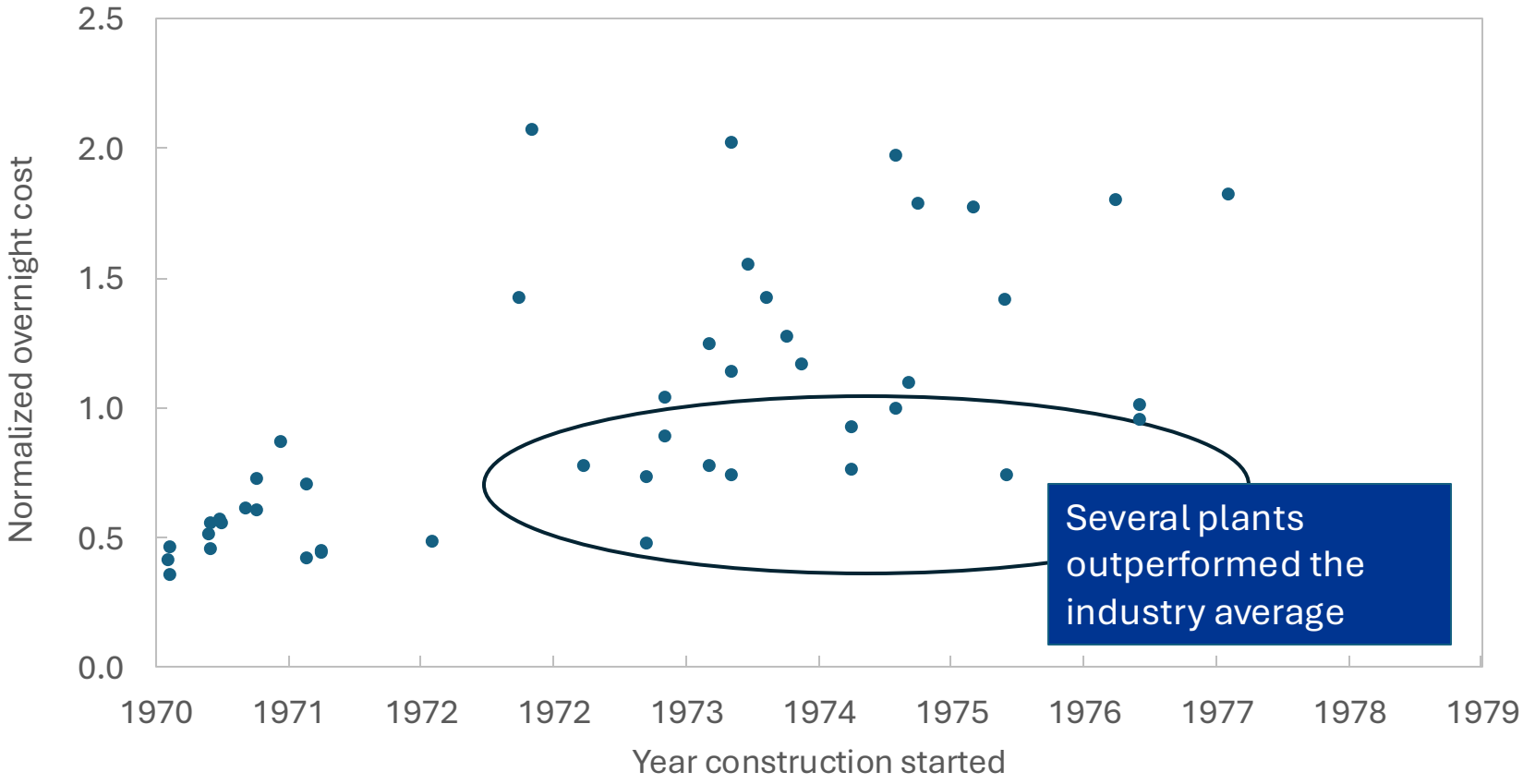
Alva

North Carolina State Legislature Presentation

February 3 2026
Strictly Confidential

Even in an uncertain regulatory environment, many plants (could be) delivered quickly and at low cost

Multiple nuclear power plants were delivered in the post TMI era *at lower rates of cost escalation than fossil plants*



Investment has focused on reactor technology – despite never correlating with delivered cost

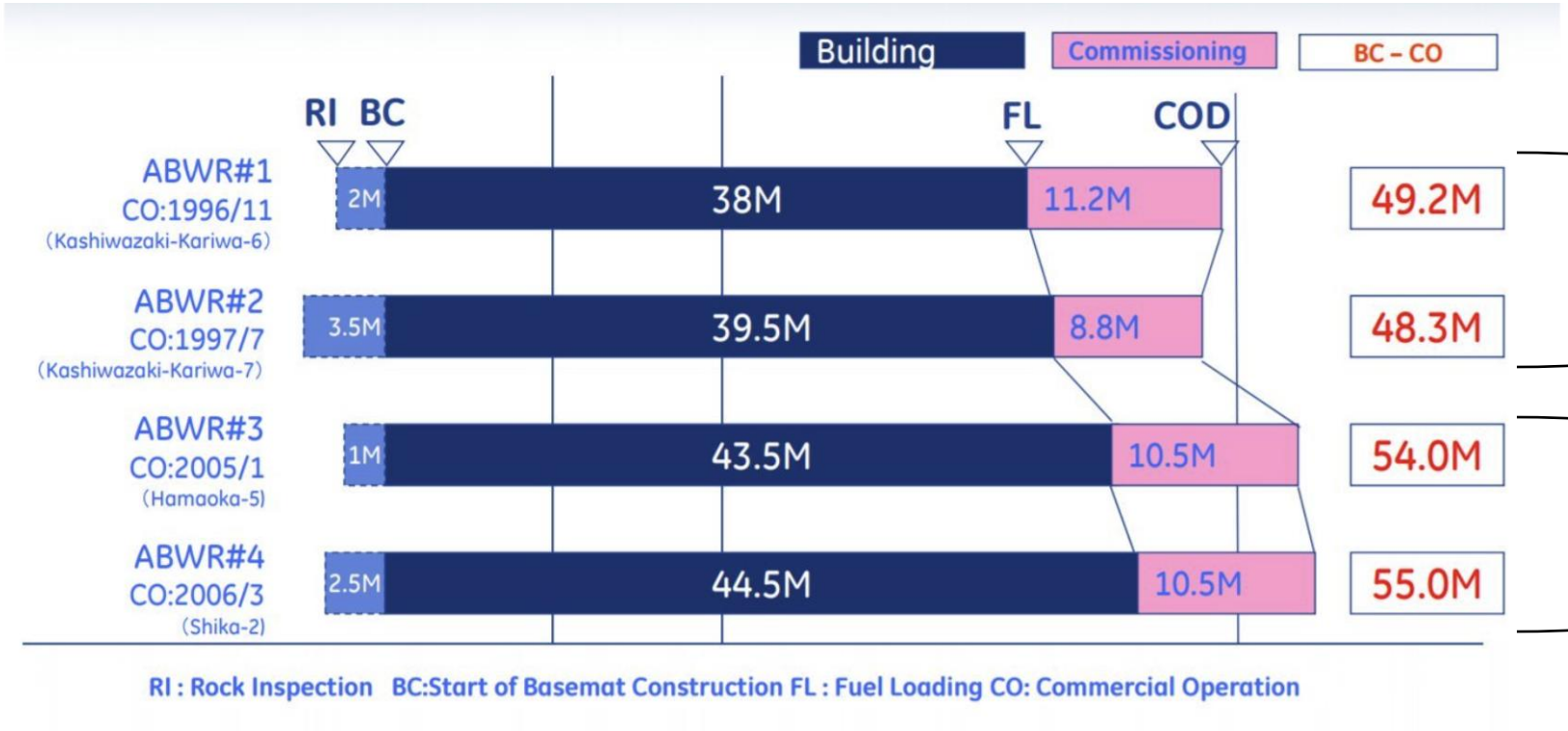
	Washington Nuclear Project 3	Waterford Unit 3	Saint Lucie 2
Reactor Vendor	Combustion Engineering		
Constructor	Ebasco		
Construction Start	1977	1974	1977
Construction Duration	**Abandoned**	**11 years**	**5 years (time to cold hydro)**
Construction Cost (2024 USD)	Resulted in largest muni-bond default (before Detroit)	**$12,000/kWe**	**$5,000/kWe**

Nuclear Technology (for LWRs) or EPC *has not been* the determining factor in project success or failure in US nuclear build outs

Nuclear New Build Success (or Failure) is Dependent on Developer Quality

	Washington Nuclear Project 3	Waterford Unit 3	Saint Lucie 2
Reactor Vendor	Combustion Engineering 2x2 PWR		
Engineering & Constructor	Ebasco		
Schedule & Cost Control	Ebasco	Ebasco	Utility Developer
Design Control	Ebasco	Ebasco	Utility Developer
Procurement	Ebasco/Combustion Eng.	Ebasco/Combustion Eng.	Utility Developer
QA\QC	Ebasco	Ebasco	Utility Developer
Regulatory + Licensing	Ebasco/Combustion Eng.	Ebasco/Combustion Eng.	Utility Developer
Construction Duration (Nuclear Concrete to First Hydo)	**Abandoned**	**11 years**	**4 years**
Construction Cost	**Resulted in largest US muni-bond default (before Detroit)**	**$12,000/kWe**	**$5,000/kWe**

Large Reactors Can Be Built Fast: ABWR Construction Track Record

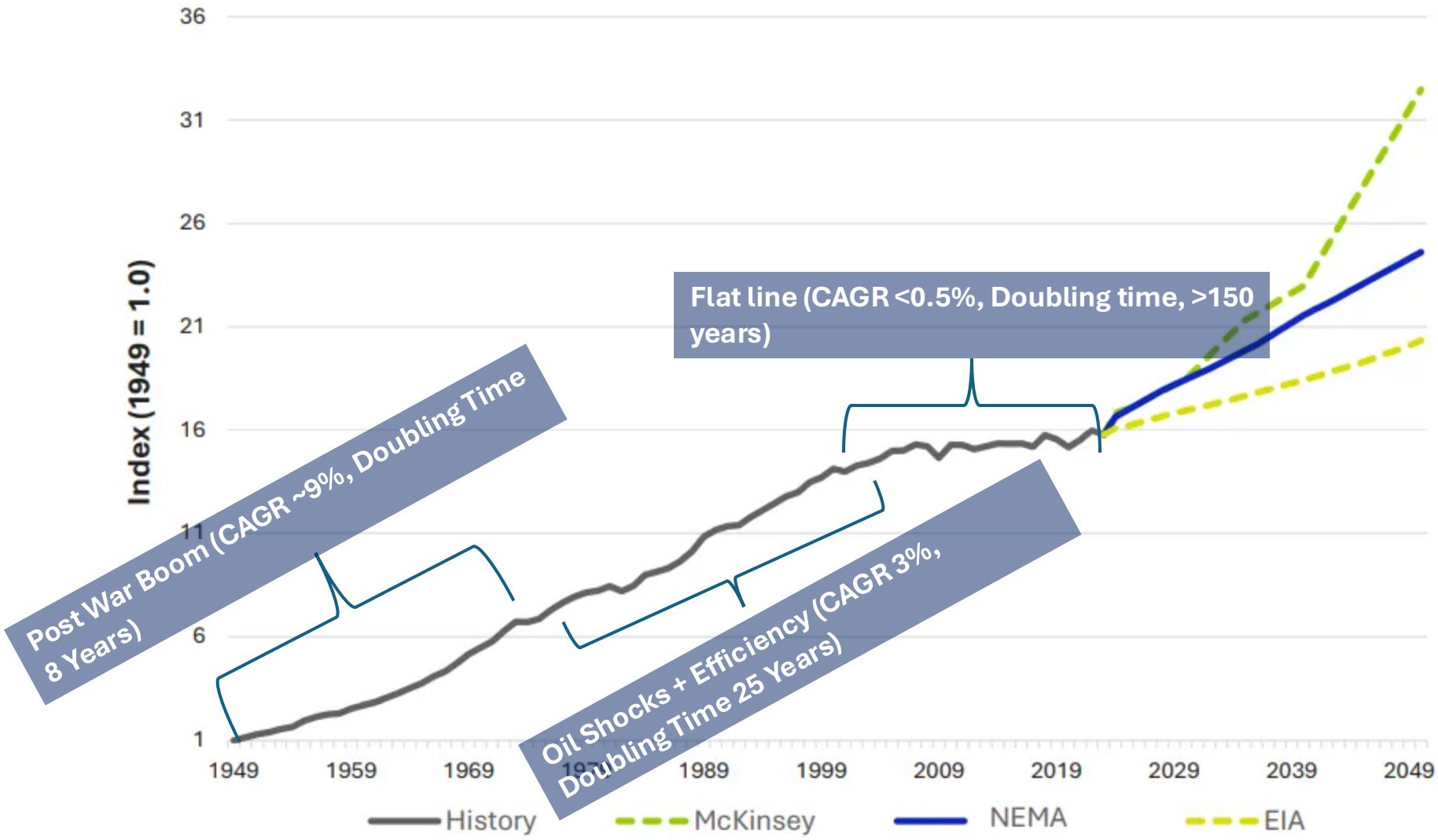


Fastest FOAK builds in world history

Single unit NOAK build performance is excellent

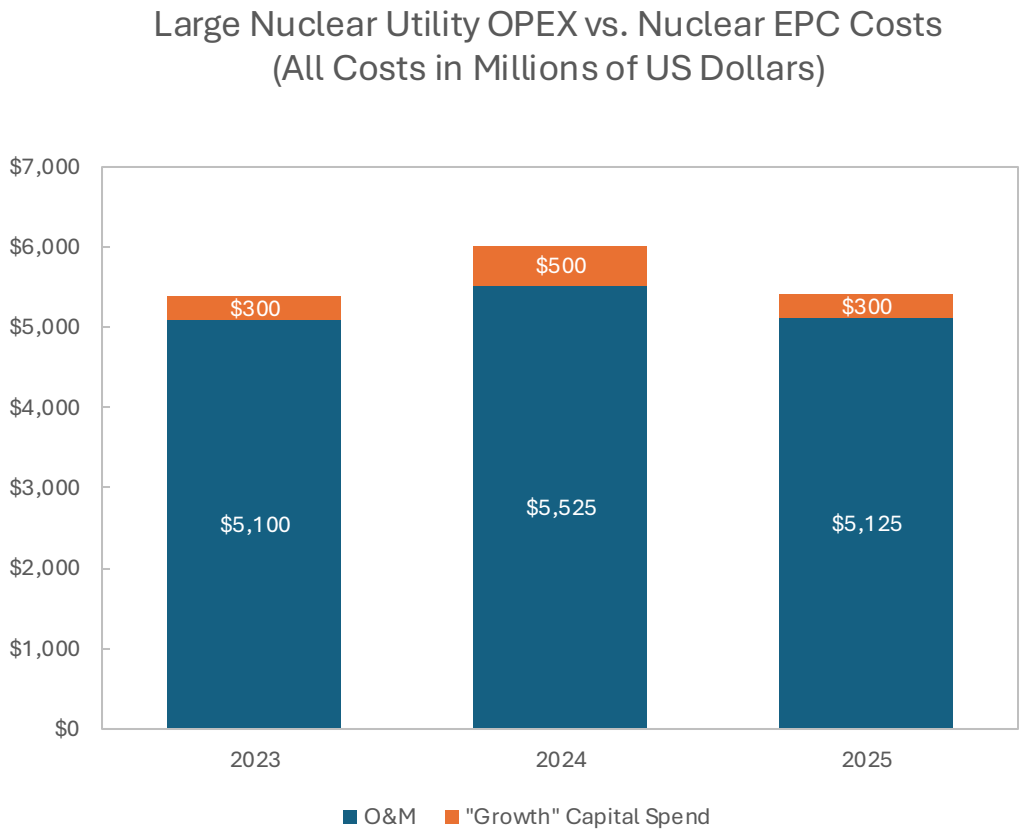
Data from IAEA PRIS

The Great Unlearning



Utilities are operators, not builders

- >90% of nuclear-utility spend is O&M / fuel, not construction or plant modifications
- Typical nuclear engineer oversees <2 large projects in their career
  - <1/4 the capex compared to oil & gas
- No “muscle-memory” → Vogtle, Summer & FPL uprates ran over budget / schedule.
- Uprates at 41 reactors across 12 owners or 10 new builds across 5 utilities → no single utility with the scale to build a permanent execution team.



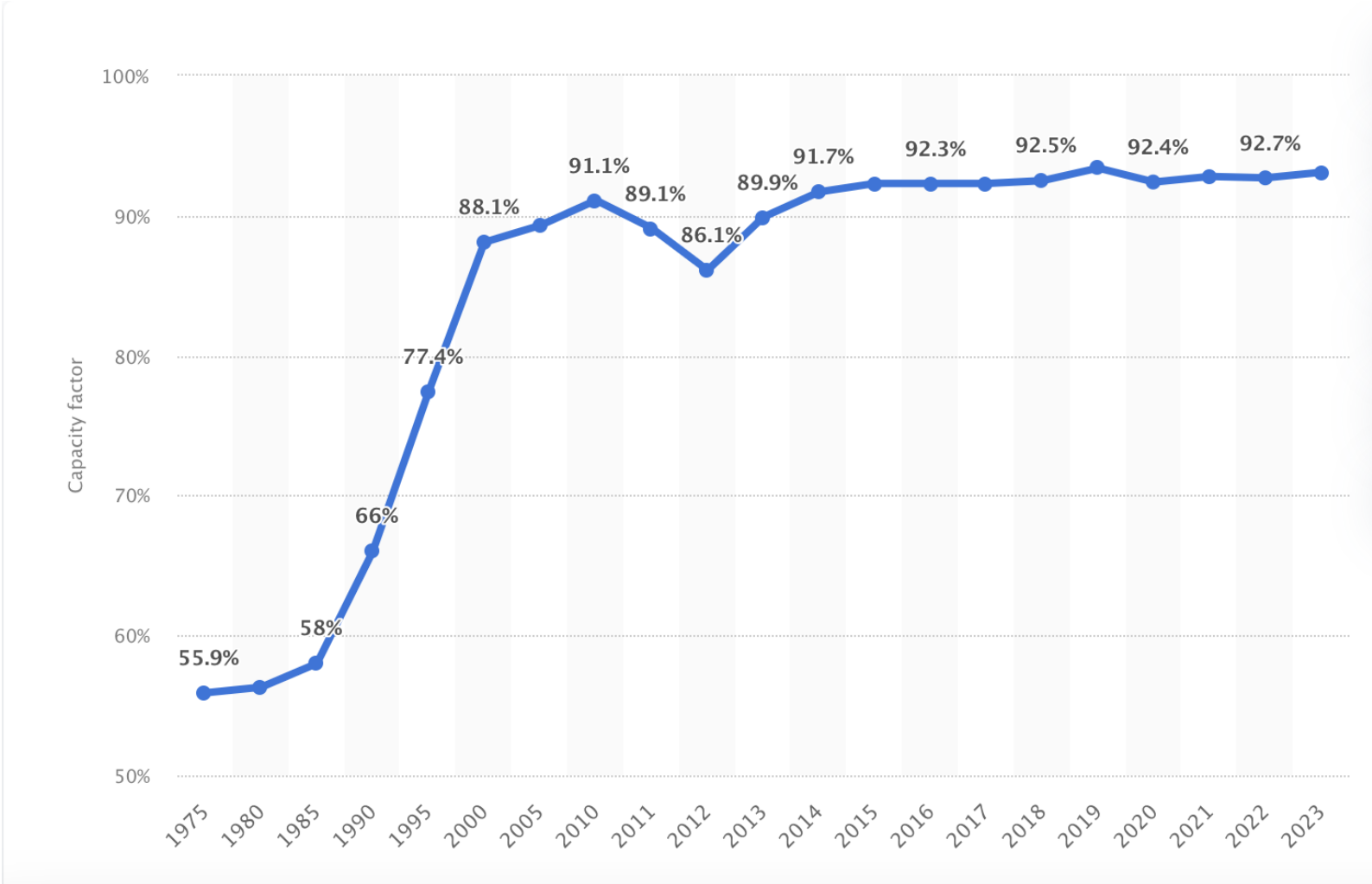
A “utility agnostic” developer capability is necessary for successful, repeatable nuclear new build programs or power uprates

Nuclear Power's High Capacity Factor is not Guaranteed

The 90%+ capacity factor in the US LWR fleet was the products of *thousands* of reactor-**years** of real world operational experience

Non-LWR technology should not be assumed to automatically have a 90%+ capacity factor

US Fleet Wide Capacity Factor (1975-2023)

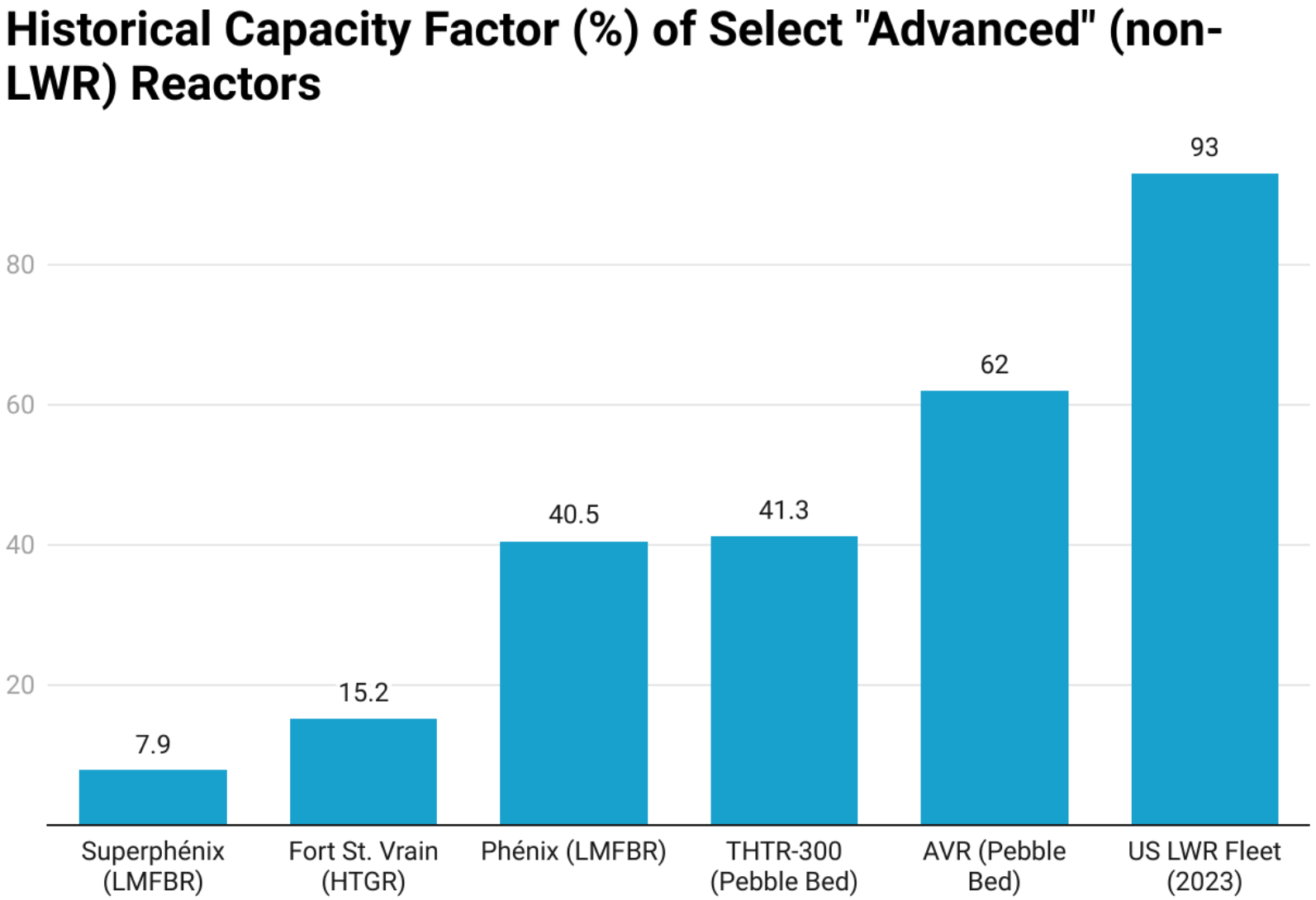


IAEA PRIS Power Reactor Information System

Non-LWR Technology Will Initially Struggle With Capacity Factor

Historical experience is clear: initial deployment of reactor technology faces significant operational challenge

Given the relative lack of experience with non-LWR technology, especially recently, one should <u>not</u> assume that non-LWRs will immediately reach LWR like capacity factor



Large vs. Small

Cost Optimization Simulation of Manufacturing, Installation, and Construction (COSMIC)

- COSMIC is a Monte Carlo code: 500-1000 iterations of cost, schedule, and risk are run for each reactor architecture
- Each iteration samples distributions of delay drivers for hundreds of construction activities:
  - 1) human error; 2)supply chain; 3) change orders
- This large dataset lets us do correlation analysis and run statistics to identify the leading causes of delay in a US build enviroment
- COSMIC can also simulate the impact of labor constraints and US construction productivity for each reactor design on construction
  - COSMIC inputs are derived from Alva's analysis of thousands of pages of regulatory documents, vendor information and confidential cost data

COSMIC allows us to take thousands of independent variables for each design and holistically simulate their impact on construction cost and schedule

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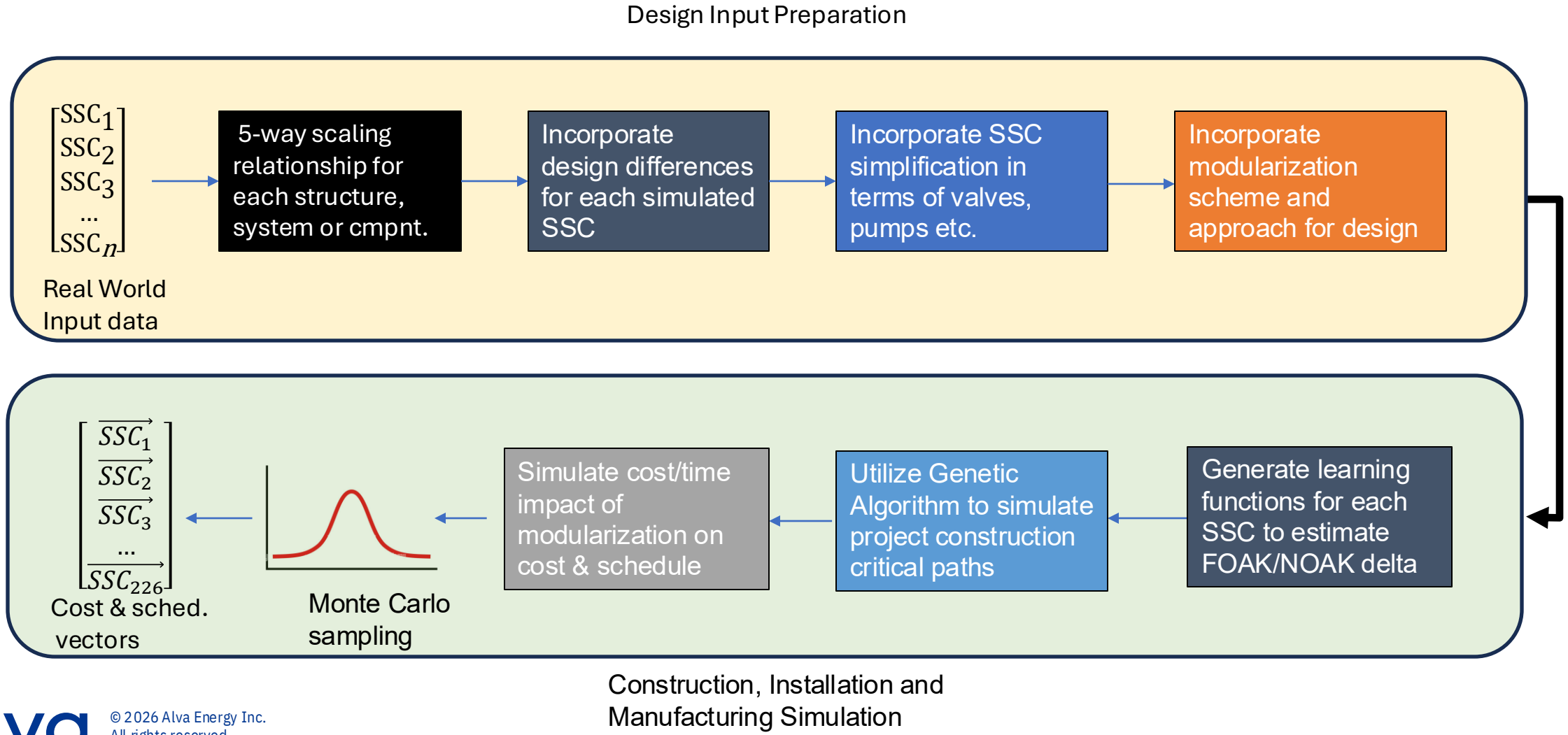
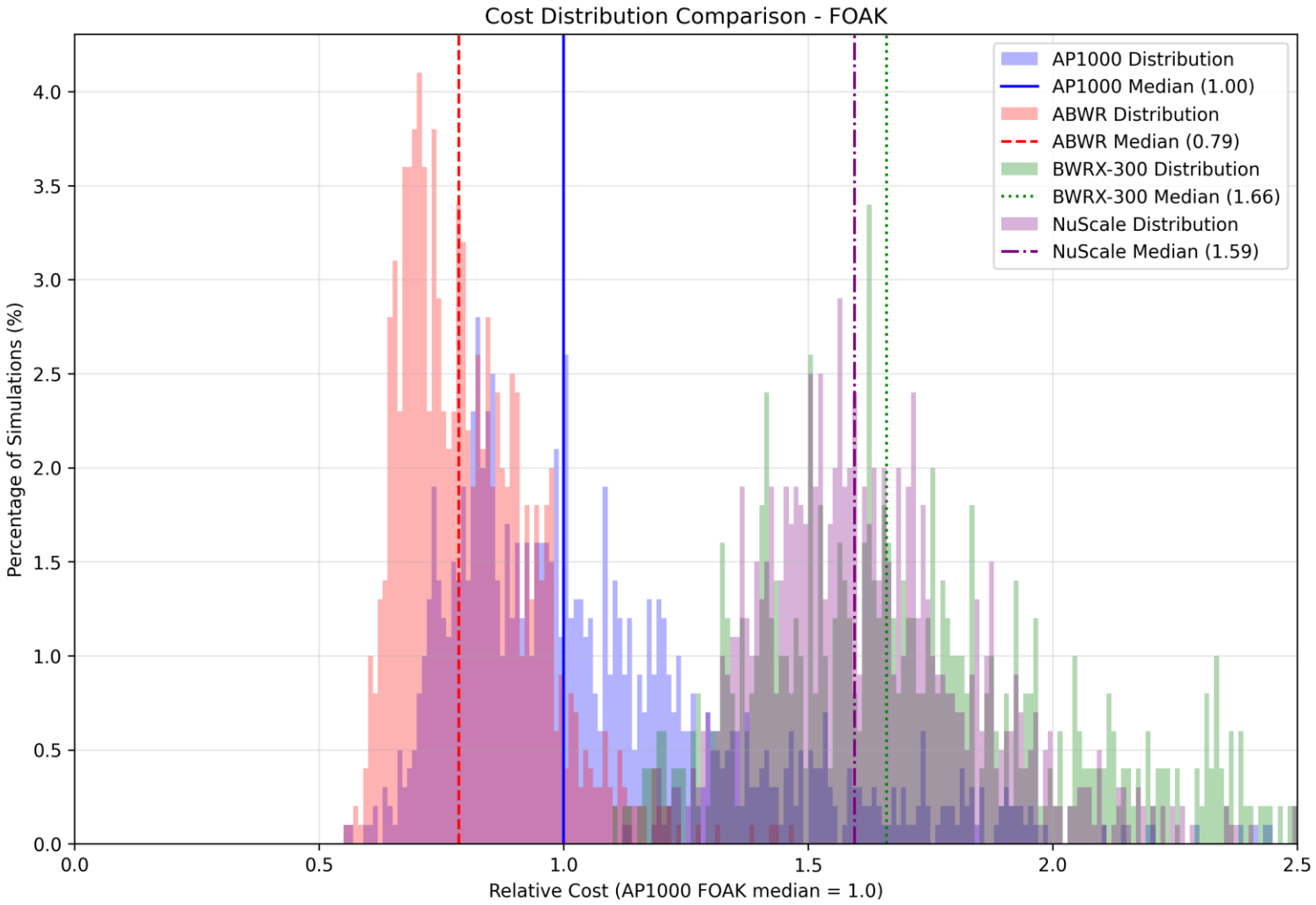
Basic COSMIC Methodological Approach



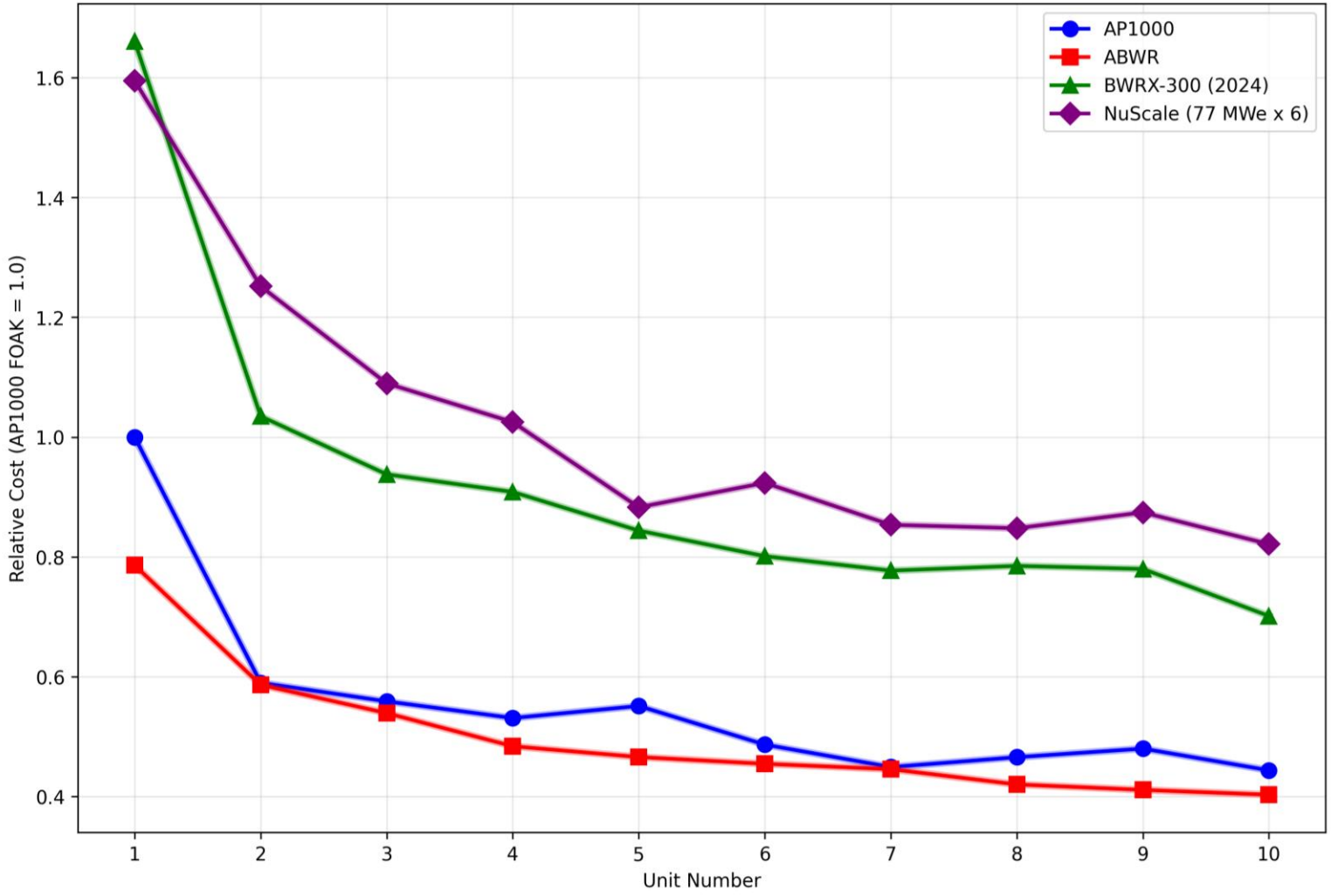
COSMIC Results

FOAK Cost Estimates

- COSMIC simulated FOAK overnight costs per kWe ABWR, AP1000, BWRX-300 (2024), APR1400+ (not shown) and NuScale VOYGR-6
- Normalized the price to the median AP1000 build of the design
- 1000 builds simulated per design
- Median Construction Labor Hours for APR1400+ was **50% higher than ABWR**
- **Median overnight cost** for APR1400+ was a **third higher than ABWR**
- Median ABWR build was 79% the price per kWe of an AP1000
- The lower median costs for the ABWR and AP1000 come from the economy of scale, and modularity does not offset these costs. A few examples:
  - The ABWR reactor building is 3X the size of the BWRX-300 reactor building, but 4.5X the power
  - NuScale uses 4.5X the steel and concrete of an ABWR but produces less total power.

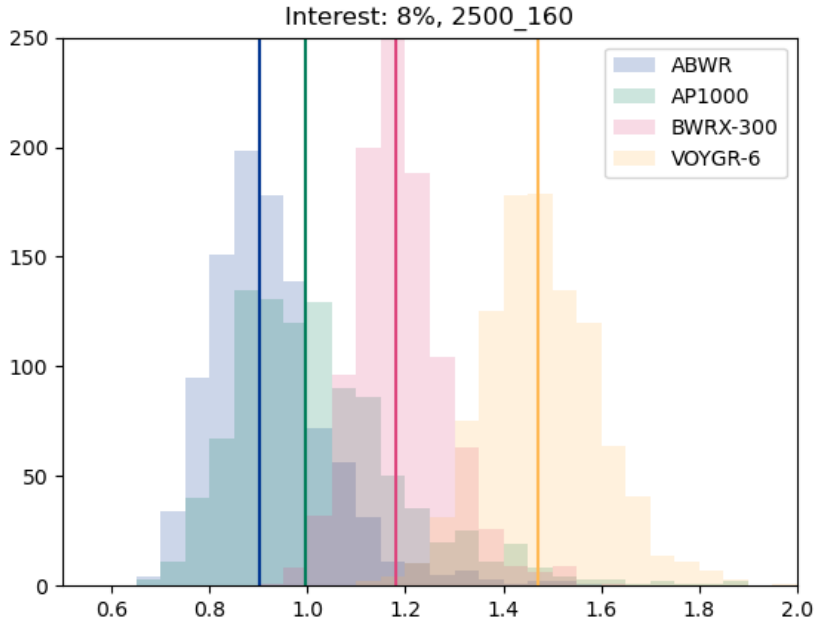


Learning Does Not Compensate for Economies of Scale



Cumulative Costs Remain Significantly Higher Even in Large Builds

Even in a high interest, labor constrained environment

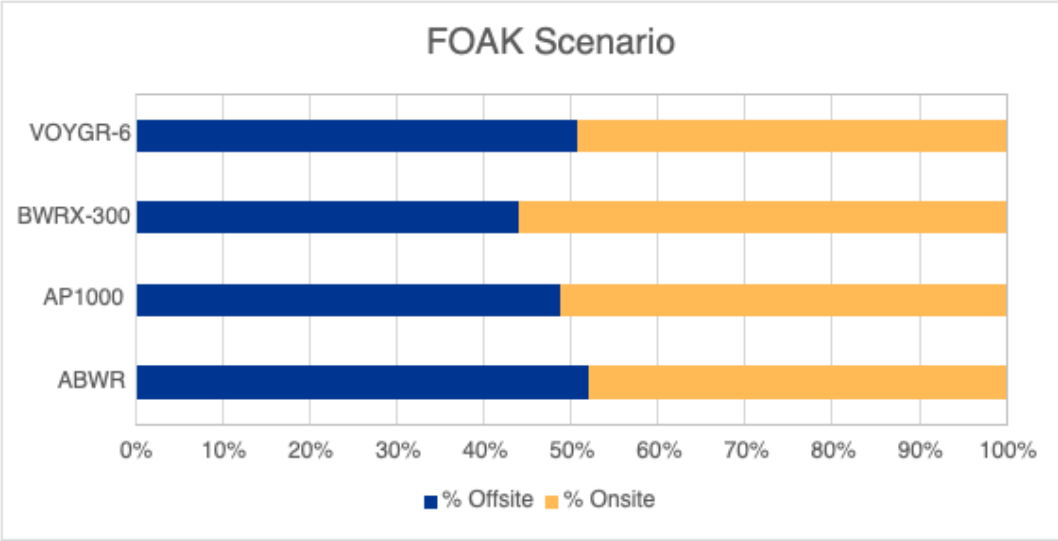


Twin unit build, assuming functioning AP10000 module supply

- 2500_160: peak labor force of 2500 craft workers, hired at 160/month, represents a CONSTRAINED labor environment.
- Results for less constrained labor on the next slide (4500_800)
- This represents a single site, sequential deployments of the same reactor (with some overlap)
- Left: 2 ABWRs, 2 AP1000s, 8 BWRX-300s, 5 VOYGR-6; Right: 4 ABWRs, 5 AP1000s, 19 BWRX-300s, 12 VOYGR-6

SMRs Utilize Similar Amounts of On- & Off-Site Labor vs. Large Reactors

Lack of scaling in civil works & instructions compensates for the increased modularization

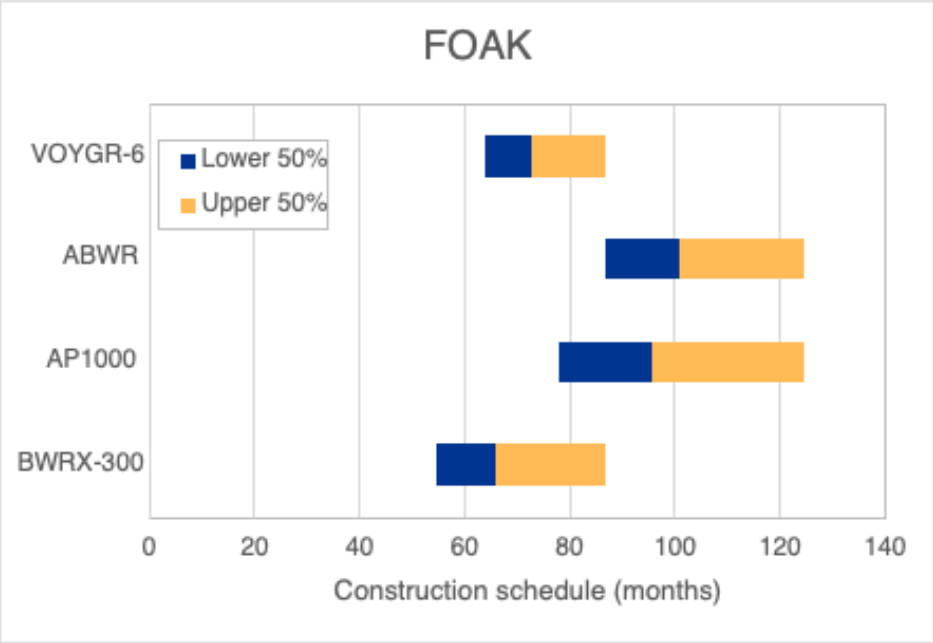


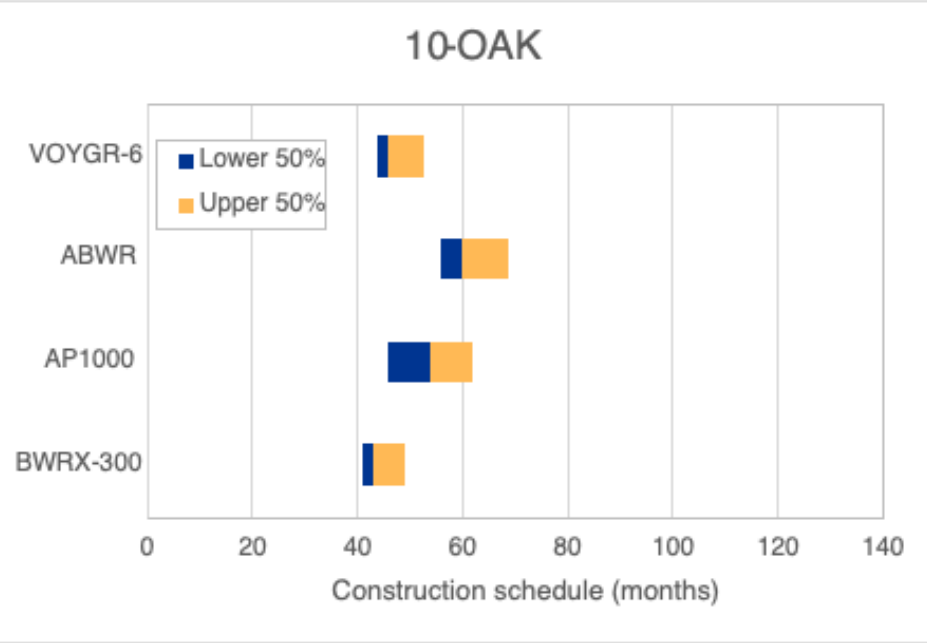
- Fractions of total direct cost that is onsite (material and labor) vs. factory procured costs
- SMRs (VOYGR and BWRX-300) have equal or less offsite cost, highlighting the challenge of modularizing nuclear power plants as a cost reduction strategy.
- Large modular reactors will be as effective, if not more, at pushing costs to factories and achieving high learning rates

Stewart, Krellenstein and Wilkinson, *Nuclear Engineering and Design* Volume 444, 1 December 2025, 114377

SMRs Can Be Significantly Faster than Large Reactors

Especially in labor constrained environments



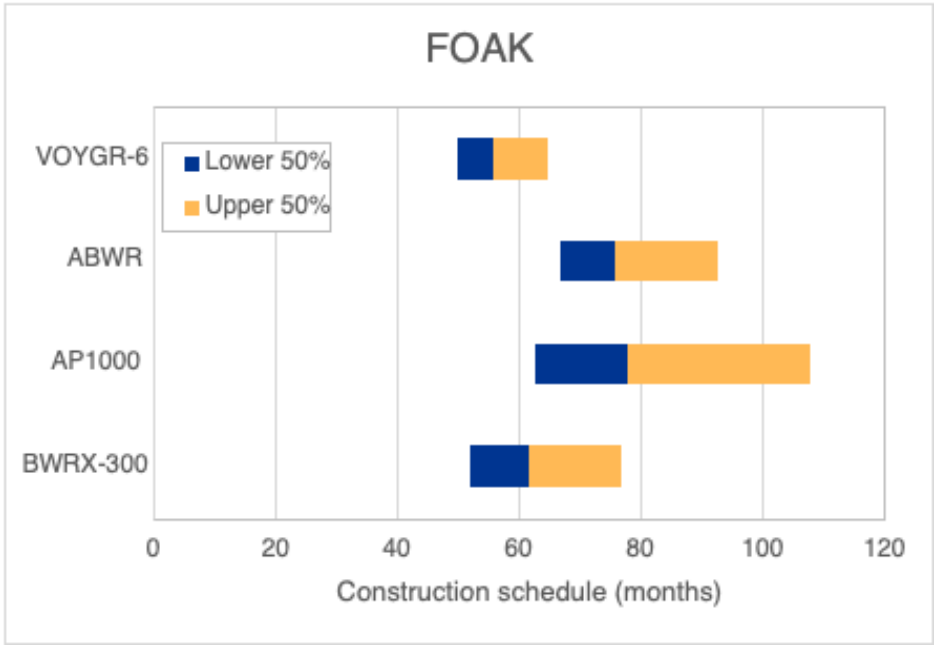


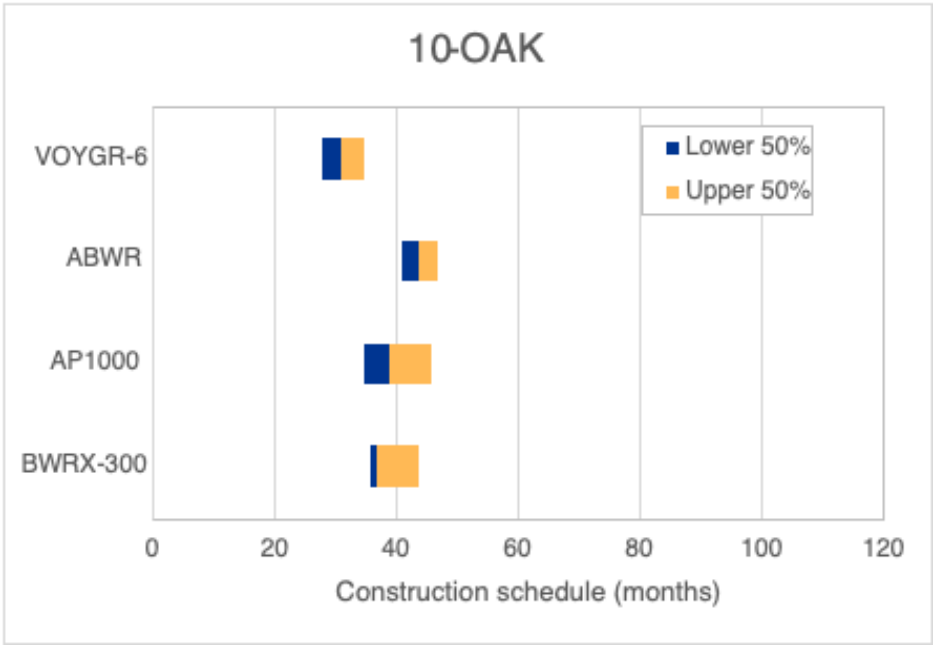
- Alva considered two labor constraints:
- 2500_160: peak labor force of 2500 craft workers, hired at 160/month, represents a tightly CONSTRAINED labor environment (this slide)
- 4500_800: peak labor force of 4500 craft workers, hired at 800/month, represents a loosely CONSTRAINED labor environment (next slide)

Stewart, Krellenstein and Wilkinson, *Nuclear Engineering and Design* Volume 444, 1 December 2025, 114377

SMRs Can Be Significantly Faster than Large Reactors (cont.)

But that advantage is less significant in less labor constrained environments





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