UNITED STATES AND CANADA · THE OFFTAKE SERIES · VOLUME I

Criticality Is Not a Customer

What stands between new nuclear and its first hyperscaler contract.



By Bijay Alex Mathew · SonTeno · The Offtake

Edition 1.0 · Data as of October 18, 2026 · Not investment advice

Every factual claim carries a source note. Every source tagged by interest.

Contents

The findings on one page 4
Executive summary 6
How to use this report 9
Methodology and sourcing 10

Chapters

1. The Milestone Is Not the Constraint 13
2. Twenty-Four Reactors, Seven Ideas 26
3. The 2028 Fuel Gap 36
4. Fast Lanes Lead to Demonstrations 49
5. The Missing Welders 62
6. The Factory Is Mostly a Frame 71
7. Read the Instrument, Not the Headline 82
8. Welcome Reactors, Unwelcome Data Centers 100
9. The Army Signed. That Is Not a Market. 112
10. Zero, Not Low 119
11. What Would Change the Answer 133

Appendices and disclosures

Appendix A: The Offtake Nuclear Register 145
Glossary 147
Disclosures 150
How this report was checked, and what the checking missed 152
Corrections and version history 153

Notes restart at 1 in each chapter and are listed at the end of the chapter they belong to, so a chapter can be excerpted without renumbering. Page numbers are for this edition.

The Offtake Research Series, Volume I

CRITICALITY IS NOT A CUSTOMER

What stands between new nuclear and its first hyperscaler contract

United States and Canada

Four privately developed reactors reached first criticality in the thirty days to July 4, 2026, all four at zero power, and a fifth followed in August. None holds the NRC commercial license that selling power as a primary purpose requires, and no hyperscaler has signed a binding power purchase agreement for a new-build advanced reactor.

By Bijay Alex Mathew

SonTeno LLC

Edition 1.0. Published October 19, 2026. Data as of October 18, 2026.

Latest edition, companion dataset and corrections:
sonteno.com/research/criticality-is-not-a-customer

Every factual claim carries a source note. Every source tagged by interest. The author's own arithmetic is labeled as such.

Not investment advice.

© 2026 Bijay Alex Mathew and SonTeno LLC. Quote freely with attribution to the edition. Not for redistribution, resale, or inclusion in a commercial product without permission.

The findings on one page

Of the seven constraints this report assesses, offtake is the least resolved, and it is the one where the sector's announcements are least supported by evidence.

Constraint	Where it actually stands
Fuel	The shortage is time, not uranium. Russia supplied 26 percent of the enrichment US reactors bought in 2025, and the waivers that still allow those imports end in January 2028. Every replacement plant of meaningful size comes online between 2029 and 2036.
Regulatory	Regulatory standing predicts little. The one certified small modular design has no new-build contract, and the company that was denied a license holds $3 billion in cash and marketable securities. Work done under the faster federal pathways does not yet count toward a commercial license; the rule that would allow it is still only proposed.
Workforce	Unresolved almost everywhere, but solvable by known means. The binding shortage is welders, machinists and inspectors, not engineers, and six of the eight companies below disclose no program to address it.
Manufacturing	Eleven of 24 developers describe building reactors in factories. Three have published both a factory they control and a production rate, one of them stated as output per unit of floor space.
Industrial supply chain	Field construction broke the last cycle: MIT's model of the next AP1000 assumed indirect costs of 51 percent of overnight cost, the reference database's median-experience figure, and worked against Vogtle's realized costs they come to 68 to 76 percent. The weak point now sits after the forging, in machining, welding and inspection, and no current public count of qualified suppliers exists; the last, Sandia's 2020 tally, counted certificates, not companies.
Offtake	**Least resolved, because it has no precedent.** No hyperscaler has signed a binding long-term PPA for a new-build advanced reactor. The count is zero, not low. Contracting against existing US plants reached about 6.9 GW of disclosed capacity, about 1.6 GW of it on two days, September 30 and October 6.
Permission	Two trends pointing opposite ways. National support for nuclear is within a point of its all-time high, while opposition to a data center nearby rose from 42 to 75 percent in a year, with two other pollsters that year at 63 and 71 percent.

What would prove this wrong. A signed, binding, long-term power purchase agreement between a hyperscaler and a new-build advanced reactor. None exists. Seven arrangements are likely to be cited as counterexamples, and none qualifies, because each is a contract with an existing plant, an uprate or a restart. 2028 is the crunch: the Russian waivers expire, the Army's deadline for a first operating reactor arrives, and four dated tests fall in the same year, across three of the seven constraints.

Eight companies against the same seven constraints.

	Fuel	Regulatory	Workforce	Mfg	Industrial	Offtake	Permission (siting)
Kairos	HALEU; LEU+ possible	NRC, building	Addressing	Demonstrated	Exposed	**PPA, TVA**	Grid
TerraPower	HALEU, at risk	NRC permit	Exposed	Not factory	Exposed	**PPA, PacifiCorp, not yet effective**	Grid
Radiant	HALEU, contracted	Four lanes	Exposed	Building	Exposed	**Army contract**	Base
X-energy	HALEU, own plant	NRC pending	Exposed	Supplier	Partial	Option	Grid
Oklo	HALEU	Denied 2022; DOE pilot, NRC pre-application	Exposed	Own, operate	Exposed	Non-binding	Mixed
Aalo	LEU 5% / LEU+ 8%	DOE pilot	Exposed	Factory	Exposed	Partnership	Behind meter
NuScale	LEU	US600 certified; US460 SDA	Exposed	Supplier	Exposed	Framework	Grid
Westinghouse	LEU	AP300 stalled	Shared firm	Field	Federal loans	LOIs; **Janus OTA**	Grid

Bold marks a signed contract, and there are four: two utility PPAs and two Army agreements. None is with a hyperscaler, which is this report's central finding. Each cell is a short label for Chapter 10's assessment of that company. Where a label and the chapter seem to differ, the chapter is the finding. Fuel gives the type first, then supply status where known. Permission is shown by siting, which decides which permissions a plant needs. Workforce and industrial supply chain read Exposed almost everywhere because they are sector-wide constraints. The workforce column records the absence of a disclosed program, not a measured weakness. Companies were selected after Chapters 2 through 9 were drafted, based on how often they appeared substantively in those chapters. The order is not a ranking.

Executive summary

Four privately developed reactors reached first criticality in the thirty days to July 4, 2026, all four at zero power, and a fifth followed in August. None holds the NRC commercial license that selling power as a primary purpose requires, and no hyperscaler has signed a binding power purchase agreement for a new-build advanced reactor.

That gap is the report's subject, and it carries the report's organizing idea. The milestone is not the constraint. Criticality is the step the sector celebrates. The step that binds is a signed contract with a hyperscaler, and no hyperscaler has signed one. The report runs to eleven chapters because the gap is not an anomaly but a pattern that repeats. In five separate places in Chapter 1, and then independently in most of the chapters after it, attention settles on one step as the hard part, while the step that actually limits progress is the adjacent one, which is harder to see. Criticality was photographed, and the contract was not. The regulator was blamed when the order book was the problem, and the reactor was rendered while the steam generator decided how small the plant could be.

The finding, in one line. Of the seven constraints this report assesses, offtake is the least resolved, and it is the one where the sector's announcements are least supported by evidence.

What the evidence shows

Capital is abundant but of the wrong kind. More than $4.5 billion of venture investment reached 81 nuclear companies globally by late July 2026, against $6.2 billion across 93 companies in the whole of 2025, which the reporting extrapolated as on pace to pass that record. This report found no project-finance loan closed for any US advanced reactor. Private money has gone to companies, mostly as equity, with at least one corporate credit facility; none of it is a loan against a plant. The only project-level debt is federal, and it is going to restarts of existing reactors and, conditionally, to the AP1000 supply chain, not to new advanced reactors. Corporate equity builds companies. Project finance builds plants, and it requires a contract a lender will lend against.

No hyperscaler has signed a binding power purchase agreement for a new-build advanced reactor. Nine different legal forms are circulating under the label "nuclear deal," and Chapter 7 separates them: signed PPAs against existing or restarting plants, PPAs for clean energy attributes rather than physical energy, utility PPAs with a hyperscaler standing behind them, development funding with an offtake right, non-binding frameworks, leases for compute rather than contracts for power, funding and rights against reactors that do not exist, options without obligations, and equity, prepayments and guarantees. The strongest confirmation of that finding comes from a company's own reporting: Constellation reported 920 MW of new long-term nuclear PPAs at an 18.5-year average tenor in the second quarter of 2026, of which zero came from new build. The breakdown is roughly 890 MW from existing generation and about 30 MW from a planned Dresden uprate. Even that increment is an existing plant producing more power, not a new one.

Four of the eight companies assessed in Chapter 10's scorecard hold a contract rather than an option, and the buyers are a federal utility, a regulated utility and the US Army, which holds two of the four. Not one is a hyperscaler. Chapter 10 reaches that conclusion by assessing companies, and Chapter 7 by assessing deals.

The fuel chain is short of time, not uranium. American uranium conversion happens at one plant, completed in 1958, and it has been switched off twice: mothballed in 1964 and restarted commercially in 1967, then suspended in November 2017 and not restarted until July 2023. The second stoppage left the country with no operating conversion capacity for nearly six years. Enrichment is the exception to the pattern. There, the constraint everyone points to is the one that actually limits supply, and it is where the federal money went. Russia supplied 26 percent of the enrichment US operators bought in 2025, and the waivers that allow it expire in January 2028. Apart from one small addition in 2027, every replacement remedy currently funded arrives between 2029 and 2036.

The workforce constraint is not engineers. Nuclear engineering bachelor's degrees fell roughly a quarter between 2012 and 2022 while doctorates reached a record in a series going back to 1966, which is a real problem and the opposite of the one usually described. The binding shortage is in the trades: nuclear-qualified machinists, welders, inspectors and nondestructive examination specialists, which the most detailed 2026 assessment finds now govern throughput, schedule and execution risk. Under-30s are 23 percent of the operating nuclear workforce against 29 percent across the rest of the energy sector, a six-point gap. Meanwhile, the Department of Energy's Energy Workforce Advisory Board finds that quadrupling nuclear capacity over twenty-five years will require tripling the workforce. The board publishes no baseline and no role mix. Applied to the 2023 headcount, tripling implies about 136,000 additional workers. That figure is this report's own arithmetic, and it says nothing about which roles are needed.

Field construction broke the last build cycle, and factory manufacturing, the proposed fix, is unproven rather than disproven. MIT's model of the next AP1000 assumed indirect costs of 51 percent of overnight cost, the figure a reference database sets for a median-experience plant. Worked against Vogtle's realized costs, indirect costs come to 68 to 76 percent. Site construction management rose 3.2 times. Far more developers describe themselves as factory builders than actually have a factory strategy: of 24 US and Canadian developers, three have published both a facility they control and a production rate. The count runs from three to thirteen depending on the rule applied, so Chapter 2 states its rule first and shows how the count changes when the line moves.

Public permission is now two problems, and they point in opposite directions. Nuclear has recovered to within a point of its all-time high in national polling, with support concentrated among Republicans and independents rather than spread broadly. Local opposition to data centers went from 42 percent to 75 percent in twelve months on identical polling wording, with two other pollsters in the same year at 63 and 71 percent. Asked in the same field period about a facility in their own area, Americans oppose a nuclear plant 53 to 45 and an AI data center 71 to 27. On net favorability that is minus 8 against minus 44, a 36-point gap. Capital in blocked and delayed data center projects went from $64 billion over eleven months to $130 billion in a single quarter, across 49 states, on a count whose funder is

undisclosed. A newsroom tally on a different measure puts 2026 cancellations at $260 billion, with roughly $1 trillion facing sustained or meaningful opposition.

Defense is a runway, not a market. The Army's Janus Program commits up to $2.2 billion across five vendors at five installations, with a September 30, 2028 deadline for a first operating reactor set by Executive Order 14299. The program sits outside both DOE indemnification and Price-Anderson, the agreements are milestone-based and fixed-price, and an Army-regulated reactor cannot pivot to commercial customers on its Army authorization.

What would change the conclusion

The single event that would show the central constraint resolving is a signed, binding, long-term power purchase agreement between a hyperscaler and a new-build advanced reactor. None exists. Hyperscaler contracting against existing US plants reached about 6.9 GW of disclosed capacity by October 6, 2026, of which about 1.6 GW was signed on two days, September 30 and October 6, and Google explained its own share of that by saying "the fastest new megawatt is often the one that can be provided by existing infrastructure." Seven arrangements are likely to be cited as counterexamples, and none qualifies, because each is a contract with an existing plant, an uprate or a restart.

Two periods on the calendar matter most. 2028 is the crunch: the Russian waivers expire, the Army deadline lands, and four dated tests fall in the same year across three of this report's constraints. 2029 to 2036 is when new fuel supply arrives: every remedy at scale comes online after the 2028 waiver deadline it was funded to meet.

What this report does not claim

It does not predict that this wave fails. Four criticalities in thirty days is evidence of real capability, and the optimistic case is given full weight rather than a token paragraph. It does not claim the constraints are permanent; the useful question is how far along each resolution actually is. And it claims no inside knowledge. Where a figure is contested or a mechanism undisclosed, the report says so.

How to use this report

Why this report exists

In the summer of 2026 I watched four companies, Aalo among them, race to reach criticality by July 4, and all four made it. The question I kept coming back to was not whether the reactors would work but who would buy the power. This report is my attempt to answer it.

Reading paths

With twenty minutes, read this summary, Chapter 7 on what the deals actually say, and Chapter 10's scorecard. That is the commercial argument end to end.

To evaluate a specific company, start with Chapter 10, which assesses eight companies across all seven constraints, then read the chapter for each constraint where that company is marked exposed. Chapter 2 is deliberately the least useful chapter for this purpose, and says so. A reactor design is the easiest part of a company to learn about and the least revealing about its prospects.

To assess a specific constraint, each of Chapters 3 through 9 stands alone. Notes restart at 1 in each chapter so a chapter can be excerpted without renumbering.

To work with the data, the companion dataset, The Offtake Nuclear Register (October 2026 edition), is at docs.google.com/spreadsheets/d/1WYGG9aLA39dohvVrg9N7vHeg6g2tnRWe7y9PS3Uq0tI. Appendix A describes what it holds and how to use it.

To check this report rather than read it, start with the notes. Every chapter ends with its own numbered notes, and every note carries a tag saying whether the source is a regulator, a reporter, an analyst, an advocate, or the company describing itself. The tag is the fastest way to see what a claim rests on. Where more than half a chapter's notes are `[company]`, that is itself a finding about the available evidence.

Methodology and sourcing

What this report is. A survey of publicly available evidence on new nuclear in the United States and Canada, assembled between August and October 2026, organized around a single analytical question: for any given company or constraint, where does the binding risk actually sit?

What it is not. It is not primary research. No interviews were conducted for attribution. It is not a forecast, and it contains no price targets and no ratings. It contains one section of recommendations, the prescription in Chapter 8, which is labeled as argument rather than finding at the point of use and states the evidentiary status of each item inline. Nothing else in the report recommends anything.

How claims were tested

Each of the five cases in Chapter 1 started as a hypothesis, and the research tried to disprove it. Two did not hold up as first stated. Chapter 1 shows one of those corrections in the text rather than hiding it.

Every chapter was then checked source by source, treating each claim as wrong until its source confirmed it. That check reversed findings in five chapters and corrected facts in six. A second, claim-by-claim pass in October 2026 had each chapter read by a checker who had not written it, against the sources its own notes name, and produced about 250 findings, all applied before publication. The most common error in both passes was a sentence that claimed more than its source said. The method is described in “How this report was checked,” at the end of the report.

Source-interest tagging

Each note opens with the tag for the source the claim rests on. Where a note adds a corroborating source, that source carries its own tag inside the note, so a reader can see what kind of evidence each part of the note is. A note that carries only this report’s own arithmetic opens with no tag, because it characterizes no external source.

`[regulator]` covers NRC, DOE and other government and agency documents, including dockets, licenses, permits, program pages and testimony. The tag means official, not neutral. A DOE program announcement is still an interested party promoting its own program.

`[reporting]` covers independent journalism and trade press, where the outlet has no financial position in the outcome.

`[company]` covers press releases, investor materials, company websites and executive statements carried in any venue: the subject describing itself.

`[analyst]` covers research from banks, consultancies, advisory firms and law firms. The work may be careful and public, and the publisher still earns fees in the sector it is measuring.

`[advocacy]` covers research and position papers from organizations with a declared stake in the outcome: industry bodies, trade associations, campaign groups, think tanks and non-

governmental organizations. The work is often rigorous and openly argued, and the publisher is arguing for something. Academic and institutional research with no fee interest and no declared position is filed under `[reporting]`.

The tag follows the claim, not the outlet. A trade article reporting a founder's projection is `[reporting]` for the facts the reporter verified and `[company]` for the projection. Where a key claim rests only on `[company]` sourcing, the text says so directly, not only in the note.

Citation form

Notes are simplified Chicago endnotes, numbered per chapter. There is no bibliography, because the companion dataset is the consolidated reference. NRC material is cited by ADAMS accession number and docket where one exists, because accession numbers are stable and web paths are not. Notes carry an Internet Archive link dated to when the copy was saved, so a reader can see what the page said when it was relied on, and can tell a fact that was wrong when written from one that was true then and has been overtaken since. Where no capture is cited, none had been confirmed when this edition was frozen.

What does not get cited

The companion spreadsheet is a derived work, not a source. It is never cited; each row lists the documents its entries were drawn from, and those documents are what a reader should cite.

The author's prior newsletter posts are not sources for facts. They may be referenced for an argument previously developed, but any fact that appeared in a post was re-verified against its original source and cited to that source.

Material from a Chatham House rule session in July 2026 informed which questions this report asks. It supplies no fact and supports no claim, because a claim that cannot be cited cannot be verified.

Known limitations

Quotations attributed to named speakers were checked word for word against the source page. A publication may still have quoted a speaker imperfectly in the first place. Every chapter has also had a claim-by-claim check against the sources its notes name. About a fifth of the claims checked could not be confirmed or refuted from those sources, usually because the claim is the report's own judgment or a negative finding; those are left as written and are not presented as sourced.

Most notes carry an Internet Archive capture. The exceptions are sources added in the final days before the freeze, and a number of earlier captures that could not be confirmed; neither set is cited as captured. Data is as of October 18, 2026, which is this edition's freeze date. The sector-wide sweep ran through September 21. The days from September 22 to October 18 were reviewed for specific developments rather than comprehensively, and what they added is listed in the version history. The companion dataset was reviewed through October 11.

Some figures rest on subscription-only benchmarks that could not be independently confirmed. Where that is true the note says so and the figure is presented as indicative.

No current census of ASME N-stamp or NQA-1 qualified suppliers is publicly available. The most recent published count, Sandia's, found 683 certificates in June 2020, and it counts certificates rather than companies, so the industrial capacity question in Chapter 6 cannot be sized from current data. The gap is in current publication, not in the underlying record.

Several figures in this report are the author's own arithmetic rather than published numbers, and each is labeled as such at the point of use.

Three questions are outside this volume. It cites published benchmark cost ranges in Chapter 7 but builds no cost model of its own, and it does not set out the contract terms that would make a first-of-a-kind agreement signable. It covers what hyperscalers are buying instead only briefly, in Chapter 7. And it rests on documents, not interviews with buyers, so its account of why no hyperscaler has signed is a reading of the evidence. Volume II takes up all three.

Chapter 1: The Milestone Is Not the Constraint

I watched the race to July 4, 2026. That day a reactor built by an Austin company founded in 2023 went critical at the Idaho National Laboratory, the fourth privately developed reactor to reach criticality in thirty days.[1]

That is a real achievement. Sustained fission is hard, and four independent teams did it inside a month, on hardware they designed themselves, at a moment when the settled view held that America had forgotten how. One qualification belongs here rather than later. All four criticalities were at zero power, and Aalo Atomics' assembly at the Idaho National Laboratory was a full-scale mock-up of the 10 MWe Aalo-X the company intends to build, not that unit.[1], [2] A zero-power assembly is what the physics is meant to be proved on, so this is not a complaint about the companies. It does mean the events were a step earlier in the sequence than the coverage implied, and Chapter 10 works the distinction.

None of those four companies has a plant selling power to a commercial customer. The nearest is Valar, which in June 2026 converted its reactor's 10 kWt output to electricity and used it to power a single Nvidia Spark unit, and which has announced a partnership with Nvidia to develop a 30 MW data center in Utah.[1] Local reporting describes the project as exploratory, and even a firm partnership would not be a financeable offtake.[3] Criticality was the milestone everyone photographed. The step that binds is a signed contract a lender will finance, and none of these companies has one. The milestone is not the constraint.

That gap keeps reappearing. In five separate places across the sector, attention settles on one step as the hard part while the step that actually limits progress is an adjacent one that is harder to see. The five instances below are one argument, and it is the lens for every chapter that follows. Each started as a hypothesis the research tried to disprove, and two did not hold up as first stated.

Scope, stated once: this report reads the public record of advanced reactor and small modular reactor developers in the United States and Canada to a data date of October 18, 2026, and asks one question of them, which is who has agreed to buy the power. All five instances are American, because the events that prompted them were. Canada enters properly in Chapter 4, which assesses the Canadian Nuclear Safety Commission's vendor design review as a regulatory pathway alongside the NRC's, with Darlington and Point Lepreau as the worked examples. The developer counts in Chapter 2 cover both countries throughout.

One: four reactors critical, then a fifth, and no financeable customer

Four reactors reached first criticality between June 4 and July 4, 2026. Antares Nuclear's Mark-0 at Idaho National Laboratory on June 4. Valar Atomics' Ward 250 at Utah's San Rafael Energy Research Center on June 18. Deployable Energy's Unity at INL on June 30. Aalo Atomics on July 4.[1] A fifth followed in August: Oklo's Groves isotope test reactor, at Lockhart, Texas, the first under the program on private land.[4]

Three of the four ran under the Department of Energy's Reactor Pilot Program, which authorizes test reactors under DOE authority rather than through Nuclear Regulatory Commission licensing. Deployable Energy took a companion route, the Nuclear Energy Launch Pad run through INL's National Reactor Innovation Center, which also works under DOE authorization.[1] The Pilot Program's stated aim was more specific than criticality alone. DOE sought criticality for at least three concepts "located outside of the national laboratories" by July 4, 2026, and invited applications for test reactor construction and operation "outside of the national laboratories using the DOE authorization process."[5]

Yet three of the four that met the deadline went critical inside a national laboratory: Antares, Deployable Energy and Aalo, all at Idaho National Laboratory. Valar was the exception, at a state facility in Utah, and Oklo's August criticality on private land in Texas was the first under the program that was neither.[1], [4]

That distinction is the commercially meaningful one. A national laboratory supplies a site, a security perimeter, an established regulatory posture and a trained workforce that no commercial deployment will have. Criticality inside that envelope proves the physics. It does not prove what the program said it was trying to prove, which is operation outside the national laboratories.

The program is an authorization pathway and nothing more. It does not finance construction, and it does not produce a license to sell power. As the American Nuclear Society noted in reviewing the program, without NRC approval none of the companies involved can deploy their designs commercially.[1]

The obvious objection is a good one: the companies in this report are not short of money. Global venture investment in nuclear reached more than $4.5 billion across 81 companies by late July 2026, on pace to pass 2025's record of $6.2 billion across 93 companies. Antares, one of the four that went critical, announced a $370 million Series C plus $100 million in debt on July 27, three weeks after the deadline it had just met.[6] Equity is the easiest thing to obtain in this sector right now, and these companies have obtained a great deal of it.

Corporate equity and project finance are different markets, though, and the second one builds plants. A lender financing a first-of-a-kind nuclear project wants revenue certainty, and the instrument that supplies it is a long-term offtake agreement with a creditworthy counterparty. First-of-a-kind projects are the hardest version of that ask: new technology, untested delivery models, unseasoned sponsors, limited operating experience, and therefore uncertain cost estimates and hard-to-predict schedules.[7] What is missing is a contract a lender will lend against.

The sector's most-discussed data center arrangement bears this out. Aalo and Crusoe announced in 2026 what both companies describe as a strategic partnership: a Crusoe Spark modular data center at INL in 2027 as a proof of concept, with a stated intent to deploy Aalo's 50 MWe reactors at Crusoe sites by the end of 2029.[8] A proof of concept and an intent are both real, and neither is a power purchase agreement.

So after July 4, five companies have demonstrated criticality across national laboratory, state and private sites, with more capital available than the industry has ever had. Each still has to

convert a demonstration into a signed, financeable customer relationship, and none has yet done so.

> **Criticality was the milestone everyone photographed. The step that binds is a signed contract a lender will finance, and none of these companies has one.**

Two: the AP300 is waiting on orders

The standard complaint about American nuclear is that the NRC is slow. The 2026 schedule data does not support it. The NRC approved a construction permit for TerraPower's Natrium reactor in Wyoming on March 4, 2026, ahead of its published schedule.[9] It granted TRISO-X a Category II license for its Oak Ridge fuel fabrication facility in February 2026, the first of its kind and the first new nuclear fuel fabrication license in more than 50 years.[10] Under the ADVANCE Act the agency has published its own numbers: the TerraPower Kemmerer review finished in 18 months, nine months ahead of schedule and 11 percent under budget, and Kairos Hermes 2 finished in 10 months against 14 planned.[11] On September 28, 2026 it issued the Tennessee Valley Authority a construction permit for a BWRX-300 at Clinch River in Oak Ridge, the second commercial advanced reactor construction permit in the country and the first for a BWRX-300. TVA describes itself as the first US utility permitted to build that design, and because the earlier advanced reactor permits all went to developers, it is also, on this report's reading, the first such permit held by a utility.[12] The final safety evaluation for it was issued on June 25, 2026, against a November 2026 date for the safety review on the agency's own published milestone schedule.[13]

This is a recent record produced under legislative and executive pressure, not a timeless property of the agency, and a reader who remembers NRC review timelines from a decade ago is remembering something real. The claim is narrow. In 2026, on the reviews that have completed, the regulator has not been the thing holding advanced reactors up.

Westinghouse's AP300 looks like the counterexample. It entered NRC pre-application engagement in May 2023. As of October 18, 2026, no design certification application had been filed. What exists is a set of white papers, all but one of which have completed NRC feedback, the exception being the paper titled "Licensing Application Approach," now marked "No longer planned." Plus a regulatory engagement plan updated on June 11, 2026.[14] Over forty months the regulator kept answering, and the application never arrived.

A common explanation blames a shortage of licensing engineers. It rests on one fact: Amentum, the engineering services firm, signed agreements with Westinghouse on August 4, 2026 to collaborate on obtaining NRC approval for the AP300,[15] while also serving as program delivery partner for Rolls-Royce SMR deployments,[16] leading a joint venture that won an owner's engineer contract with a maximum value of $406 million for the Rolls-Royce SMR units at Wylfa, the UK's first SMRs, and supporting EDF's UK stations.[17] Two competing reactor vendors,

Westinghouse and Rolls-Royce SMR, share one engineering firm, which also serves the UK's incumbent nuclear operator. The fact is true and interesting, but it does not explain the AP300.

The simpler explanation is commercial, and the company's own description of its strategy points at it. CEO Dan Sumner in August 2026: "Westinghouse is pursuing a disciplined APX technology strategy built on the proven AP1000 reactor and extended through the AP300 SMR." Extended through: the AP300 is a follow-on to the priority product, not the priority. Sumner's next sentence cuts the other way, saying the Amentum collaboration "is expected to accelerate the licensing of the AP300 SMR" with the NRC. An intention to accelerate licensing is not an application, and over forty months none has been filed, but the company's stated position is that the AP300 is being licensed, not shelved. In the same period, DOE announced $17.5 billion in supply chain loans toward ten new AP1000 reactors with construction beginning by 2030, Westinghouse holds a strategic partnership with the Department of Commerce on AP1000 deployment, and the company confidentially filed for an IPO.[18] Licensing work on the large reactor has continued since: on October 14, 2026 the NRC issued a direct final rule renewing the AP1000 design certification through 2066, on a design control document revised to incorporate lessons from Vogtle Units 3 and 4, effective December 28, 2026 unless significant adverse comments are received.[18]

A company with $17.5 billion of conditional federal supply chain loan support announced in June 2026, attached to its large reactor, an IPO in preparation, and no comparable order book for its small one has an obvious reason not to spend scarce senior engineering time finishing a design certification application for the small one. No AP300 order book has been announced and Westinghouse, still private, publishes none, so the comparison rests on the absence of a public record rather than on a disclosed figure. Westinghouse has not said this explicitly either, so the inference is the report's, not the company's. It is the most economical reading of the facts, and it describes a decision, not a bottleneck.

The AP300 also received sign-off from the UK's Department for Energy Security and Net Zero in August 2024, on an application Westinghouse had filed there. Westinghouse produced a regulatory submission for a different government in the same period it did not produce one here.[19]

The AP300 delay widely attributed to regulation is commercial, and Westinghouse is waiting for a reason to proceed. That is instance one arriving from the opposite direction. There the gap was a customer contract a lender would finance; here it is an order book big enough to justify a licensing spend. In neither case is it the step the public conversation names.

Whether the licensing-engineer shortage is real stays open. Chapter 5 takes up the workforce question on its own evidence, because the AP300 is not available as proof, and finds the tighter constraint in the trades rather than among licensing engineers.

Three: fuel supply hinges on one Ohio cascade

Public conversation about nuclear fuel collapses into one word, uranium, and then into one worry, that somebody else controls the ore.

The Department of Energy estimates domestic demand for high-assay low-enriched uranium could reach 50 metric tons per year by 2035.[20] Against that stands the demonstrated American

production record. Centrus completed the second phase of its DOE contract in June 2025 with 900 kilograms delivered, and by the time production under that demonstration contract ended in June 2026 it had produced more than 1,900 kilograms cumulatively. The material comes from a cascade of centrifuges in Piketon, Ohio. A $900 million DOE award, finalized in 2026, funds an expansion to 12 metric tons a year, with first new capacity expected in 2029.[21]

Kilograms sit on one side of the comparison and metric tons on the other. The shortfall is not in the ground. What barely exists here yet are the centrifuges that raise the U-235 fraction to the level advanced reactors need.

HALEU is already being rationed. When DOE made its first HALEU allocations in April 2025, fifteen companies had requested material and five received it: TRISO-X, TerraPower, Kairos Power, Radiant Industries, and Westinghouse. Commercial supply outside that program was, as of April 2025, available only from TENEX, a Rosatom subsidiary, and TerraPower's Natrium project had been hindered by HALEU availability.[22] A company can hold an NRC construction permit, which TerraPower does, and still have no reliable way to fuel the reactor the permit is for.

A reactor design that requires HALEU therefore carries a supply risk that a design running on standard low-enriched uranium does not, and that risk is independent of how good the reactor is. Several developers have made the fuel choice a deliberate strategic fork. Chapter 2 counts who bet which way, and Chapter 3 works through the supply chain behind the split. The ore was never the problem. HALEU enrichment, one cascade in southern Ohio, was.

Four: the steam generator sets plant size

Apollo Atomics raised a seed round of $31 million by the company's count ($26 million, including $5 million of debt, in TechCrunch's reporting), and in August 2026 described publicly what it is actually building: a smaller steam generator, not a better reactor core.[23]

The company's argument is that conventional steam generators are hand-built, several stories tall, and are the reason a reactor plant cannot shrink past a certain point. Apollo's version is roughly person-sized, uses a metal block threaded with needle-thin channels instead of large tubes in a water bath, and is meant to be manufactured, not assembled on site. The company says this lets the whole reactor be about forty times smaller, and targets three cents per kilowatt hour. What exists so far is a single 40 kilowatt reactor built with MIT to demonstrate the approach, against a commercial range of 10 to 300 megawatts from 2028. CEO Assil Halimi, on the ambition: "We don't want to be incremental in nuclear and just improve a small thing. Our target is to beat natural gas."[24]

The economic claim can be set aside, because it is a projection against a 2028 deployment target, not a result. The physical claim carries the weight, and its obvious stronger version is false. The steam generator is not the most expensive thing in a nuclear plant, and neither is the reactor. On the World Nuclear Association's breakdown, the entire nuclear steam supply system, reactor and steam generators together, is about 12 percent of total capital cost. Onsite labor is 25 percent.[25]

The claim that survives is narrower and more interesting. The heat exchanger, not the core, sets how small a plant can be built and whether it can be built in a factory at all. A company trying

to shrink a plant has to solve the steam generator whether or not the steam generator is what it is paying for.

The cost breakdown points to something larger. If the reactor system is 12 percent of capital cost and the labor to assemble everything on site is 25 percent, then the expensive part of a nuclear plant is construction, not any single component. Chapter 6 takes that up directly.

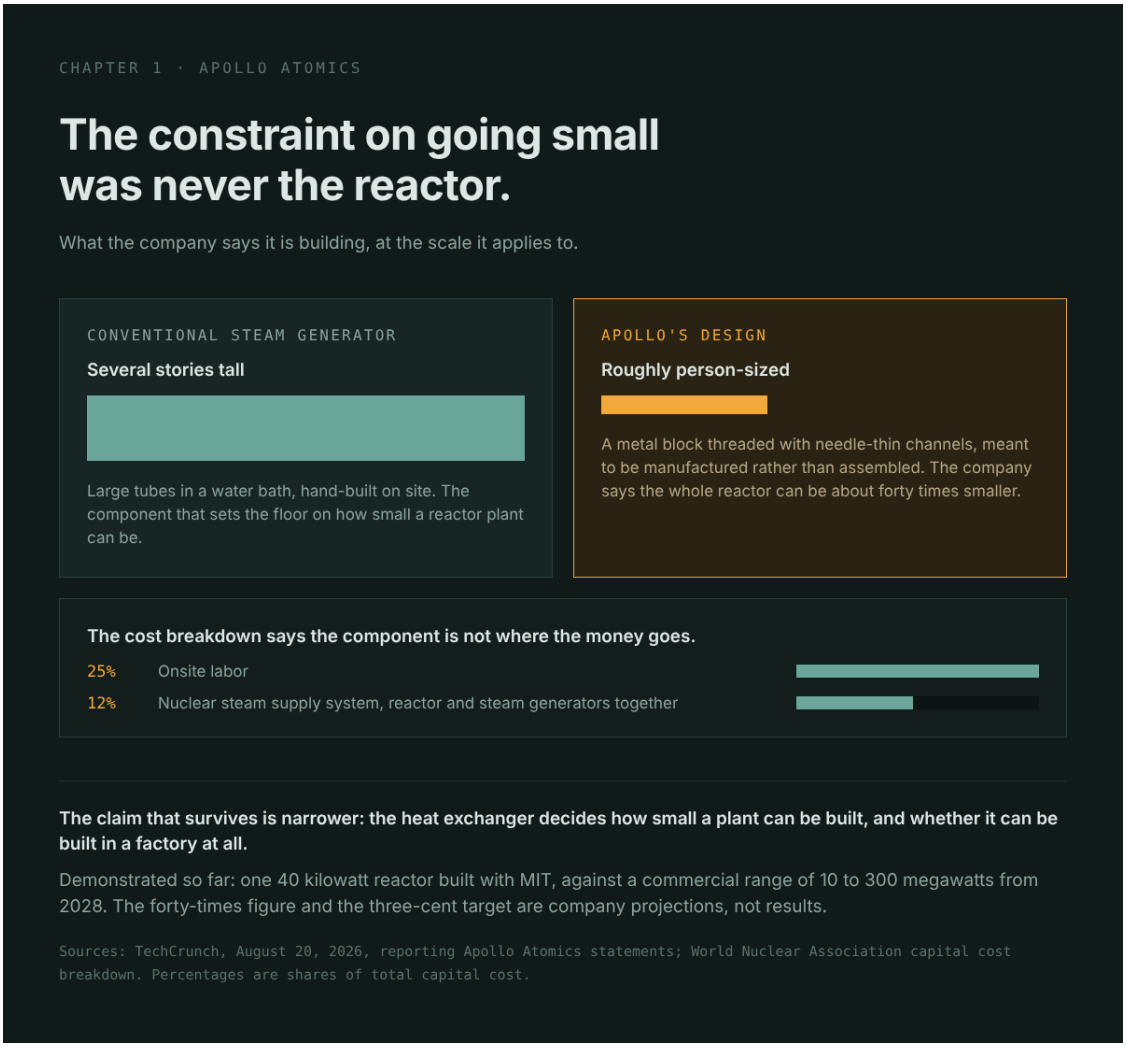


Figure 1.1. The heat exchanger, not the reactor, sets how small a plant can be built.

Every rendering shows the reactor. Nobody photographs the steam generator, and nobody photographs the construction schedule at all.

Five: conversion runs through a single plant

The easy version of this argument says federal money went to enrichment and fabrication, so the real gap must be conversion, the step nobody funded. The cost figures do not support it.

McKinsey’s assessment of the domestic fuel cycle puts the investment required across the whole chain at $105 to $170 billion. Enrichment accounts for $30 to $40 billion of it. Conversion

accounts for $30 to $45 billion, as much or more.[26] And conversion is the only step the analysis ties to a single operator: “Having a single conversion operator creates capacity constraints, so US nuclear operators have relied on imports from Canada, China, France, and Russia, as well as on their own stockpiled reserves in recent years.” The analysis names capacity shortfalls at other steps too, expecting domestic enrichment capacity to “fall short of demand” and warning that fabrication capacity could become a constraint, but those are shortfalls of quantity, not of redundancy.

Conversion is no neglected afterthought, and enrichment is not obviously the biggest gap either. The two steps are comparable in what they need and different in how they fail, and the failure mode is what matters.

Enrichment is short of capacity. There are machines, there are not enough of them, and the shortfall is filled by imports, including Russian supply whose waivers under the Prohibiting Russian Uranium Imports Act end no later than January 1, 2028.[26] A shortfall of that kind tightens supply gradually, and it can be met, expensively, from abroad while domestic capacity is built.

Conversion depends on a single plant. Between mining and enrichment sits conversion, turning yellowcake, the uranium concentrate that comes out of the mill, into uranium hexafluoride, and in the United States that step happens in exactly one place: Metropolis Works, in Metropolis, Illinois. The plant was completed in 1958 and made its first UF6 deliveries in 1959.[27] It is the country’s only domestic uranium conversion facility, and at its present and projected operating capacity it covers roughly half of current US demand.[26] Its licensed ceiling is 15,000 metric tons of uranium a year, cut to 7,000 in 2017 and restored on the 2023 restart, and the plant produces well below it.[28] The operator’s own page gives a different figure again, a nameplate capacity of about 17,600 metric tons of uranium as UF6 after a 2007 expansion, which it does not reconcile with the licensed ceiling.[27] Chapter 3 works through the tonnages. Here the argument uses only the proportional claim, that one plant covers about half of demand.

The plant’s interruptions are the more useful fact. Built in the late 1950s against a government contract, it was mothballed in 1964 and restarted as a commercial facility in 1967.[28] It was idled again in November 2017 during a global oversupply of UF6, and restarted in July 2023.[29] The second stoppage left the United States with no operating conversion capacity at all for nearly six years. The step is not fragile because the plant is old. It is fragile because there is one of it, and when the economics turned against that one plant, the country’s conversion went dark with it.

The plant’s ownership has also just changed. It is now run by Solstice Advanced Materials, spun off from Honeywell in October 2025, with ConverDyn, a Solstice and General Atomics partnership, as exclusive marketing agent. Solstice has an engineering study underway toward expansion.[29]

A capacity shortfall and a single-facility shortfall are different risks. One is a question of how much supply there is. The other is a question of whether there is any.

The challenger is a startup and has no plant. Raven-Flint Nuclear’s license application, docketed by the NRC, is not for one. Submitted in July 2026 and answered with a request for

additional information on August 24, it seeks to raise the uranium the company may hold at its Idaho Falls laboratory from an administrative 1.5 kilograms to 500 kilograms for bench-scale work, and does not seek authorization for commercial production. A pilot plant is the next step after it, designed for 500 tons of conversion capacity a year, with a commercial facility at 5,000 to 10,000 tons. The trade report gives those figures in tons without stating whether they are tons of uranium or of UF6, so they are not directly comparable with the licensed ceiling above. The process is described as converting without elemental fluorine. Raven-Flint has not disclosed how. It was one of twelve companies selected in the second round of DOE's Nuclear Energy Launch Pad in August 2026.[30]

It already has a prospective customer. Raven-Flint has signed a letter of intent with Aalo Atomics for conversion services beginning in 2028, and Raven-Flint's chief executive says Aalo is looking to take one hundred percent of the pilot plant's output.[30] That letter rests on a single trade-press report, which attributes the details to Raven-Flint's chief executive; Aalo has not commented.

The full output of an unbuilt plant, using an undisclosed mechanism, is sought by the customer under a letter of intent. That reflects on neither company. It shows how badly this step is needed.

Binding constraints produce no announcement

Five times, the celebrated milestone was not where the risk sat.

Assumed constraint	Actual constraint
Criticality	A contract a lender will finance
The regulator	The order book
Mining	Enrichment
The reactor core	The heat exchanger, which sets minimum plant size
Capacity shortfalls	Single-facility shortfalls

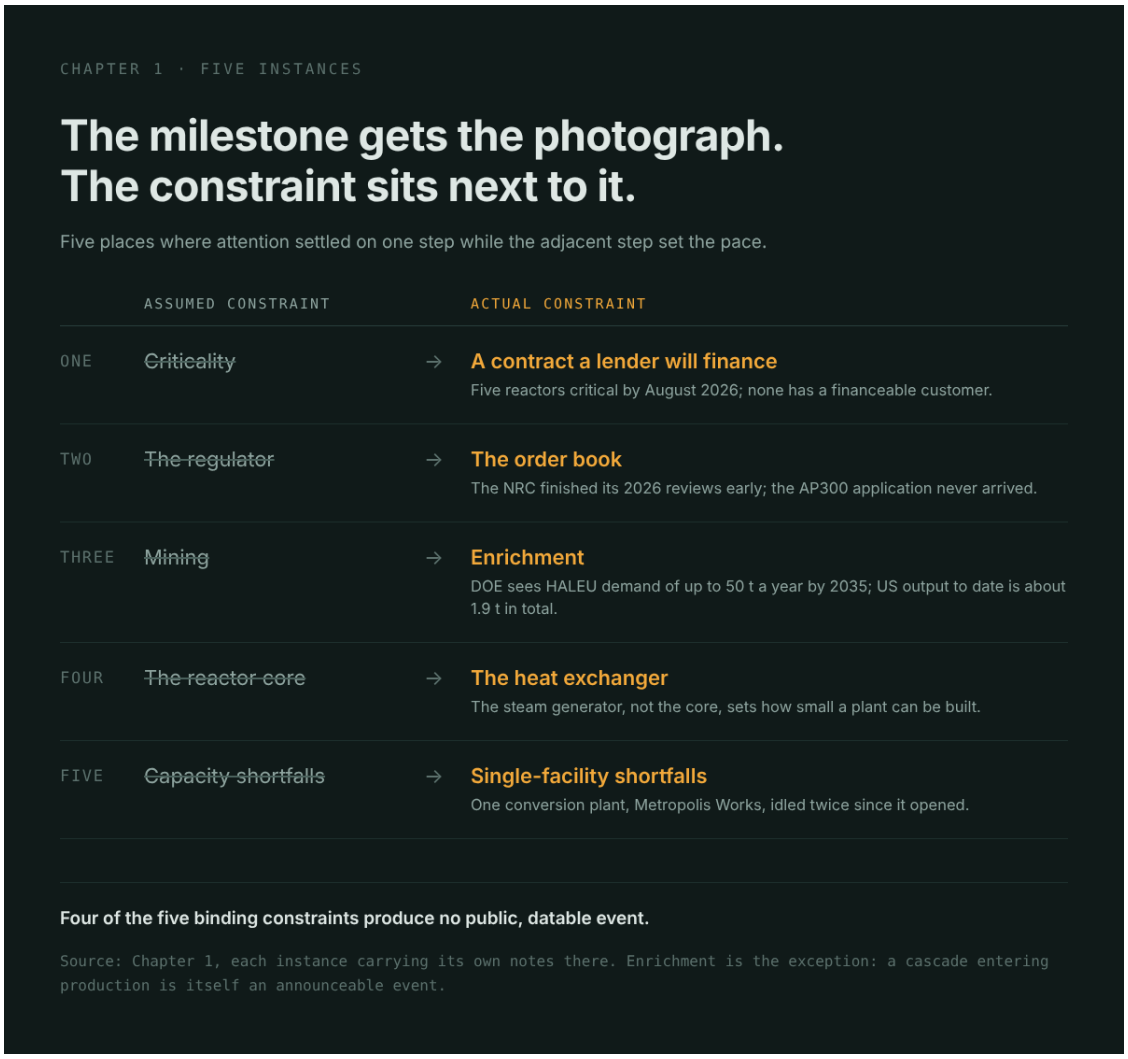


Figure 1.2. Five times, the celebrated milestone was not where the constraint sat.

The shape repeats for a reason other than carelessness. Four of these five binding constraints produce no public, datable event. Enrichment is the exception, since a cascade entering production is itself an announceable event. A reactor going critical has a date, a place, a photograph, and a press release. A contract that has not been signed has none of those. Neither does a plant that has no second copy, a component nobody renders, or an order book not yet large enough to justify a licensing spend. Attention goes where the events are, and events cluster at the technical milestones, because technical milestones are the part of this business that resolves on a schedule. Commercial and industrial constraints resolve on negotiation, and negotiation has no announcement until it is over.

The pattern is therefore less about nuclear than about what any sector notices when part of its work happens on a date and part of it does not.

The next chapters test the pattern

If the pattern is real, the chapters that follow should keep finding it on their own. Each starts from a question, and the answer is whatever the sources support.

Chapter 2 asks whether reactor design, the thing companies market on, is where the differentiation actually lives. Chapter 3 asks whether the fuel chain's binding step is the one receiving federal money. Chapter 4 asks what each regulatory pathway costs the company that chooses it. Chapter 5 asks whether the workforce constraint is real and separable from the supply chain one. Chapter 6 asks whether field construction rather than component pricing is what broke the last generation of projects. Chapter 7 asks whether the buyer class, rather than the technology, is what changed. Chapter 8 asks whether public permission is one problem or two. Chapter 9 asks whether the defense pathway is a market or a runway. If most of those chapters find that the obvious constraint was the real one after all, the pattern is wrong, and the report should say so.

One test is already available, from the previous generation of large reactor projects. Vogtle Units 3 and 4 in Georgia were originally projected at about $14 billion with completion by 2017. The units entered commercial operation in 2023 and 2024. Cost to the owners is projected around $31 billion, approaching $35 billion counting Westinghouse's $3.7 billion settlement.[31] V.C. Summer in South Carolina was abandoned in July 2017, with Santee Cooper alone having spent about $4.7 billion in construction and interest on its 45 percent share.[32]

Neither Summer's abandonment nor Vogtle's cost overrun happened because the reactor design failed. The physics worked at both. What failed was everything around the reactor. The same shape appeared one generation of projects earlier, which is reason to treat the pattern as more than a framing device.

Neither failure nor permanence is claimed

Two limits apply here and to every chapter that follows.

This is not a prediction that the current wave fails. Four criticalities in thirty days is evidence of real capability, and Chapter 2 gives the bull case its full weight.

Nor are these constraints permanent. Conversion has a challenger with a prospective customer. Enrichment has federal money. The useful question is how close each constraint actually is to being resolved, which Chapter 10 works through company by company.

The finding

In all five instances, the binding step sits beside the celebrated one, and for the companies that reached criticality in 2026 that step is a signed, financeable customer contract none of them yet holds.

The contract, the order book, the enrichment cascade, the steam generator and the single conversion plant limit progress, and four of the five produce no public, datable event until they are resolved. For any given company, the question the rest of this report asks is where the

constraint that nobody is photographing sits, and what would have to be true for that company to resolve it.

Sources

Notes are numbered per chapter. Each carries a source-interest tag: `[regulator]` for government and agency documents, `[reporting]` for independent journalism and trade press, `[company]` for a subject describing itself, `[analyst]` for banks, consultancies and law firms that earn fees in the sector, and `[advocacy]` for organizations with a declared stake in the outcome. Most notes carry an Internet Archive capture, most of them made September 18, 2026, so a reader can check what a page said on or near the date it was read. Notes for sources added in the days before the freeze date largely do not; the back matter states what is outstanding.

1. [reporting] American Nuclear Society, Nuclear Newswire, "The deadline arrives: Checking in on the Reactor Pilot Program." ans.org, archived September 18, 2026 ; [reporting] American Nuclear Society, Nuclear Newswire, "Aalo Atomics achieves criticality on July 4." ans.org, archived September 18, 2026 ; [reporting] World Nuclear News, "Criticality for third US reactor ahead of 4 July deadline." world-nuclear-news.org, archived July 9, 2026 The World Nuclear News report is the source for Deployable Energy's Launch Pad route. The first ANS report is the source of the zero-power status of the Antares, Valar and Deployable Energy criticalities, and of Valar's conversion of a 10 kWt output to electricity connected to an Nvidia Spark chip as part of a partnership "to develop a 30-MW data center in Utah." The June 30 date for Deployable Energy is from U.S. Department of Energy, "U.S. Department of Energy Meets President Trump's Goal, Delivers Third Advanced Reactor," July 1, 2026, [regulator] energy.gov , which says Unity "achieved criticality late yesterday"; the company announced it on July 1. Aalo's 2023 founding is from World Nuclear News, "Aalo Atomics secures funding to build its first reactor," August 20, 2025, [reporting] world-nuclear-news.org , which says the company "was founded in 2023"; BetaKit reported in August 2024 that Aalo was incorporated in 2022, and the two are not reconciled here. These three sources accessed October 18, 2026.

2. [reporting] American Nuclear Society, Nuclear Newswire, "Aalo Atomics achieves criticality on July 4." ans.org, archived September 18, 2026 Source of the description of the Aalo assembly as a full-scale zero-power version of the planned 10 MWe Aalo-X. The zero-power status of the other three criticalities is from note 1. The same source is used at Chapter 10 note 25.

3. [reporting] Deseret News, Eva Terry, "New partnership touts nuclear-powered AI with minimal water use," July 1, 2026. deseret.com Describes the partnership as aiming "to explore the development of artificial intelligence data centers in Utah," and reports the Ward250 as generating 100 kilowatts of electricity, a different figure from the 10 kWt in the ANS report at note 1, which is the one used in the text; the two are not reconciled here. The company's own site, [company] valaratomics.com, archived September 18, 2026, accessed September 14, 2026, does not describe the Nvidia demonstration or partnership; an earlier draft cited it for both. A partnership, not a power purchase agreement; no dollar figure disclosed.

4. [company] Oklo Inc., "Oklo achieves criticality at the Groves isotope test reactor," August 2026. oklo.com, archived September 18, 2026 Reported as the fifth criticality under the DOE Reactor Pilot Program and the first on private land.

5. [regulator] U.S. Department of Energy, Office of Nuclear Energy, "U.S. Department of Energy Reactor Pilot Program." energy.gov, archived September 18, 2026 Source of the siting language: the program sought criticality for "at least three advanced nuclear reactor concepts located outside of the national laboratories by July 4, 2026," and invited applications for "qualified test reactor construction and operation outside of the national laboratories using the DOE authorization process."

6. [reporting] Axios, "Nuclear energy startup funding is heating up," July 28, 2026, citing PitchBook data. axios.com, archived September 18, 2026

7. [analyst] Hunton Andrews Kurth, "Bankability will decide SMR success." hunton.com, archived September 18, 2026 Source of the lender requirements summarized here: revenue certainty via long-term offtake with creditworthy counterparties, construction risk allocation, and sponsor credibility.

8. [reporting] POWER Magazine, "Aalo, Crusoe Plan 2027 INL Demonstration Pairing Nuclear Power and AI Data Center Load." powermag.com, archived September 18, 2026 Both companies characterize the arrangement as a strategic partnership with a stated intent to deploy by end of 2029. No power purchase agreement is described by either company or by the reporting.

9. [reporting] American Nuclear Society, Nuclear Newswire, "NRC approves TerraPower construction permit." ans.org, archived September 18, 2026 Note: sources differ on how far ahead of schedule the review finished, giving both three months against an end-2025 target and five months against an August 2026 target. The text claims only that it finished ahead of the NRC's published schedule, which both accounts support.

10. [reporting] American Nuclear Society, Nuclear Newswire, "NRC grants license for TRISO-X fuel manufacturing using HALEU," February 17, 2026. ans.org, archived September 18, 2026

11. [regulator] U.S. Nuclear Regulatory Commission, "Licensing Efficiencies," ADVANCE Act implementation. nrc.gov, archived September 18, 2026 Source of the Kemmerer and Hermes 2 review durations. These are the agency reporting on its own performance and should be read as such; the Kemmerer completion is independently reported in note 9.

12. [company] Tennessee Valley Authority, "TVA First U.S. Utility to Receive Construction Permit for BWRX-300 Advanced Nuclear Reactor," September 29, 2026, PR Newswire. prnewswire.com, archive lookup Source of the second-permit characterization and of TVA's narrower statement that it is "the first U.S. utility permitted to construct the BWRX-300 SMR." That the permit is the first held by a utility for any advanced reactor design is this report's reading, from the developer-held permits at notes 9 and 11. The

release says “only the second advanced reactor construction permit ever issued in the nation”; NucNet, cited below, puts it as the second commercial one, which is the wording used here because Kairos holds two earlier non-commercial permits. The issuance is corroborated by Exchange Monitor, “NRC issues construct permit to TVA for Clinch River SMR project,” September 29, 2026, [reporting] exchangemonitor.com which reports that the Commission “granted the Tennessee Valley Authority (TVA) a construction permit Tuesday,” and by NucNet, September 29, 2026, [reporting] nucnet.org, archive lookup, which calls it “only the second commercial advanced reactor construction permit ever issued in the US” and the first for a BWRX-300. The NRC had published no release and had not updated its project page when this was written. The issue date is from Federal Register, “Tennessee Valley Authority; Clinch River Nuclear Unit 1; Construction Permit and Record of Decision,” October 5, 2026, [regulator] federalregister.gov That notice states that “The Construction Permit No. CPAR-2 was issued on September 28, 2026” and records a Record of Decision of the same date. The company and trade-press items above are dated September 29, the day the issuance was made public.

13. [regulator] U.S. Nuclear Regulatory Commission, “Clinch River Nuclear Site Application,” milestone schedule. nrc.gov, archive lookup Source of the milestone dates: environmental report submitted April 28, 2025, preliminary safety analysis report May 20, 2025, schedule letter July 25, 2025, final safety evaluation report June 25, 2026, mandatory hearing August 13, 2026, and a construction permit decision targeted for fall 2026, with the safety review itself carrying a November 2026 date. Reading the June date against the November date as five months early is this report’s comparison, not the agency’s. The single unit, Docket 50-615, the nominal 300 MWe and 870 MWt ratings and the GE Vernova Hitachi design are from Federal Register, “Tennessee Valley Authority; Clinch River Nuclear Site, Unit 1; Notice of Hearing,” July 7, 2026, federalregister.gov, archive lookup. The hearing was uncontested; no intervention petitions were filed. The application was docketed on July 9, 2025, per Federal Register, “Tennessee Valley Authority; Clinch River Nuclear Site, Unit 1; Construction Permit Application,” 90 FR 31709, July 15, 2025, [regulator] govinfo.gov An earlier draft gave August 4, 2025, which that notice does not support.

14. [regulator] U.S. Nuclear Regulatory Commission, “Westinghouse AP300,” pre-application activities. ADAMS accession ML23124A012 (AP300 Pre-Application Regulatory Engagement Plan, May 2023); ML24332A034 (updated Regulatory Engagement Plan). nrc.gov, archived September 18, 2026

15. [reporting] World Nuclear News, “Westinghouse and Amentum sign AP1000/AP300 collaboration agreements,” August 4, 2026. world-nuclear-news.org, archived September 18, 2026

16. [company] Amentum, “Amentum and Rolls-Royce SMR Partner on Building First Small Modular Reactors in the UK and Czech Republic,” January 20, 2026. amentum.com, archived September 18, 2026

17. [company] Amentum, “Amentum-Led Joint Venture Secures $406 Million Contract as Owner’s Engineer for UK’s First Small Modular Reactors,” April 2026. amentum.com, archived September 18, 2026 This is the Litmus Nuclear joint venture with Cavendish Nuclear, contracted to Great British Energy - Nuclear as Owner’s Engineer at Wylfa for up to 14 years. Source of the maximum value of $406 million and of Rolls-Royce SMR as the reactor technology at Wylfa, which makes this engagement a second one with the same vendor named at note 16 rather than a third vendor. It is a separate award from the EDF work, which is valued at up to $730 million (GBP 540 million) over ten years and announced January 27, 2026, in Amentum, “Amentum Expands UK Nuclear Energy Specialist Services Portfolio with $730 Million Major Contracts Win,” [company] amentum.com, archived September 18, 2026, which is the source for the EDF work in the text; see also Chapter 5 note 13.

18. [reporting] American Nuclear Society, Nuclear Newswire, “Westinghouse updates: AP1000 potential, IPO, Amentum partnership,” August 5, 2026. ans.org, archived September 18, 2026 Source of the Sumner quotation and of his following sentence on accelerating AP300 licensing, the $17.5B DOE supply chain loan figure, the Department of Commerce partnership, and the confidential IPO filing. The conditional character of the loans and the June 2026 date are from American Nuclear Society, Nuclear Newswire, “DOE announces $17.5B in conditional loans for AP1000 builds,” June 23, 2026, [reporting] ans.org The AP1000 renewal through 2066 and its basis in Vogtle Units 3 and 4 are from U.S. Nuclear Regulatory Commission, news release 26-080, “NRC Updates AP1000 Design Certification, Streamlines Future Reactor Licensing,” October 14, 2026, [regulator] nrc.gov Accessed October 18, 2026, which states that the action “does not authorize the siting, construction or operation of any facility.” The direct final rule form, Revision 20 of the design control document, the November 13, 2026 comment deadline and the December 28, 2026 effective date absent significant adverse comments are from Federal Register, “AP1000 Design Certification Renewal,” October 14, 2026, 91 FR 65091, [regulator] federalregister.gov

19. [reporting] American Nuclear Society, Nuclear Newswire, “UK gives OK to Westinghouse AP300 SMR,” August 2024. ans.org, archived September 18, 2026 Partial paywall; the UK Department for Energy Security and Net Zero sign-off and its date are visible in the free portion. The precise Generic Design Assessment step entered is not, and is not claimed here. The article’s headline describes an application filed with the UK; its body describes the sign-off.

20. [regulator] U.S. Department of Energy, Office of Nuclear Energy, “HALEU Frequently Asked Questions.” energy.gov, archived September 18, 2026

21. [company] Centrus Energy Corp., “Centrus Achieves Key Production Milestone with Delivery of 900 Kilograms of HALEU to the Department of Energy,” June 25, 2025. investors.centrusenergy.com, archived September 18, 2026 The 900 kg figure is a cumulative contract phase milestone, not an annual production rate. The cumulative total of more than 1,900 kilograms, the June 30, 2026 end of the demonstration contract, the $900 million task order, the 12 metric ton a year initial build-out and the 2029 first-capacity date are from Centrus Energy Corp., “Centrus Signs Contract with Department of Energy for $900 Million Award; Intends to Transition HALEU Production Cascade to Commercial Operation,” July 1, 2026, SEC Form 8-K, Exhibit 99.1, [company] sec.gov

22. [reporting] POWER Magazine, “DOE Allocates First Round of HALEU to Five U.S. Advanced Nuclear Reactor Developers,” April 2025. powermag.com, archived September 18, 2026

23. [reporting] TechCrunch, “Apollo Atomics wants to make nuclear power cheaper by shrinking an overlooked part,” August 20, 2026. techcrunch.com, archived September 18, 2026 The company’s own release of the same day is headlined $31 million in seed financing, against TechCrunch’s $26 million including $5 million of debt; see Chapter 2 note 3. The text gives both, leading with the company’s figure, as the companion dataset does.

24. [company] Apollo Atomics, statements by CEO Assil Halimi and company projections as reported in TechCrunch, August 20, 2026. techcrunch.com, archived September 18, 2026 The forty-times-smaller figure and the three cents per kilowatt hour target are company projections against a 2028 deployment target, not demonstrated results.

25. [advocacy] World Nuclear Association, "Economics of Nuclear Power," citing the WNA 2020 World Nuclear Supply Chain report. world-nuclear.org, archived September 18, 2026 Shares of total capital cost, in the WNA breakdown by labor, goods and materials: nuclear steam supply system 12 percent, mechanical equipment 16 percent, electrical and generating equipment 12 percent, construction materials 12 percent, onsite labor 25 percent. These are shares of total capital cost on one reference breakdown and vary by design and by whether financing is included; they are used here only to show that no single component dominates.

26. [analyst] McKinsey & Company, "Securing the US nuclear energy supply: Understanding domestic nuclear fuel production options in the United States." mckinsey.com, archived September 18, 2026 Source of the enrichment investment range ($30-40B of $105-170B across the supply chain) and of the finding that the single US conversion facility covers approximately 50 percent of current US demand at present and projected operating capacity. The source also expects domestic enrichment capacity to fall short of demand and names fabrication capacity as a possible constraint. The January 1, 2028 end of the Russian import waivers is not in this source; it is from the Prohibiting Russian Uranium Imports Act, Public Law 118-62, as set out in the NRC backgrounder at Chapter 3 note 4.

27. [company] ConverDyn, "Honeywell's Metropolis Works Facility." converdyn.com, archived September 18, 2026 This page gives nameplate capacity as approximately 17,600 mtU as UF6 following a 2007 expansion: "Expansion completed to raise nameplate capacity to 17,600 mtU as UF6." The licensed figures in the text come from note 28.

28. [advocacy] World Nuclear Association, *US Nuclear Fuel Cycle*, updated August 19, 2026. world-nuclear.org, archived September 18, 2026 "Built in the late 1950s to fulfil a government contract before being mothballed in 1964 and then restarted as a commercial facility in 1967." The 1958 completion and 1959 first-delivery dates at note 27 come from the operator and are not contradicted by this: the mothballing followed the government contract work.

29. [reporting] World Nuclear News, "Solstice plans expansion of US conversion facility." world-nuclear-news.org, archived September 18, 2026

30. [reporting] American Nuclear Society, Nuclear Newswire, "Raven-Flint U conversion plans land on NRC docket, in Launch Pad," September 4, 2026. ans.org, archived September 18, 2026 Source of the July 2026 application, which the article describes as raising the company's possession limit at its Idaho Falls laboratory from an administrative cap of 1.5 kg to 500 kg for bench-scale demonstrations and as not seeking authorization to conduct commercial production; of the pilot and commercial capacities, which it gives in tons without stating the basis; and of the letter of intent, with the one hundred percent figure attributed to Raven-Flint cofounder and chief executive Nick Smith as what Aalo is looking to take. The fluorine-free process is a company description; Raven-Flint has not disclosed the mechanism, which the text states.

31. [reporting] Georgia Public Broadcasting, "A second new nuclear reactor is completed in Georgia. The carbon-free power comes at a high price," April 29, 2024. gpb.org, archived September 18, 2026 Cost basis: projected cost to the owners, plus Westinghouse's $3.7B settlement for the approximately $35B figure. Excludes ratepayer financing costs, which are reported separately and vary by source.

32. [reporting] POWER Magazine, "SCANA, Santee Cooper Abandon V.C. Summer AP1000 Nuclear Units, Citing High Costs." powermag.com, archived September 18, 2026 Since publication: Santee Cooper selected Brookfield in October 2025 and signed a memorandum of understanding in December 2025 toward restarting the project. This does not change the 2017 abandonment or its cost, which is what the text uses it for.

Chapter 2: Twenty-Four Reactors, Seven Ideas

Twenty-four advanced reactor developers are active in the United States and Canada by this report's scope, and reactor design is the thing they market on. Their materials describe helium, sodium, molten salt, lead, heat pipes, even a pressurized water reactor a mile down a borehole, and read company by company, the field looks like twenty-four distinct ideas.

Sorted by coolant, the twenty-four fall into seven families, and every one of those families was investigated decades ago, most of them at the national laboratories these companies now test at. Seven of the developers are building light water reactors, six on their own disclosure and a seventh on the reporting of its seed round. Light water is the most thoroughly understood reactor technology in existence. Nobody in this sector invented a coolant.

The real divergence is fuel, a choice most of them barely market at all. Twelve developers are committed to HALEU-range fuel, eight to standard low-enriched uranium, and four fall outside both groups. That split will decide which of them can get fuel. Manufacturing, by contrast, is marketed heavily. Eleven companies say they will build reactors in factories, and three have published a building and a production rate. The design is the easiest thing to learn about any of these companies, and the least revealing.

Twenty-four developers fall into seven coolant families

The table counts each company once, by the coolant that moves heat out of its core.

Coolant family	Developers
Light water	7
Gas, helium	5
Sodium	4
Molten salt	3
Lead and lead-bismuth	2
Heat pipe and solid-state conduction	2
Heavy water	1

Three entries need explaining. Bluecore Energy's own materials say only that its reactor is water-cooled, which could mean light water or heavy water, two different technologies, and the difference matters in a report that covers Canada, where the operating fleet runs on heavy water. Coverage of its $50 million seed round in September 2026 settles it: a water-cooled small modular reactor on a floating barge, using established light water technology and commonly available low-enriched uranium. Bluecore is counted in the light water row on that reporting, as Atlas below is counted on reporting; its source is listed with this chapter's notes. An earlier draft gave Bluecore a row of its own on the claim that no source settled the question, which was wrong.

Atlas Atomics gets a row for the opposite reason: not because it has disclosed too little to classify, but because what it is reported to be building does not belong in the water family at all. Heavy water is counted here as a family of its own. A heavy water design moderates with a different substance, underpins the Canadian fleet rather than the American one, and carries a different fuel consequence, because it can run on uranium at enrichments a light water reactor cannot use. Grouping it with light water would hide the one thing about it that matters. Atlas is the single entry in that row. It is in stealth, has published no specification of any kind, and is counted on the strength of reporting rather than its own disclosure: its selection in the second round of DOE's Launch Pad in August 2026 was announced as being for heavy water reactor technology, and Chapter 11 covers the October 2026 financing that brought it into the count.

Antares Nuclear uses sodium, but not the way sodium reactors do. Its sodium is sealed inside heat pipes, where the working fluid circulates within each tube rather than being pumped around a loop, so it never flows through the core as a bulk coolant. It is counted with the heat pipes, not with circulating sodium designs such as TerraPower's. NuCube, the other entry in that row, is a different design: its own site describes "Solid State Power Conversion" and no circulating coolant, and the companion dataset records a solid-state heat pipe. Its placement in this row is the report's judgment rather than a sourced classification.

The table is the report's own classification, not an external finding. The counts come from grouping the companion dataset, which records coolant, fuel, manufacturing model, buyer class, and deployment structure for each company, with the public source for each field. Gaps where sourcing was not found stay gaps in the counts, never filled by inference. Any classification can be checked against its entry.

Seven families across twenty-four companies is not a scandal. It is physics. There are only so many ways to move heat out of a core, so the coolant cannot be the differentiator the marketing presents it as.

Nobody in this sector invented a coolant.

Three companies have a factory and a rate

The next place to look is manufacturing, because factory construction is the sector's signature promise: small units, factory-built, on a knowable timeline. It answers the schedule risk that broke the last generation of projects, and almost every company here has some version of it on its website.

It ought to split the field into factory builders and everyone else. It does not, and the reason turns on what counts as a factory bet. A company is counted here as making the factory bet when it has publicly stated an intention to manufacture reactors, or complete reactor modules, at volume, in a facility it controls. That takes three elements. The reactor is the product, there is a production rate, and the company carries the risk of the facility.

Three companies satisfy all three.

Radiant is building the R-50 factory at Oak Ridge, Tennessee, on former Manhattan Project land, with a stated target of roughly fifty reactors a year and first mass-produced delivery in 2028.[1] Aalo built a 40,000 square foot pilot line in Austin, shipped the first five full-scale non-nuclear test modules for its Aalo-0 prototype to Idaho National Laboratory in December 2025, and has published a phased plan rising to a facility above four million square feet, rated at one gigawatt a year per million square feet. Antares is building out a 145,000 square foot facility in Torrance, California, which it describes as capable of producing ten units a year, alongside the 322,000 square feet of vertically integrated R&D space it opened as Antares Prime.[2] Each has a building with an address and a number the company put its name to; for Antares, the number appeared in a company-contributed article on its Series B rather than on its own site. Everything else in the manufacturing column is softer, and the softness is the finding.

The other twenty-one sort into six groups.

Four state mass production without naming a facility. Deployable Energy's chief executive frames the company around the idea that "nuclear energy should be a product, not a project," built on an existing industrial supply base rather than a dedicated plant. Last Energy describes its plant as "engineered for modular, factory production." Terrestrial Energy has presented its sealed core-unit as factory-built and replaced every seven years instead of being refueled in place. Valar's chief executive told Bloomberg in August 2026 that the company was moving from "demonstrating the operability of an integrated reactor system to producing fleets of them en masse"; the comparison with car production lines is the reporting's.[3] None is yet attached to a plant.

Four state a factory intention with neither facility nor rate. Hadron's SEC filing describes "a maximally standardized, factory-fabricated" reactor. NuCube's site says its reactor is "Compact enough to be transported via conventional road or rail freight." Nuclea calls its design factory-fabricated and transportable, from pre-licensing. Apollo's funding announcement is headlined as turning proven reactor technology into "a Factory-Built Product."[3] These are design goals stated in the language of manufacturing.

Two have outsourced the manufacturing to the same supplier. Doosan Enerbility is NuScale's module supplier under a 2019 agreement and began forging the first module in 2023, for the Carbon Free Power Project; no 2026-dated update on manufacturing status was located.[4] X-energy holds a binding reservation with Doosan for sixteen complete sets of main power system components, and Doosan is building a Changwon facility sized for roughly twenty Xe-100 reactors a year.[5] Both are significant commitments, and neither is a factory the company controls.

Three have manufacturing activity that is not reactor production. Kairos leads NuCAMP, a consortium exploring precast concrete and additive manufacturing for nuclear construction, in a twelve-month exploratory phase under an MOU.[6] Antares, counted above on its Torrance facility, also runs Antares Prime, which it describes as vertically integrated R&D space "to accelerate in-house manufacturing and iteration"; that space alone would not meet the test.[7] Oklo acquired ARMEC in June 2026 to expand vertically integrated manufacturing, with no line and no rate stated.[8] Oklo does not sell reactors at all. It builds, owns and operates plants and sells the power.[9] NANO integrates across fuel and transport, not reactor hardware.

Six are doing something else and say so. ARC Clean Technology's pitch is a 100 MWe sodium-cooled unit whose core is designed to run twenty years or more without refueling, not a production line. Deep Fission's innovation is siting, placing a pressurized water reactor a mile down a borehole and relying on geological isolation at depth instead of a large above-ground containment structure, which is the company's own framing.[10] TerraPower's Natrium is a 345 MW grid-scale design poorly suited to modular output, a judgment that is this report's rather than the company's.[11] Applied Atomics licensed a dormant, previously NRC-reviewed design and describes itself as serving customers who want firm power, with a plan to design and deploy a vertically integrated SMR power plant.[11] First American Nuclear builds through industrial partners, with AtkinsRéalis as exclusive engineering, procurement and construction management provider for its lead-bismuth-cooled design.[11] Natura commercializes through a university research alliance.

Two have disclosed no manufacturing approach. Bluecore, at seed stage, has stated none. Atlas Atomics is in stealth and has published no specification of any kind. Neither is counted as making the factory bet or as rejecting it; the record is simply empty, and that is a different thing from a different strategy.

So the count depends on where the line sits. Three companies have a factory and a rate. Seven if mass-production language without a plant counts. Eleven if any stated factory intention counts. Thirteen if a supplier's factory counts as the developer's own.

The number that matters is three. Measured against the sector's disclosed capacity to keep it, the signature promise holds for three of eleven. On manufacturing, the convergence is in the marketing: a single frame has been adopted more widely than the strategy behind it, so a reader cannot tell from public materials which companies are making the factory bet and which are describing something else in the language that sells.

None of this says the others are lying. Deployable Energy and Valar intend to mass-produce, Hadron's claim sits in an SEC filing with consequences attached, and NuScale and X-energy rely on a supplier that is building a real plant. The finding is narrower. Only three have disclosed both a facility and a production rate, and a reader deciding where the factory risk sits should know which three.

Fuel is where the developers really split

Twelve of the twenty-four are committed to HALEU or to TRISO fuel at HALEU-range enrichment. Eight are designed around standard low-enriched uranium, meaning five percent U-235 or below, one of them on the reporting of its seed round rather than its own disclosure. The remaining four sit outside both groups. One describes itself as fuel-agnostic, and one is in stealth and has published no fuel specification at all, though it is reported to be developing heavy water reactor technology, which can in principle run on unenriched uranium. The other two have specified enrichments between five and ten percent, which falls inside the HALEU band by regulatory definition, while stating they will buy commercially rather than apply for allocated material. That is a useful reminder that what separates the two groups is a supply route and not a number, and the gap has a cost of its own: above five percent, most existing US fabrication licenses and transport packages do not yet cover the fuel.

Unlike the coolant, this split has immediate commercial consequences (see Chapter 1 on HALEU supply). When DOE made its first HALEU allocations in April 2025, fifteen companies had requested material and five were selected to receive it.[12] Commercial supply outside that program was, as of April 2025, available only from TENEX, a Rosatom subsidiary, and TerraPower's Natrium project had, in the same reporting, "been hindered by a lack of HALEU availability" while its construction permit application was still pending.[12] The NRC authorized issuance of that permit on March 4, 2026.[11]

Twelve developers, then, have designed around a fuel currently rationed by a federal allocation process with more applicants than material. Eight have designed around a fuel that is simply available. Four are in neither position, and two of those four have chosen the band between them, where the material can be bought but the licenses to fabricate and ship it are still being written.

No company's homepage leads with its fuel supply route, because a supply route makes a poor story. Yet the route separates a company that can order fuel from one that has to apply for it, and it was chosen years before anyone knew how tight the supply would be.



Figure 2.1. Sorted three ways, the 24 developers split into seven coolant families, three factory bets with a production rate, and twelve dependent on rationed fuel.

The coolant is what gets photographed. The fuel supply route decides how soon a design can reach production. Chapter 3 works through the supply chain behind that split.

Skeptics see a hype cycle spread too thin

The skeptics' case gets full weight, because it is a serious case made by serious people.

Dennis Wamsted, a co-author of the Institute for Energy Economics and Financial Analysis's 2024 report on small modular reactors, and David Schlissel, formerly IEEFA's director of resource planning analysis, have argued that the current wave is a hype cycle driven by data center demand, not by demonstrated economics. Wamsted, on the industry's implicit assumption about first-of-a-kind hardware: "They're going to work perfectly right out of the box."[13] Nothing in the history of this industry supports that assumption, including at the plants that eventually worked.

Schlissel's criticism of federal strategy is more specific and harder to wave off. Instead of funding many designs in parallel, he argues, policymakers should "pick two or three designs and go out and build them. Build one of each."[13] The field runs the other way, with twenty-four developers in seven coolant families and a federal program structure that has now run two rounds of Launch Pad selections and a Reactor Pilot Program on top of standard NRC licensing. The United States is spreading its bets across a field wider than the one Schlissel thinks is manageable.

The structural argument, from utility analyst Bill Tilles, should worry this sector most. Reactors face a reverse economy of scale, where shrinking a unit raises cost per watt instead of lowering it.[13] The rest of the SMR pitch assumes the opposite. If Tilles is right, factory production has to recover not just the usual first-of-a-kind learning curve but a cost penalty that works against the premise of going small.

The skeptics also have a precedent, and that part of their case is not a projection.

NuScale and UAMPS failed mainly on commercial structure

NuScale held the only NRC-certified SMR design, the 50 MWe US600. Its Carbon Free Power Project with Utah Associated Municipal Power Systems, however, had been redesigned around a larger 77 MWe module, 462 MW across six of them at Idaho National Laboratory. That configuration was not certified. The 77 MWe US460 received only a Standard Design Approval, in May 2025, eighteen months after the project was canceled.[14] In January 2023 the target power price was raised from $58 per MWh to $89. On November 8, 2023, NuScale and UAMPS terminated the project, having concluded it would not reach the subscription level needed to proceed.[15]

The project had a developer holding the only certified SMR design, federal support and a named site, and was canceled before construction, on a configuration that was never certified. It is the concrete version of everything Wamsted, Schlissel and Tilles argue.

It failed, though, for a different reason than the one usually cited. The Clean Air Task Force's post-mortem attributes the failure primarily to commercial structure, not design. Its finding is that the project "was not positioned for commercial success from its inception," with subscriptions never reaching the level the original twelve-module configuration required, and that the underlying error was treating a first-of-a-kind project as a full commercial endeavor rather than a demonstration. CATF does note that the VOYGR design's limited modularity made it more expensive and less adaptable than alternatives, but treats it as compounding the commercial problem rather than causing the cancellation, and puts design completion alongside reshaping the business case in its recommendations. It also points to a poor fit between the project and its customer.[16]

The most advanced SMR project in the United States died because it could not assemble a customer base. The physics was never tested, because the commercial structure failed first. That is the pattern from Chapter 1, at the scale of an entire flagship project.

Supporters point to private capital and new demand

The case for the sector gets equal weight.

Jordan Bramble, chief executive of Antares, argues that the skeptics' framing misreads where the capital is coming from. SMR developers are drawing on venture and institutional capital with a different risk profile from the regulated utility financing that built and broke Vogtle. Private markets, he argues, have repeatedly funded emerging technologies well before their costs were known, and he points to Anthropic, OpenAI and Commonwealth Fusion Systems as live examples.[13]

The argument is better than it first appears, and Chapter 1 supplies the evidence. Global venture investment in nuclear ran to more than $4.5 billion across 81 companies in 2026 by late July.[17] That capital is going out without waiting for Tilles to be proven wrong, on the assumption that the winners will be decided before costs are known, which is how several now-dominant industries were in fact financed.

Tilles's argument also has an answer, if an unproven one. He is describing what happens when a plant is shrunk and built the same way. The factory bet claims a different way of building, in which volume production recovers what unit scale gives up. Nobody has yet produced reactors at volume, so whether that works is unknown, but the claim does address the objection.

Demand has also changed since the 2023 cancellation. Bank of America's research projects global nuclear capacity rising from 442 GW to 683 GW by 2040, with sustained new build of roughly 18 GW annually led by the United States and China.[18] That is sell-side research describing a market that did not exist when UAMPS walked away, a source with interests of its own but not one arguing the sector's case.

The finding

For anyone assessing a company in this sector, the reactor design is the easiest thing to learn about and the least informative.

The skeptics' case and the sector's case are both coherent, both held by people who know the industry well, and the evidence to decide between them does not exist yet. What can be said is narrower and more useful to a reader evaluating a specific company. Coolant does not distinguish these companies: seven families cover all twenty-four, and seven companies sit in the light water family, the most thoroughly understood reactor technology there is. Manufacturing could distinguish them, but only three companies have disclosed enough to be judged on it, and the factory frame has spread far wider than the factory strategy. Fuel is the fork with the nearest-term consequences and the least marketing attached to it. And the one SMR project that got furthest died of a commercial problem, not a technical one. That is an uncomfortable conclusion for a chapter about reactor technology, and it is where the evidence points.

Sources

Notes are numbered per chapter. Each carries a source-interest tag: `[regulator]` for government and agency documents, `[reporting]` for independent journalism and trade press, `[company]` for a subject describing itself, `[analyst]` for banks, consultancies and law firms that earn fees in the sector, and `[advocacy]` for organizations with a declared stake in

the outcome. Most notes carry an Internet Archive capture, most of them made September 18, 2026, so a reader can check what a page said on or near the date it was read. Notes for sources added in the days before the freeze date largely do not; the back matter states what is outstanding.

The chapter's developer counts are the report's own classification, and the per-company sourcing behind them sits in the companion dataset rather than in these notes. Three classifications discussed individually in the text rest on reporting and are sourced here. Bluecore Energy's light water design and low-enriched fuel: [reporting] Pulse 2.0, Amit Chowdhry, "Bluecore Energy Raises $50 Million Seed Funding To Develop Floating Nuclear Power Systems," September 10, 2026, https://pulse2.com/bluecore-energy-raises-50-million-seed-to-develop-floating-nuclear-power-systems/ Accessed October 18, 2026, which describes "established light-water nuclear reactor technology" fueled with "commonly available low-enriched uranium." Bluecore's own site does not specify either. Atlas Atomics' heavy water technology: [reporting] American Nuclear Society, Nuclear Newswire, "Second round of Launch Pad selections includes eight newcomers," August 25, 2026, https://www.ans.org/news/2026-08-25/article-8338/second-round-of-launch-pad-selections-includes-eight-newcomers/ (archived: https://web.archive.org/web/20260918044711/https://www.ans.org/news/2026-08-25/article-8338/second-round-of-launch-pad-selections-includes-eight-newcomers/), the source at Chapter 4 note 1. First American Nuclear's lead-bismuth coolant: the American Nuclear Society report at note 11. These three classifications, and Antares's place among the companies with a factory and a rate, differ from the October 2026 edition of the companion dataset as first posted and are corrected in its revision 3, October 19, 2026.

1. [reporting] World Nuclear News, "Radiant to locate microreactor factory in Tennessee." world-nuclear-news.org, archived September 18, 2026

2. [company] Aalo Atomics, "Announcing our new factory HQ in Austin, Texas," August 21, 2024, and "Aalo Gigawatt Factory," aalo.com, archived September 18, 2026. aalo.com, archived September 18, 2026 Phase footprints and the gigawatt-per-year-per-million-square-feet ratio are the company's own published targets, unverified by any third party, with no delivery date attached to the later phases. The Antares facility and rate in the text are from POWER Magazine, "Antares Raises $96 Million in Series B Funding to Accelerate Nuclear Microreactor Development," December 3, 2025, [company] powermag.com Accessed October 18, 2026, which describes "a 145,000-square-foot facility in Torrance, California, capable of producing 10 units per year." The item is published as contributed content, written by the company and edited by the publisher, so it carries the company tag. Antares's own description of Antares Prime is at note 7. The December 2025 shipment of five full-scale non-nuclear test modules for the Aalo-0 prototype to Idaho National Laboratory is reported at nucnet.org, archived September 18, 2026 [reporting].

3. [company] Hadron Energy, SEC filing, sec.gov, archived September 18, 2026; [company] NuCube Energy, company site, nucube.energy, archived September 18, 2026; [reporting] SiliconANGLE, "Raising $1B in funding, Valar Atomics plans to mass produce small nuclear reactors for the AI industry," August 3, 2026, siliconangle.com, archived September 18, 2026. Accessed September 15, 2026. The SiliconANGLE item is the source of the Valar quotation, which is chief executive Isaiah Taylor speaking to Bloomberg, and of the comparison with car production lines, which is the reporter's. Deployable Energy: [reporting] Atomic Insights, "Atomic Show #345 - Bobby Gallagher, CEO Deployable Energy," May 18, 2026, atomicinsights.com Last Energy: [company] Last Energy, "Technology," lastenergy.com , which also states that its design "enables full factory fabrication"; an earlier draft's twenty-four-month build figure was not found on the company's site and is not used. Terrestrial Energy: [company] Terrestrial Energy, presentation to the 2022 Hybrid Molten Salt Reactor Workshop, Oak Ridge National Laboratory, October 11, 2022, msrworkshop2023.ornl.gov , which describes "the sealed and replaceable Integral Molten Salt Reactor (IMSR) 'Core-unit'" and shows it replaced every seven years; the company's current technology page carries neither detail. Apollo Atomics: [company] Apollo Atomics, "Apollo Atomics Secures $31 Million to Turn Proven Reactor Technology Into a Factory-Built Product," PR Newswire, August 20, 2026, prnewswire.com ; the phrase is in the headline. These five sources accessed October 18, 2026.

4. [reporting] World Nuclear News, "Doosan starts forging components for NuScale SMR," May 5, 2023. world-nuclear-news.org, archived September 18, 2026 Chapter 6 carries the fuller account: Doosan placed long-lead material orders in December 2022, began forging in 2023 for the since-terminated Carbon Free Power Project, and, together with Korean financial investors, has made an equity investment of nearly $104 million in NuScale. No 2026-dated update on VOYGR module manufacturing status was located.

5. [reporting] POWER Magazine, "X-energy, Doosan lock in 16-unit Xe-100 component reservation as Doosan commits to new SMR factory," December 18, 2025. powermag.com, archived September 18, 2026 The reservation is binding and covers reactor pressure vessels, steam generator vessels, cross vessels and hot gas ducts. The Changwon facility is Doosan's.

6. [reporting] American Nuclear Society, Nuclear Newswire, "Kairos Power, others launch NuCAMP to develop nuclear workforce," August 20, 2026. ans.org, archived September 18, 2026 Initial phase is a twelve-month exploratory effort; funding is not disclosed.

7. [company] Antares Industries, company site. antaresindustries.com, archived September 18, 2026 "We opened Antares Prime, 322,000 sq-ft of vertically integrated R&D space, to accelerate in-house manufacturing and iteration." The 145,000 square foot Torrance facility described as capable of producing ten units a year, cited at note 2, is what places Antares among the companies with a factory and a rate. An earlier draft set it aside because no company source attaches the rate to a date, a criterion the chapter's stated test does not contain; the test is applied as stated.

8. [company] Oklo Inc., "Oklo acquires ARMEC to expand vertically integrated manufacturing capabilities for advanced reactor and fuel manufacturing programs," June 8, 2026. businesswire.com, archived September 18, 2026 Oklo also acquired Creative Engineers Inc. Neither announcement states a reactor production rate.

9. [analyst] Zacks Equity Research, "OKLO Business Model Explained: When Revenue Could Arrive." finance.yahoo.com, archived September 18, 2026 Analyst commentary rather than primary reporting; used only for the uncontested description of Oklo's build-own-operate structure, which the company also states publicly.

10. [company] ARC Clean Technology, "Technology," arcenergy.co Accessed October 18, 2026, for the ARC-100's 100 MWe rating and a core "designed to operate for 20+ years without refueling." [company] Deep Fission, Inc., "Gravity Reactor: Small modular PWR a mile underground." deepfission.com, archived September 18, 2026 The borehole siting approach is the company's own description, which credits "geological isolation at depth" and says no large above-ground containment structure is needed; it does not say the rock is the containment. No independent verification of the containment claim is cited here, and none is implied.

11. [regulator] U.S. Nuclear Regulatory Commission, press release 26-028, March 4, 2026. nrc.gov, archived September 18, 2026 Natrium is rated 345 MWe with an energy storage system able to boost output to 500 MWe. The same release is the source of the March 4, 2026 authorization to issue TerraPower's construction permit. Applied Atomics: [company] Applied Atomics, "Applied Atomics Secures Exclusive Land-Based License for mPower Small Modular Reactor Technology from BWX Technologies," GlobeNewswire, June 17, 2026, globenewswire.com ; it names no power purchase agreement, and an earlier draft's statement that the company sells power under contract is not used. First American Nuclear: [reporting] American Nuclear Society, Nuclear Newswire, "AtkinsRéalis partners with First American Nuclear," May 14, 2026, ans.org , for AtkinsRéalis as "exclusive engineering, procurement, and construction management provider" and the EAGL-1's lead-bismuth coolant. Both accessed October 18, 2026.

12. [reporting] POWER Magazine, "DOE Allocates First Round of HALEU to Five U.S. Advanced Nuclear Reactor Developers," April 2025. powermag.com, archived September 18, 2026

13. [reporting] Heatmap News, "Data Centers Are Fueling a Tiny Nuclear Hype Cycle." heatmap.news, archived September 18, 2026 The article is by Katie Brigham, August 11, 2026. Source of Wamsted's and Schlissel's co-authorship of IEEFA's 2024 report, *Small Modular Reactors: Still too expensive, too slow and too risky*, of the Wamsted and Schlissel quotations, Bill Tilles on reverse economy of scale, and Jordan Bramble's counter-argument on capital pools.

14. [regulator] U.S. Nuclear Regulatory Commission, "NRC Approves Standard Design for NuScale US460 Small Modular Reactor," press release 25-033, May 29, 2025. nrc.gov, archived September 18, 2026 The release states that the approval "is based upon the staff's final safety evaluation report, issued May 28." A POWER Magazine article on the same approval has since been removed by the publisher; the regulator's own release is the better source in any case. A standard design approval is a staff-level approval and, unlike a design certification, does not carry the same finality; issues resolved in it can be revisited at subsequent licensing steps.

15. [reporting] Utility Dive, "NuScale, UAMPS terminate small modular reactor project in Idaho." utilitydive.com, archived September 18, 2026 Source of the November 8, 2023 termination date, which the article, dated November 9, reports as announced the previous Wednesday, the 462 MW and six-module configuration, and the $58 to $89 per MWh revision. A figure of $119 per MWh circulates in secondary discussion of this project and could not be traced to a primary source; it is not used here.

16. [advocacy] Clean Air Task Force, "Lessons learned from the recently cancelled NuScale-UAMPS project," November 2023. catf.us, archived September 18, 2026

17. [reporting] Axios, "Nuclear energy startup funding is heating up," July 28, 2026, citing PitchBook. axios.com, archived September 18, 2026 The figure is global, not US and Canada only.

18. [reporting] NucNet, "Bank of America Research Points To Nuclear Growth And Potential Of Small Modular Reactors," January 2026. nucnet.org, archived September 18, 2026 Partially paywalled. The 442 GW to 683 GW by 2040 projection and the 18 GW annual new build figure are in the accessible portion. A claim that Bank of America projects meaningful SMR construction only from 2035 appears in earlier project materials; it is not in the accessible portion of this source and is not used here.

Chapter 3: The 2028 Fuel Gap

In January 2026, the Department of Energy awarded $2.7 billion over ten years to restore American uranium enrichment.[1] In June, Urenco USA announced a 2.1 million separative work unit (SWU) expansion of its New Mexico plant.[2] Domestic enrichment capacity is funded, announced and on the calendar.

The calendar is the problem. The shortage is time, not uranium. Russia supplied 26 percent of the enrichment US operators bought in 2025,[3] and the waivers that allow those imports end no later than January 1, 2028.[4] Replacement capacity at scale arrives between 2029 and 2036. Every step in the fuel chain takes years to expand, money cannot shorten those lead times by much, and reactors can be ordered faster than the fuel behind them can be supplied.

Enrichment also breaks the pattern found elsewhere in this report: it is both the tightest step and the one getting federal money. The utilities that buy fuel dispute that there is a shortage at all, and their case gets its own section below.

Each step in the fuel chain is its own industry

Public conversation compresses the fuel chain into one word, uranium. In practice it is a sequence of separate industries, each with its own capital, geography and failure mode.

Mining and milling produce uranium concentrate, known as yellowcake and traded by the pound of U3O8. Conversion turns it into uranium hexafluoride (UF_6), a gas. Enrichment raises the share of U-235 in that gas. Fabrication then does two jobs: deconversion turns the enriched gas back into a solid, and fabrication proper makes that solid into fuel for a specific reactor.

Surplus at one step does nothing for a shortage at the next, so a bottleneck anywhere constrains the whole chain.

> **The shortage is time, not uranium.**

Mines have the ore but the longest lead times

American uranium production tripled in 2025, to 2.1 million pounds of U3O8, the most since 2017.[5] Exploration drilling rose from 1,324 holes to 1,824. Against consumption, that is small. US-origin material accounted for 7 percent of total deliveries to US reactors in 2025. The largest foreign sources were Canada at 32 percent, Kazakhstan at 28, Australia at 15, Uzbekistan at 7 and Namibia at 4, with the balance from other origins.[6] Two of the top five are close allies, and Russia is not among them.

By the industry's own assessment, there is enough ore. The World Nuclear Association's 2025 fuel report concluded that "sufficient uranium resources exist to meet the need for uranium in the Upper Scenario to 2040," with the qualification that investment and timely decisions are needed to bring it out of the ground.[7]

What ore in the ground cannot fix is lead time. New uranium mines typically require 10 to 20 years from discovery to full operation, and mines that came online between 2020 and 2024 averaged 17.8 years.[8] One analysis of mine permitting across all minerals puts current lead times at nearly 30 years, five times longer than in the 1990s.[9] ConverDyn's Malcolm Critchley describes the same shift from the industry side. The development window has moved from 8 to 15 years out to 10 to 20, and "the time to develop new mines is actually getting longer, not shorter."[10]

One case cuts against the trend and is routinely overstated. The Velvet-Wood uranium and vanadium mine in Utah was approved in May 2025 under emergency permitting procedures invoked against the declared national energy emergency. The Bureau of Land Management announced the expedited process on May 12 with "a completion timeline of 14 days"[11] and issued its decision on May 23, eleven days later.[12]

Those fourteen days covered the final federal environmental assessment, not the approval as a whole. Anfield Energy had filed its Plan of Operations the previous year, setting out operating controls, reclamation actions and a reclamation surety estimate with the technical bases behind them, work assembled over a longer period, and the site had been mined before.[11] The sequence still took years. The case shows that the final review can be shortened when the government decides it should be, and whether future cases show more remains open.

Conversion runs through one 1950s plant



Figure 3.1. US uranium conversion runs through one plant, switched off twice since it opened.

All uranium conversion in the United States happens at one plant. Metropolis Works, in Metropolis, Illinois, was built in the late 1950s, and its operator dates completion to 1958 (Chapter 1 note 27). It sat idle from November 2017 to July 2023, and three years after its restart it is still running well below its licensed capacity.

The price signal is the most direct evidence that the step is tight. One sell-side analysis puts the five-year increase in North American conversion and UF6 prices at 176 percent and 233 percent respectively, and the conversion service fee at $62.00 per kilogram of uranium in August 2026, against a spot uranium price of $86.90 per pound.[13] Treat those figures with caution: the primary benchmarks from UxC and TradeTech are subscription-only, the figures could not be corroborated independently, and the analyst publishing them has a financial stake in the outcome.

Conversion is a small part of fuel cost: the national laboratory's long-term price band for the service runs from $6.0 to $17.9 per kilogram in 2020 dollars, figures assumed to cover production costs.[14] A service whose expected price is single-digit to low-double-digit dollars per kilogram is selling for $62. That gap is scarcity rent, created by four things together. Years of low prices pushed plants like Metropolis offline. Only a handful of plants exist worldwide, so any disruption moves price disproportionately. Western utilities simultaneously chased a limited pool of non-Russian capacity. And new capacity takes years to build, so the market could not rebalance.[15]

The Idaho National Laboratory's 2021 cost basis report notes that no significant new conversion facilities had been built in 30 years, in the context of demand growth in Asia before Fukushima.[14] The one Western exception, Orano's Comurhex II, is covered below.

The plant runs well below what it is licensed to do. Licensed capacity is 15,000 metric tons of uranium a year.[16] Solstice Advanced Materials, which now operates it, projected more than 10,000 metric tons of uranium hexafluoride for 2026, which is about 6,800 metric tons of uranium on a common basis: roughly 45 percent of the license, and roughly 36 percent of the 19,000 metric tons the United States consumes a year. Solstice holds a customer backlog of more than $2 billion.[17]

New entrants are appearing. Uranium Energy Corp has received an NRC docket number for a 10,000 metric ton per year conversion facility, though it had not selected a site as of March 2026.[18] Raven-Flint Nuclear, covered in Chapter 1, says it is developing a process that converts without elemental fluorine, demonstrated so far at bench scale, with a pilot plant as its next step. The company has not disclosed how the process works, and the claim rests entirely on its own description of itself as relayed by trade reporting.[19]

Lead time is again what binds. Orano's Comurhex II conversion project, the most recent greenfield build in the West, launched in 2007 and was inaugurated in September 2018. That took eleven years and a combined investment of about EUR 1.15 billion across two facilities.[20] Metropolis, an existing plant, stood idle for nearly six years and three years after its restart is still not at full rate.

Critchley's framing is fair and more optimistic: conversion plants can be built faster than reactors, so "there's still time to react."[10]

Enrichment's replacement arrives after the Russian cutoff

Chapter 2 found that 12 of 24 US and Canadian developers designed around HALEU, and enrichment decides whether those designs get fuel.

Conventional enrichment comes first, because the supply risk there is larger and less discussed. The US power reactor fleet requires about 13 million separative work units per year.[16] Urenco USA, the only operating commercial LEU enrichment facility in the country, has a current capacity of 4.3 million SWU a year from 63 cascades, roughly a third of demand.[16], [21] An earlier figure of 4.8 million, which still circulates, is the capacity reached when the plant's third phase began operating in 2015; Urenco has since given 4.3 million. Its site license was amended in 2015 to allow up to 10 million SWU, so its announced expansions sit within the existing ceiling,[16], [22] which removes a regulatory step the other projects in this chapter still have to

complete. No company statement that the expansions need no further amendment was located, so that reading is this report's. Centrus also operates at Piketon, producing HALEU not yet used by commercial reactors.[16]

Most of the rest is imported, and the largest single source is Russia. In 2025, US operators purchased 12.7 million SWU at an average of $108.70 each. By origin, Russia supplied 26 percent, the United States 23 percent, France 18 percent, the United Kingdom 14 percent and the Netherlands 8 percent.[3] Foreign sources supplied 77 percent of the enrichment purchased by US operators, and the Russian share has risen from about 17 percent a decade ago.[23]

The Prohibiting Russian Uranium Imports Act banned imports of Russian-produced unirradiated low-enriched uranium, the form in which that enrichment reaches US operators, effective August 11, 2024, subject to waivers. Those waivers terminate no later than January 1, 2028,[4] about fifteen months from now. Against that, Urenco USA adds about 700,000 SWU per year by early 2027, while the Centrus and Orano expansions are not expected until 2029 and beyond.[23] That one addition is partly delivered. Urenco USA announced on October 8, 2026 that production had started in the sixth cascade of the expansion, that the six installed cascades can produce more than 500,000 SWU a year, and that the project was 75 percent complete and ahead of schedule. A seventh cascade is expected later in 2026 and the last in spring 2027.[24]

Those proportions can be stated, and the EIA publishes them directly rather than leaving them to be derived: Russian-origin supply was 3,284 thousand SWU of a 12,710 thousand SWU total in 2025, about 3.3 million SWU a year and 26 percent of all enrichment purchased.[3] The only addition that lands before the waivers expire is Urenco's 700,000, which is a little over a fifth of it, and part of that is already producing. That is the EIA's own table rather than this report's arithmetic.

The federal response is real money on a real timeline. DOE's $2.7 billion went in three $900 million task orders, to American Centrifuge Operating, a Centrus subsidiary, for HALEU, to General Matter for HALEU, and to Orano Federal Services for LEU expansion. A separate $28 million award went to Global Laser Enrichment; three times $900 million is the whole of the $2.7 billion, so the smaller award sits alongside it rather than inside it.[1] The Centrus award is framed around HALEU, but the same Piketon expansion also adds new LEU capacity for the existing fleet, with first new production expected in 2029, which makes Centrus part of the answer to Russian dependence as well.[25] Urenco USA's 2.1 million SWU expansion followed in June 2026.[2]

One of those three awards can be measured against the shortfall and one cannot. Orano publishes a figure: Project IKE is designed for an initial 4 million separative work units a year, under a license written for 7 million, with ramp-up to commercial production in 2031 or 2032 and operations planned from January 2032.[26] That initial figure alone exceeds the 3.3 million SWU a year the Russian share represents. It arrives three to four years after the waivers that permit that share expire, which is the whole of the problem: the capacity is sufficient and late rather than insufficient. Centrus publishes no separative work unit figure for the LEU portion of its Piketon expansion in the sources used here, so the largest HALEU award cannot be sized the same way.[25] That gap is in the disclosure rather than in the research, and it matters: a buyer cannot plan against capacity announced in dollars and years but not in units.

The smallest of those awards has since found a buyer. Global Laser Enrichment, owned 51 percent by Silex Systems and 49 percent by Cameco, agreed in September 2026 to sell Cameco all future production from its planned Paducah Laser Enrichment Facility, at "pricing for its products equivalent to Cameco's average realised price, net of appropriate selling costs".[27] The plant would re-enrich the more than 200,000 metric tons of depleted tails stored at the former gaseous diffusion site, under a long-term agreement with the Department of Energy signed in November 2016, which Silex says provides feedstock for up to 30 years, and GLE expects about 70,000 metric tons of new feed from them over the plant's life.[28] The World Nuclear Association's country profile puts the planned capacity at up to 6 million separative work units per year,[16] which would be larger than the only commercial enrichment plant now operating in the country. That figure should be treated as uncertain. The Association's own enrichment page estimates the Paducah plant at 0.5 to 1.0 million SWU a year and applies the 6 million figure instead to the superseded 2012 Wilmington license.[29] Silex adds a third figure: if the license is granted, GLE would be permitted to construct up to 8 million SWU at the site.[28] That is a license ceiling rather than a plant capacity, and neither GLE nor Silex publishes an expected operating capacity in separative work units for Paducah. GLE says it will serve low-enriched uranium, LEU+ at 5 to 10 percent U-235, and HALEU, though its license application covers enrichment only to 8 percent and no date for HALEU has been published.[30]

A second Paducah application followed in the same month. General Matter filed a Part 70 license application with the NRC on September 28, 2026 for a commercial enrichment plant at the same site, covering low-enriched uranium at 3.5 to 5 percent U-235 and LEU+ at 5 to 10 percent, with an amendment for HALEU intended during 2027. The company targets commercial production by the end of the decade and has asked for a review of roughly twelve months against the eighteen the NRC typically takes.[31] The site came from a Department of Energy lease signed in August 2025 covering 100 acres and a minimum of 7,600 cylinders of uranium hexafluoride already stored there, against a planned $1.5 billion facility and 140 full-time jobs.[32] Two applications are now pending at Paducah at once, on different technologies, for different products, both drawing on material the government already holds at the site.

None of that capacity is licensed. GLE completed its application in July 2025 and the NRC docketed it that August.[30] The company expects a license in early 2027, with a final investment decision and construction to follow.[27] A GLE vice president told an industry conference in August 2026 that significant construction would come in 2027 and that the company hoped to complete the facility by 2030. Trade reporting on the Cameco agreement gives the same 2030 date, subject to government support, favorable market and industry conditions, and a positive feasibility assessment and final investment decision.[33]

The published schedules for the new capacity run as follows.

Project	Announced	Added capacity	First production
Urenco USA, current expansion	in progress, 75 percent complete	700,000 SWU	early 2027, partly producing
Centrus, Piketon	January 2026	not published	2029
Orano, Project IKE	NRC application March 2026	4 million SWU, licensed for 7	2031 to 2032
Urenco USA, New Mexico	June 2026	2.1 million SWU	cascades from 2032, complete 2036

Project	Announced	Added capacity	First production
Global Laser Enrichment, Paducah	NRC application July 2025	up to 6 million SWU, disputed; license ceiling sought 8 million	from 2030
General Matter, Paducah	NRC application September 2026	not published	2030

First production comes three to six years after announcement, and Urenco's expansion is not complete until ten years out. On these schedules, the replacement capacity arrives after the Russian supply it replaces is gone, and nothing in the fuel chain can pull those dates forward. A new LEU cascade has a three to four year lead time, which the enrichers interviewed for the Nuclear Scaling Initiative's supply chain study framed as shorter than any new reactor build.[8]

The GLE project at Paducah is the closest thing in the chain to a counter-case, and it does not overturn the finding. Its feedstock already exists on US soil and sits outside the Russian question entirely, its buyer is committed before the plant is built, and its licensing is further along than that of any project announced since. Two things hold it back. The output date is 2030 at the earliest, two years after the waivers expire, which places it with the rest of the replacement capacity rather than ahead of it. And no laser enrichment plant has ever operated commercially anywhere in the world. GLE held an NRC license for a commercial plant at Wilmington from 2012, terminated in 2021 without the plant being built,[30] and the October 2025 milestone, which the company presents as making it the only operator of third-generation laser enrichment under plant-like conditions, was a technology demonstration independently assessed at readiness level six.[28] The largest enrichment capacity announced in the country rests on a process that has not yet enriched uranium at commercial scale. General Matter's application at the same site uses centrifuge enrichment rather than lasers, so it carries no equivalent first-of-a-kind process risk, but it has published no capacity figure and its 2030 target sits with the rest of the replacement capacity rather than ahead of it.

HALEU is tighter still. Centrus had produced more than 1,900 kilograms cumulatively by the time production under its demonstration contract completed in June 2026, against a 12 metric ton per year expansion whose first new capacity is expected in 2029.[34] A full cascade of 120 machines produces roughly 6,000 kilograms per year and can be brought online in about 42 months from funding, with an additional cascade every six months after that.[35] Funding does not change those figures. DOE has now run three allocation rounds, rationing material to named recipients.[36]

Advanced fuel fabrication has barely started

Conventional fabrication capacity is adequate. Westinghouse Columbia is at 1,600 metric tons per year, Framatome Richland at 1,200 and Global Nuclear Fuel in Wilmington at 1,000, for roughly 3,800 metric tons of heavy metal per year across the three.[16] The total is the sum of the three plant figures rather than a published national figure.

Advanced fuel is thinner. TRISO-X received the first-ever NRC Category II license to process HALEU in February 2026, for a facility whose first unit, TX-1, is planned at 5 metric tons of uranium per year, roughly 700,000 pebbles, enough for up to 11 Xe-100 reactors. It is budgeted at $768 million, with a five-year construction duration. On September 24, 2026 the company

reported vertical construction of the 214,000 square foot building complete, with interior build-out, fuel fabrication equipment installation and supporting facilities still ahead and no operations date stated.[37]

Standard Nuclear plans about 2 metric tons per year initially across facilities in Tennessee and Idaho, scaling to a stated 5 metric tons collectively.[38] A Standard Nuclear and Framatome joint venture at Richland targets a further 2 metric tons per year from 2027, pending regulatory approvals. This and the previous figure involve the same company and the same fuel technology.[39]

In total, US advanced-fuel fabrication capacity that is operating or near-term is under 10 metric tons per year, and none of the announced large-scale capacity is in commercial production yet. The one operating exception is small: Standard Nuclear's existing Oak Ridge facility, SN-0, can produce up to 0.5 metric tons of uranium as TRISO annually, and the source does not say whether that output is commercial.[38] X-energy's announced second unit, TX-2, housing two further lines with 20 metric tons a year between them, would take that site to 25 metric tons. It falls inside the license already issued for the facility but is still in design, not under construction.[37]

Deconversion is the step most coverage leaves out. Oklo and Centrus said in March 2026 that they had agreed to pursue discussions on a deconversion hub at Piketon, noting that a central hub "could eliminate the need for each fuel fabrication facility to establish its own deconversion line".[40] No investment figure or timeline was disclosed.

A price appeared in October 2026. NANO Nuclear signed a definitive agreement to buy Radnostix's deconversion and fluorine-extraction assets for $13.5 million, $9.5 million in cash and $4 million in stock, including an NRC Part 40 license for a facility in Lea County, New Mexico. The seller's release states that the facility contemplated under that license "was not previously constructed," so the price buys a license, patented technology, engineering and safety analyses, permitting material, equipment and project records, and not a plant. Closing remains subject to NRC consent to the license transfer, New Mexico approvals, satisfactory site arrangements and other conditions, and was expected in approximately 90 to 120 days.[41] Two qualifications matter. This is deconversion of depleted uranium hexafluoride with fluorine recovery, which is a different application from deconverting enriched product for fuel fabrication, the job the Piketon hub would do. And no source located states whose depleted uranium the facility would process.

A license for a plant nobody built was priced at $13.5 million, which is one measure of what the permission is worth on its own. The same pattern recurs throughout this report: an overlooked step between two closely watched ones.

Separate from building any plant, a new fuel type has to be qualified. That takes two to four years of irradiation plus 18 to 24 months of post-irradiation examination, which the same study puts at a baseline of roughly four to six years before definitive data exists, longer if a first attempt fails.[8]

The utilities buying fuel behave as if there is no shortage

The utilities that buy this fuel behave as though they do not believe the shortage thesis, and that behavior is the evidence. No utility quoted in this report argues the case directly, and the forecasts they negotiate against are questioned by the trade press and by the industry's own association as well.

US utility uranium inventories rose to 118.3 million pounds at the end of 2025, up 3 percent from 115.1 million a year earlier.[42] Against annual purchases of 46.9 million pounds that is roughly two and a half years of cover, or about 2.9 years measured against the 40.9 million pounds actually loaded into reactors in 2025, though half of it is already enriched or fabricated and therefore committed downstream. Purchases fell 16 percent in 2025, from 55.9 million pounds to 46.9 million.[5], [42]

Contracting volumes agree. Sprott's John Ciampaglia attributed weak uranium prices to "a lack of contracting by utilities and a lack of buying in the spot market," with roughly 82 million pounds contracted as of mid-December 2025, after a November spike from 48 million, against a theoretical replacement benchmark near 150 million.[43]

On enrichment specifically, World Nuclear News, summarizing the World Nuclear Association's 2025 fuel report, wrote that "when it comes to uranium enrichment, on a global scale supply exceeds demand through to at least the early 2030s," adding that the regional picture is more segmented for geopolitical reasons. The quoted wording is the trade publication's, not the report's. What the report itself says, as quoted in the same article, is that "given the modular nature of centrifuge technology and the construction times for nuclear power reactors, the expansion of enrichment capacity can take place in a timely way, and supply disruption should be avoided."[10] That recasts the enrichment problem as one of sourcing, which calls for different solutions than a shortage of volume.

The supply gap forecast is itself contested by the buyers. Energy Intelligence reported that the WNA's revised secondary supply figures "prompted bitter disagreement between producers looking to lock in higher long-term price commitments and the utilities on the other side of the negotiating table," and that the mid-2030s gap partly reflects a technical change in how secondary supplies are accounted for.[44]

Producers forecasting a shortage are the sellers, and utilities disputing it are the buyers. Neither party is disinterested.

Developers committed to scarce fuel face the gap

The inventory and contracting data establish that the existing US reactor fleet is not about to run short of fuel. That fleet burns standard LEU, holds two and a half years of cover, and has functioning supplier relationships. The data say nothing about fuel for developers that have not yet built a plant, which is this report's subject.

A developer that has not yet built a plant and has committed to a fuel type produced nowhere at commercial scale needs a supply contract to make its project financeable. Chapter 1 established that the binding constraint for these companies is a contract a lender will finance, and a fuel supply agreement is part of that package.

For that reason, the most consequential fuel development of 2026 is a contract. In September 2026, Centrus and Radiant signed a definitive multi-year HALEU contract including Radiant prepayments to Centrus to support its enrichment capacity program. Deliveries are due before the end of the decade; duration, volumes and pricing were not disclosed.[45]

That is a reactor developer financing its own fuel supplier. Chapter 7 shows the same structure on the customer side, where Meta prepays Oklo for power that does not exist yet. When a supply chain cannot respond on the timeline the buyers need, the buyers start funding it themselves.

The joint release also leans on national security. Centrus states that because its technology is US-origin, the enrichment it supplies to Radiant is "unobligated," meaning it can be used for national security applications. Radiant's chief nuclear officer, Dr. Rita Baranwal, said the agreement gives its reactor "a continued source of HALEU for commercial and national security applications and removes one of the biggest constraints facing advanced nuclear deployment."[45] That is Chapter 9's argument arriving inside a fuel contract. It is also a customer declaring, in a release issued jointly with its supplier, that the constraint this chapter documents has been removed, on the strength of an agreement whose deliveries begin later in the decade. Centrus's own statement in the release claims progress, not removal. That claim should be weighed against the evidence above.

The finding

The US fuel chain has enough uranium but not enough time, because almost all funded replacement capacity arrives after the Russian waivers expire in 2028.

Mining has the resources and rising production, but the longest lead times in the chain.

Conversion is tight, and the one available price analysis, though uncorroborated, agrees. ConverDyn's chief executive, who co-chaired the fuel report's working group, expects conversion can be fixed faster than reactors can be built.

Enrichment is where the gap is and where the federal money went; here the obvious constraint really is the binding one.

Advanced fuel fabrication has under 10 metric tons per year of operating and near-term capacity, nothing at scale in commercial production, and a fuel qualification clock of roughly four to six years on top of the plant build.

Underneath all four steps sits the same fact. Apart from Urenco's 700,000 SWU addition in 2027, a little over a fifth of the roughly 3.3 million SWU of Russian supply at risk, every remedy currently funded arrives between 2029 and 2036. The Russian waiver expiry is 2028, and the deployment targets in Chapter 11's calendar cluster in 2027 and 2028.

Sources

Notes are numbered per chapter. Each carries a source-interest tag: `[regulator]` for government and agency documents, `[reporting]` for independent journalism and trade

press, `[company]` for a subject describing itself, `[analyst]` for banks, consultancies and law firms that earn fees in the sector, and `[advocacy]` for organizations with a declared stake in the outcome. Most notes carry an Internet Archive capture, most of them made September 18, 2026, so a reader can check what a page said on or near the date it was read. Notes for sources added in the days before the freeze date largely do not; the back matter states what is outstanding.

1. [regulator] U.S. Department of Energy, "U.S. Department of Energy awards $2.7 billion to restore American uranium enrichment," January 5, 2026. energy.gov, archived September 18, 2026

2. [company] Urenco, "Urenco USA plans significant expansion of US uranium enrichment capacity," June 2, 2026. urenco.com, archived September 18, 2026

3. [regulator] U.S. Energy Information Administration, *2025 Uranium Marketing Annual Report*, Table 16. eia.gov, archived September 18, 2026

4. [regulator] U.S. Nuclear Regulatory Commission, "Backgrounder on the Uranium Import Ban," dated October 31, 2024. nrc.gov, archived September 18, 2026 Statute: Prohibiting Russian Uranium Imports Act, Public Law 118-62, May 13, 2024.

5. [regulator] U.S. Energy Information Administration, "Today in Energy," August 28, 2026. eia.gov, archived September 18, 2026

6. [regulator] U.S. Energy Information Administration, *2025 Uranium Marketing Annual Report*. eia.gov, archived September 18, 2026

7. [advocacy] World Nuclear Association, press statement on the *World Nuclear Fuel Report 2025*, September 5, 2025. world-nuclear.org, archived September 18, 2026 An industry association is an interested party on the question of whether more investment is needed; the finding is used here because it cuts against the association's own advocacy interest.

8. [analyst] Solestiss for the Nuclear Scaling Initiative, *Landscape of U.S. Domestic Advanced Nuclear Energy Supply Chain*, March 2026. nuclearscaling.org, archived September 18, 2026

9. [analyst] S&P Global Market Intelligence, "Mine permitting delays: discovery to production timeline," July 8, 2026. spglobal.com, archived September 18, 2026 Figure covers all mineral categories, not uranium specifically.

10. [reporting] World Nuclear News, "Fuel cycle players respond to supply gaps," September 5, 2025. world-nuclear-news.org, archived September 18, 2026 Quoting Malcolm Critchley of ConverDyn, an interested party in conversion capacity.

11. [regulator] Bureau of Land Management, "Interior expedites permitting for critical energy project to address national energy emergency," May 12, 2025. blm.gov, archived September 18, 2026 The release states "a completion timeline of 14 days" for the accelerated environmental review; the decision followed on May 23, eleven days later. Corroborated on the prior Plan of Operations and the previously mined status of the site by Anfield Energy Inc., "U.S. Department of the Interior Announces Expedited Permitting for Anfield's Velvet-Wood Mine," May 13, 2025, anfieldenergy.com, archived September 18, 2026 [company]. Anfield is the project owner and benefits from a favorable permitting narrative; the Plan of Operations filing date and the brownfield status are matters of record rather than characterization, and are used here only as such.

12. [regulator] U.S. Department of the Interior, "Interior Department approves Utah uranium-vanadium mine," May 23, 2025. doi.gov, archived September 18, 2026

13. [analyst] Ocean Wall, "The Conversion Gap No One Is Building For," August 17, 2026. thehoot731.substack.com, archived September 18, 2026 Sell-side analyst commentary. Primary conversion price benchmarks from UxC and TradeTech are subscription-only, so this figure could not be independently confirmed against a primary benchmark and should be read as indicative.

14. [regulator] Idaho National Laboratory, *Advanced Fuel Cycle Cost Basis Report, Module B: Conversion*, INL/EXT-21-61659 Rev. 1, February 2021. sai.inl.gov, archived September 18, 2026

15. [analyst] Yellowcake Analytics, "Uranium conversion and the UF6 market," updated July 11, 2026. yellowcakeanalytics.com, archived September 18, 2026

16. [advocacy] World Nuclear Association, *US Nuclear Fuel Cycle*, updated August 19, 2026. world-nuclear.org, archived September 18, 2026 The licensed figure moved over time: original nameplate up to 15,000 metric tons of uranium a year, cut to 7,000 in 2017, then upgraded and relicensed to 15,000 on the July 2023 restart, with the plant reported at 50 to 70 percent of capacity after it. The 6,800 metric ton figure is calculated here, applying the standard mass fraction of uranium in uranium hexafluoride, about 0.676, to Solstice's projection of more than 10,000 metric tons of UF6; Solstice does not publish the conversion, and the projection is itself about 20 percent above the 2024 plan. Chapter 1 carries McKinsey's assessment that the facility can meet about 50 percent of US demand at current and projected operating capacity; that is a judgment about capacity rather than a single year's projected output, and this report does not reconcile the two bases. US annual demand of about 19,000 metric tons is from this note's source. So are the Urenco USA cascade count of 63 and the license history: Urenco applied in May 2014 to raise the plant's licensed capacity to 10 million SWU a year, and the NRC approved it in March 2015.

17. [reporting] World Nuclear News, "Solstice plans expansion of US conversion facility," February 11, 2026. world-nuclear-news.org, archived September 18, 2026 Both this source and note 16 give the same sequence: 15,000 tU nameplate, reduced to 7,000 tU in 2017, relicensed to 15,000 tU on the 2023 restart.

18. [reporting] World Nuclear News, "UEC expands output at Wyoming mine, initiates licensing of conversion facility," March 23, 2026. world-nuclear-news.org, archived September 18, 2026

19. [reporting] American Nuclear Society, Nuclear Newswire, "Raven-Flint U conversion plans land on NRC docket, in Launch Pad," September 4, 2026. ans.org The fluorine-free process is the company's own description of itself, relayed here through trade reporting. Raven-Flint's own site did not respond when this note was last checked, so no company page is cited and no direct verification against one is claimed. The company has not published the mechanism; see Chapter 1 note 30. No independent source describes the process.

20. [reporting] World Nuclear News, "Orano launches new conversion facility," September 11, 2018. world-nuclear-news.org, archived September 18, 2026 Investment figure from Orano's own Comurhex II description; the EUR 1.15 billion covers both the Malvesi and Tricastin facilities.

21. [reporting] American Nuclear Society, Nuclear Newswire, "Urenco to add 2.1 million SWU of enrichment capacity at its New Mexico plant," June 2, 2026. ans.org, archived September 18, 2026

22. [regulator] U.S. Nuclear Regulatory Commission, "Urenco USA," facility page. nrc.gov Source of the license number, SNM-2010, on NRC docket 70-3103, expiring June 9, 2040. The 2015 amendment raising the ceiling to 10 million SWU is from note 16. An earlier draft attributed to Urenco a statement that the site "is already licensed for up to 10 million SWU of capacity" and that the announced expansions need no amendment; neither Urenco release cited in this chapter carries that statement and no other company source for it was located, so the no-amendment reading is presented in the text as this report's own.

23. [reporting] Energy Connects, "Kremlin still key for US atomic power despite looming import ban," July 30, 2026. energyconnects.com, archived September 18, 2026

24. [company] Urenco, "Urenco USA completes 75% of current US uranium enrichment capacity project," October 8, 2026. urenco.com Source of the start of production in the sixth cascade and of the 75 percent completion figure. The release publishes no separative work unit figure for the capacity now in production, no revised completion date and no NRC licensing detail, so the 700,000 SWU total in the table above remains the June 2026 company figure at note 2 rather than a measured output.

25. [reporting] POWER Magazine, "Centrus Signs $900M DOE Contract, Pivots Sole U.S. HALEU Cascade to Commercial Operation," July 2, 2026. powermag.com, archived July 15, 2026; Centrus Energy, "Centrus Launches Commercial LEU Enrichment Activities," December 19, 2025. [company] centrusenergy.com, archived August 10, 2026. Accessed September 21, 2026. POWER describes the initial buildout as 12 metric tons of annual HALEU capacity "along with new LEU capacity earmarked to work down a commercial LEU backlog," with first new capacity expected by 2029. Centrus gives the same 2029 date for its first new production capacity. Neither source states the LEU capacity in separative work units, so this report cannot say how much of the Russian share it would replace.

26. [company] Orano, "Project IKE enrichment," company page. orano.group Source of the initial 4 million SWU capacity, the 7 million SWU license capacity, the September 2027 construction start, the ramp to initial commercial production in 2031 or 2032 and operations planned from January 2032, and the 150 developed acres of a 624-acre site in Roane County. Two qualifications. The figures are the applicant's own and no independent confirmation was located. And the enrichment level agrees across sources: Orano's page describes a current license design for LEU+ up to 10 percent U-235, and the Federal Register notice of intent to prepare an environmental impact statement for the application, "Orano Enrichment USA LLC; Uranium Enrichment Facility," 91 FR 35584, June 11, 2026, Docket No. 70-7038, [regulator] govinfo.gov Accessed October 18, 2026, gives a maximum of 10 weight percent U-235. The 8 weight percent maximum with re-enrichment of depleted tails belongs to the GLE Paducah application at note 30, not to Project IKE.

27. [reporting] World Nuclear News, "Cameco in offtake agreement for US laser enrichment plant," September 16, 2026. world-nuclear-news.org, archived September 17, 2026 Source of the quoted pricing language, the ownership split, the tails and new-feed tonnages, the product slate and the early 2027 license expectation. Cameco is both a 49 percent owner of GLE and the sole buyer under the agreement, so the pricing is set between related parties. The comparison with the only operating US commercial enrichment plant is this report's, against the Urenco USA figures earlier in this chapter.

28. [company] Silex Systems Limited, "Global Laser Enrichment," company page. silex.com.au, archive lookup Source of the HALEU capability statement, of the acquisition of "over 200,000 metric tonnes of depleted tails owned by the DOE," and of the October 2025 technology readiness level six milestone. Source also of the statement that, if the license is granted, GLE "will be permitted to construct up to 8 million Separative Work Units (SWU) at the PLEF," and that the November 2016 agreement "provides the feedstock for the production of natural grade UF6 for up to 30 years." The November 2016 date of the tails agreement with the Department of Energy is from Global Laser Enrichment, "Business," gle-us.com, archive lookup [company], which states no term. An earlier draft gave the agreement a forty-year term, which no source located supports. The 70,000 metric ton new-feed figure is from note 27. Silex also states an expected production rate equivalent to a uranium mine producing up to 5 million pounds of uranium oxide a year, which is a different basis from the separative work figure in note 16 and is not reconciled here. The tails inventory was reported as roughly 300,000 tonnes when the Department of Energy agreement was announced in November 2016 and as more than 200,000 tonnes in company material from 2025 onward; no public source located reconciles the two. Lifetime output is likewise given as about 70,000 metric tons of new feed in note 27 and about 100,000 tonnes of natural-grade uranium over 30 years or more in note 16.

29. [advocacy] World Nuclear Association, "Uranium Enrichment," which estimates the planned Paducah Laser Enrichment Facility at "0.5 to 1.0 million SWU/yr" and attributes a 6 million SWU/yr figure to the full license to construct and operate issued for Wilmington in September 2012. world-nuclear.org This contradicts the up-to-6-million figure on the Association's own United States country profile at note 16 by a factor of six to twelve. The discrepancy is unresolved here. One plausible mechanism is that the Wilmington licensed capacity has been carried across to the Paducah project, since the two figures are identical. Silex's page at note 28 gives an 8 million SWU license ceiling for the site, which is a permitted maximum rather than a planned operating capacity; no company source publishes the latter, so neither Association figure can be checked against the applicant.

30. [regulator] Federal Register, "Global Laser Enrichment, LLC; Paducah Laser Enrichment Facility; Notice of Receipt of Application for License," March 6, 2026. federalregister.gov, archive lookup The application covers enrichment of natural uranium hexafluoride to a maximum of 8 weight percent U-235 and re-enrichment of depleted tails; the notice does not mention HALEU. Docketing date August 4, 2025. The completion of the application in July 2025 is reported by American Nuclear Society, Nuclear Newswire, "GLE completes Paducah Laser Enrichment Facility license application," July 3, 2025, ans.org, archive lookup [reporting]. The earlier Wilmington license, SNM-2019, issued September 25, 2012 and terminated January 5, 2021, is recorded at U.S. Nuclear Regulatory Commission, "Global Laser Enrichment," nrc.gov, archive lookup.

31. [company] General Matter, "Filed," company post, September 28, 2026. generalmatter.substack.com Source of the filing date, the product range and the statement that "Next year, we intend to submit an amendment to produce High-Assay Low-Enriched Uranium (HALEU)." Corroborated by World Nuclear News, "General Matter submits licence application for enrichment plant," September 29, 2026, [reporting] world-nuclear-news.org , which gives the three product bands as LEU at 3.5 to 5 percent, LEU+ at 5

to 10 percent and HALEU at 10 to 20 percent, and the target of commercial enrichment by the end of the decade. The twelve-month request against an eighteen-month typical review is reported by Nuclear Engineering International, "General Matter seeks enrichment licence," October 2, 2026, [reporting] neimagazine.com, archived October 12, 2026 . No Federal Register notice of receipt had been published when this was written, and no capacity figure in separative work units has been published by the company or appears in the reporting read.

32. [reporting] World Nuclear News, "General Matter submits licence application for enrichment plant," September 29, 2026, for the 100-acre parcel, the minimum of 7,600 cylinders of uranium hexafluoride and the August 2025 lease date. world-nuclear-news.org The $1.5 billion facility cost and the 140 full-time jobs come from the Commonwealth of Kentucky, Office of the Governor, "Gov. Beshear Joins General Matter To Celebrate Milestone for $1.5 Billion Uranium Enrichment Facility in Paducah, Set To Create 140 Full-Time Jobs," August 5, 2025. kentucky.gov The Internet Archive capture of this page does not resolve and is therefore not cited; the live page does. Those two figures are a state economic development announcement rather than a company filing. The sources read do not state the enrichment assay of the leased cylinders, which matters because GLE's business at the same site is re-enrichment of depleted tails; the material is described only as uranium hexafluoride already stored at the plant.

33. [reporting] American Nuclear Society, Nuclear Newswire, "Panelists talk domestic enrichment expansion at Global 2026," August 21, 2026. ans.org, archive lookup Source of the statement by GLE's Nima Ashkeboussi on 2027 construction and a 2030 completion target. The 2030 date and its conditions are repeated in American Nuclear Society, Nuclear Newswire, "Cameco becomes selling agent for all Global Laser Enrichment output," September 22, 2026, ans.org

34. [advocacy] World Nuclear Association, *Uranium Enrichment*, updated September 4, 2026. world-nuclear.org, archived September 18, 2026

35. [reporting] POWER Magazine, "Centrus completes 900-kg HALEU delivery to DOE," June 25, 2025. powermag.com, archived September 18, 2026

36. [reporting] American Nuclear Society, Nuclear Newswire, "NASA and Radiant selected to receive HALEU," July 27, 2026. ans.org, archived September 18, 2026 Allocation quantities are not disclosed by DOE.

37. [reporting] POWER Magazine, "TRISO-X secures first-ever NRC Category II license for commercial advanced nuclear fuel fabrication," February 13, 2026. powermag.com, archived September 18, 2026 Construction status from X-energy, "TRISO-X advances to next phase of construction," August 24, 2026, [company] globenewswire.com, archived September 18, 2026 Vertical construction completion, the 214,000 square foot figure and the remaining scope are from X-energy, "TRISO-X Completes Vertical Construction of TX-1 Fuel Fabrication Facility," September 24, 2026, [company] x-energy.com, archive lookup, which restates the capacity as approximately 700,000 pebbles a year, 5 metric tons of uranium, enough for up to 11 Xe-100 reactors, and states no date for operations.

38. [reporting] American Nuclear Society, Nuclear Newswire, "Standard Nuclear plans TRISO production at two new facilities in 2026," July 24, 2026. ans.org, archived September 18, 2026

39. [reporting] Tri-Cities Area Journal of Business, "Framatome expansion, advanced fuel," October 12, 2025. tricitiesbusinessnews.com, archived September 18, 2026

40. [company] Centrus Energy Corp., "Oklo, Centrus announce planned joint venture to advance nuclear fuel services in Ohio," March 9, 2026. centrusenergy.com, archived September 18, 2026 Described by both parties as planned; no definitive agreement, investment figure or timeline is disclosed.

41. [company] Radnostix, Inc., "Radnostix Signs Definitive Agreement to Divest DUF6 and Fluorine Assets to NANO Nuclear," October 1, 2026, PR Newswire. prnewswire.com Source of the $13.5 million price and its split, the 10 CFR Part 40 license and the asset list, the Lea County location, the quoted statement that the facility "was not previously constructed," and the closing conditions of NRC consent to the license transfer plus New Mexico approvals, expected in approximately 90 to 120 days. Radnostix is the seller and takes part of the price in buyer stock, so it has an interest in the transaction being read favorably; the price, the asset list and the unbuilt status are terms of the agreement rather than characterization. No throughput figure is stated. The agreement had not closed as of this writing. Corroborated by Interesting Engineering, October 1, 2026, [reporting] interestingengineering.com, archive lookup.

42. [regulator] U.S. Energy Information Administration, *2025 Uranium Marketing Annual Report*, Tables 18 and 22. eia.gov, archived September 18, 2026 Table 22 gives the inventories. The 40.9 million pounds loaded into reactors in 2025 is from the report's text on Table 18, and the 16 percent decline in purchases is the report's own: "The 2025 total of 46.9 million pounds U3O8e was 16% lower than the 2024 total of 55.9 million pounds U3O8e." The 2.9 years of cover is this report's arithmetic.

43. [analyst] Sprott Asset Management, "Uranium Outlook 2026," December 19, 2025. sprottetfs.com, archived September 18, 2026 Sprott manages uranium funds and benefits from higher uranium prices. The under-contracting observation is not an admission against interest: in the same piece it is the premise of a bullish thesis, with Ciampaglia anticipating a catch-up trade in 2026 as deferred utility contracting returns. The contracting volumes are used here as data, not as testimony.

44. [analyst] Energy Intelligence, "World Nuclear Association projects uranium supply gap in controversial forecast," September 5, 2025. energyintel.com, archived September 18, 2026

45. [company] Centrus Energy Corp. and Radiant Industries, "Centrus and Radiant announce long-term partnership for domestic HALEU," September 9, 2026. prnewswire.com, archived September 18, 2026 Corroborated by World Nuclear News, world-nuclear-news.org, archived September 18, 2026 [reporting]. Contract duration, volumes and pricing are not disclosed by either party.

Chapter 4: Fast Lanes Lead to Demonstrations

By late August 2026, four of the companies selected for the second round of DOE's Launch Pad had already reached zero-power fueled criticality: Antares on June 4, Valar on June 18, Deployable Energy on June 30 and Oklo in August.[1] Aalo, which reached criticality on July 4, is not among them. None of that work yet counts toward a commercial NRC license. The DOE reactors are classified as non-commercial test reactors, and the mechanism that would let fast-lane work count toward NRC commercial licensing is still a proposed rule as of October 18, 2026. And pathway may not be the binding constraint at all: of the 11 commercial projects in Third Way's April 2026 survey, seven had secured offtake and only two had NRC construction permits. What the fast lanes buy today is a demonstration.

Five regulatory lanes are open to an advanced reactor developer in the United States and Canada. Four are presented as faster than NRC standard licensing. Three actually are; on the evidence below, Canada is not. None of the four, on its own, gives a company the right to sell power.

Five lanes, and only one sells power

The five are standard NRC licensing, the DOE Reactor Pilot Program, the DOE Nuclear Energy Launch Pad, the Army's Janus agreements under Other Transaction Authority, and Canada's Vendor Design Review at the CNSC. Only NRC licensing ends in permission to sell power commercially, and the Canadian lane issues no license at all.

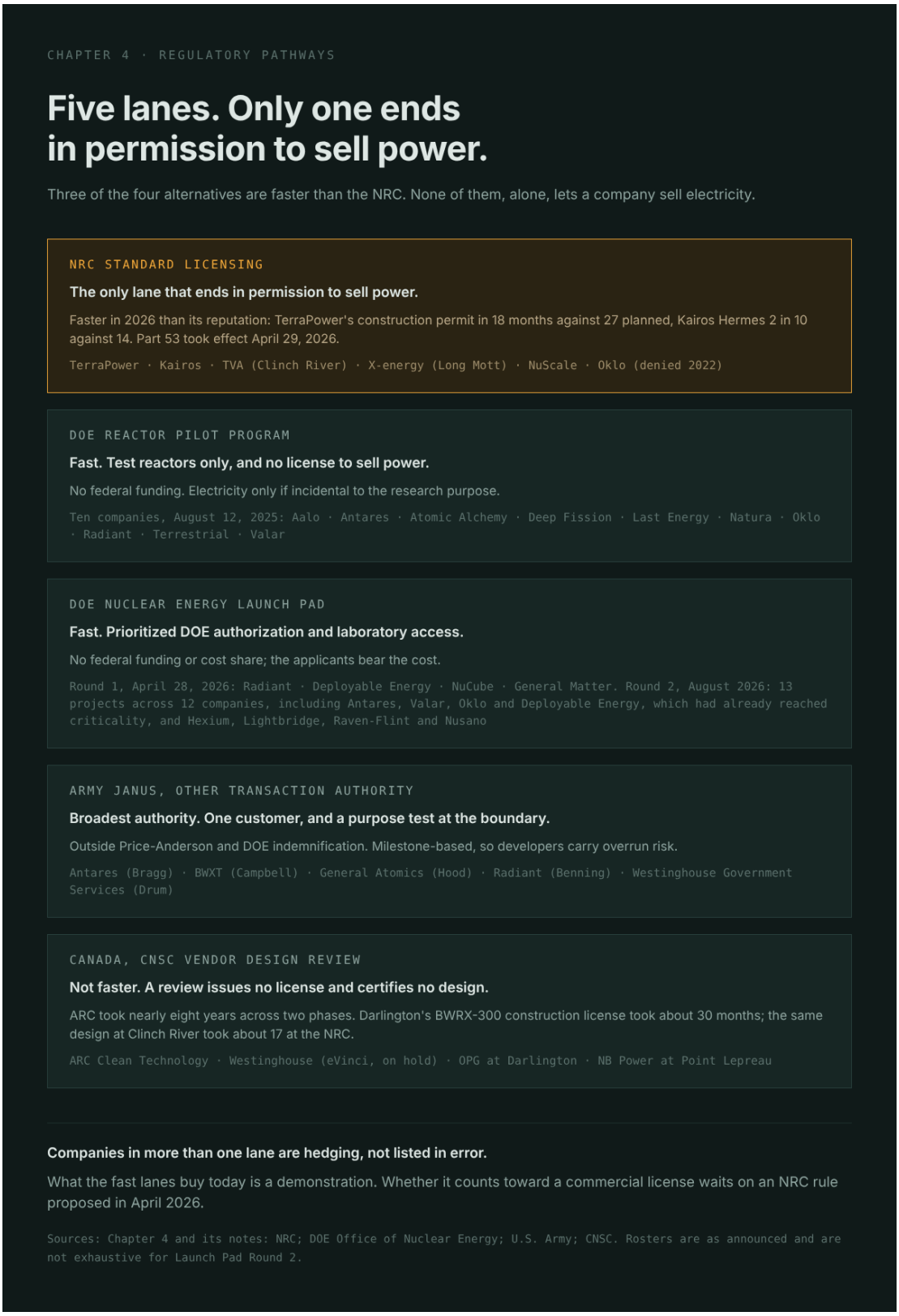


Figure 4.1. Five regulatory lanes. Only NRC standard licensing ends in permission to sell power.

NRC standard licensing

The only US lane that ends in permission to sell power commercially. Construction permits, operating licenses, combined licenses, design certifications.

It changed materially in 2026. The NRC's Part 53 rule, a risk-informed, performance-based, technology-inclusive framework, took effect on April 29, 2026.[2] It is the first new licensing framework since Part 52 in 1989 and the first major standards update since Part 50 in 1956, and the NRC beat the statutory deadline Congress had set for end of 2027.[3]

Jeremy Bowen, the NRC's acting deputy office director for new reactors, is reported as expecting design approval under Part 53 in 18 months or less, with application cost reduced by half or more. Both are reported characterizations of his position, not quoted speech.[3] Part 53 also helps capital-constrained developers: an applicant without fully committed financing at the application stage can rely on a license condition requiring a later financial demonstration, which loosens existing financial-qualification standards.[4]

Financial qualifications are being contested in a live proceeding. Long Mott Energy, a Dow subsidiary, applied in March 2025 to build four Xe-100 reactors at Dow's Seadrift site in Texas. On January 22, 2026 an Atomic Safety and Licensing Board granted intervention to the San Antonio Bay Estuarine Waterkeeper and admitted one contention in part, that the application "relies upon but does not meet the 10 C.F.R § 50.12(a)(2)(ii), (vi) requirements for an exemption to the financial qualifications requirements in 10 C.F.R. § 50.33(f)". Contentions on functional containment and on environmental impacts were rejected.[5] Whether that contention has since been resolved could not be established from the public record. The mandatory hearing was held on September 22, 2026 and written comments were accepted to October 6; no permit had issued as of this writing.[6]

The point for this chapter is narrow. An admitted challenge to an advanced reactor application that turns on money rather than on reactor physics is Chapter 7's argument arriving inside a licensing docket.

Fees are discounted, though not falling. The ADVANCE Act mandated a reduced hourly rate for advanced reactor applicants: $154 per hour in FY2026 against a professional rate of $337, more than 50 percent off. Both rates rose from FY2025, when they were $148 and $318.[7] Pre-applicant eligibility for that rate sunsets September 30, 2030.[8]

Reviews have shortened as well (see Chapter 1). TerraPower's Kemmerer construction permit was reviewed in 18 months against 27 planned, nine months ahead of schedule and 11 percent under the resource estimate. Kairos Hermes 2 took 10 months against 14 planned, 43 percent under resource estimate.[9]

The tradeoff in this lane used to be time. Now it is mostly the cost and rigor of assembling an application good enough to file, and Chapter 1's AP300 finding suggests that problem is commercial before it is technical.

DOE Reactor Pilot Program

Authorizes test reactors outside the national laboratories under DOE's own authority, bypassing NRC licensing entirely. The legal basis is Section 5 of Executive Order 14301 and 42

U.S.C. § 2140.[10] Under its own standard, DOE is to complete each safety-basis review within 45 days of accepting the submission: the nuclear safety design agreement, the preliminary documented safety analysis and the final documented safety analysis, each at its own stage gate, with a readiness review before fuel is loaded.[11]

Two things about the program are routinely misstated. First, DOE provides no project funding. The department's own selection announcement is explicit: "Each company will be responsible for all costs associated with designing, manufacturing, constructing, operating, and decommissioning their test reactors."[12] DOE supplies the authorization, not money. It says authorization will help the selected companies raise private funding and will provide what it calls "a fast-tracked approach to future commercial licensing activities."[12] The second half of that claim is the one tested here.

Second, the reactors are classified as non-commercial test reactors for research. The Energy Reorganization Act reserves NRC jurisdiction over reactors operated as utilities or used to demonstrate commercial suitability, and electricity generation may occur only if incidental to the underlying programmatic purpose.[13] DOE may not use the authority to demonstrate commercial suitability or to operate a reactor as part of a commercial power enterprise.[14] Radiant's Rita Baranwal summed up the limit for NPR: "The only thing we will not be doing at [Idaho National Laboratory] this summer is generating electricity."[15]

The selections were announced on August 12, 2025: eleven projects across ten companies, namely Aalo Atomics, Antares Nuclear, Atomic Alchemy, Deep Fission, Last Energy, Natura Resources, Oklo, Radiant Industries, Terrestrial Energy and Valar Atomics.[16]

DOE Nuclear Energy Launch Pad

Run by the National Reactor Innovation Center at Idaho National Laboratory. Round 1, announced April 28, 2026, covered four projects: Radiant Industries, Deployable Energy, NuCube Energy in partnership with Idaho State University, and the enrichment company General Matter, all four drawn from the applicant pools of the Reactor Pilot Program and the Fuel Line Pilot Program.[17] Round 2, announced in late August 2026, added 13 projects across 12 companies, eight of them newcomers. It also expanded the fuel-cycle participation that Round 1 began with General Matter, since Hexium, Lightbridge, Raven-Flint and Nusano are fuel and isotope companies.[1]

The program provides a prioritized pathway to DOE authorization, access to national laboratory expertise and facilities, and regulatory support. It provides no federal funding or cost sharing: "The applicants bear the cost of the project. So DOE is not providing funding, cost share, or any other form for these projects."[1]

Round 2's composition is the most telling fact about Launch Pad. Four of the companies selected had already reached zero-power fueled criticality and applied anyway: three Reactor Pilot participants and Round 1's Deployable Energy.[1] They still needed the support.

DoD Other Transaction Authority, the Janus Program

On August 26, 2026 the Army announced agreements worth up to a combined $2.2 billion for vendors to own, construct and operate nuclear microreactors: Antares at Fort Bragg, BWXT at

Fort Campbell, General Atomics at Fort Hood, Radiant at Fort Benning, Westinghouse Government Services at Fort Drum.[18] Radiant's share is up to $750 million; the Army declined to disclose the other four.[19] The program spans FY2027 to 2031, targets more than 20 microreactors, and drives toward the September 30, 2028 deadline in Executive Order 14299 for a first operational reactor regulated by the Army.[20], [21]

The legal basis differs from DOE's and is broader. Section 91 of the Atomic Energy Act lets the President authorize the Department of Defense to operate utilization facilities for military purposes, and Section 110(b) exempts those facilities from NRC licensing.[21] The department is not subject to the limits on commercial demonstration that bind DOE.[22]

The boundary still exists, and it is a purpose test rather than a technology test. Where civilian power sales are incidental to a military mission such as base islanding, the Department of Defense may regulate the facility. Where "commercial or utility service predominates, NRC licensing applies." As one analysis of the program puts it, "Jurisdictional boundaries are determined less by reactor design than by purpose."[21]

One feature of this lane does not appear in the press coverage. Janus sits outside both DOE's standard nuclear indemnification regime and the NRC's Price-Anderson framework, so developers "will not automatically receive coverage under existing statutory schemes." Lawyers analyzing the program expect indemnification to be central to the negotiations, and note that the Army may reach existing frameworks through Public Law 85-804 authority or an interagency agreement with DOE, which makes indemnification an open negotiating point, not a settled gap.[21] A second feature, the contracting structure, is better covered: the press describes the OTAs as fixed-price and milestone-based,[20] and under them developers bear cost-overrun risk.[21]

Canada, the CNSC

Canada's Vendor Design Review is an optional, cost-recovered, pre-licensing service. The CNSC is unusually direct about its limits: a VDR "does not involve the issuance of a licence and does not certify a reactor design," and its conclusions "do not bind or otherwise influence future decisions made by the Commission."[23]

ARC Clean Technology is the worked example. Phase 1 began September 2017 and finished October 2019. Phase 2 ran March 2022 to July 2025. The review took nearly eight years from Phase 1 start to Phase 2 completion, roughly five and a half of them in active review. It concluded that "no fundamental barriers to licensing were identified at this time," with eight areas requiring additional work.[24] NB Power's site preparation license application for Point Lepreau went to the CNSC on June 30, 2023 and was still awaiting additional submissions as of this writing.[25] The CNSC record shows no construction license application, though it does not state affirmatively that none has been filed.

For comparison, Ontario Power Generation's Darlington BWRX-300 construction license took about 30 months, application in October 2022[26] to license in April 2025, and the license runs to 2035.[27]

The same design has now been permitted on the other side of the border. TVA filed its Clinch River application in two parts, on April 28 and May 20, 2025, the NRC docketed it on July 9,

2025, and the construction permit issued on September 28, 2026. Measured the way Darlington is measured, from application to authorization, that is about seventeen months against Darlington's thirty, about fifteen of them after docketing.[28] Same reactor, two regulators, and the comparison no longer has to be assembled from unlike designs.

Set against the 18-month review of TerraPower's construction permit, the NRC now looks materially faster at authorizing construction than it did before the ADVANCE Act, and faster than the CNSC on both comparisons available. That comparison is assembled here from two dockets; neither regulator publishes it.

What the fast lanes buy today is a demonstration.

Leading companies run several lanes at once

The companies furthest along are in several lanes at once.

Company	Regulatory processes running at once
Oklo	DOE Reactor Pilot, DOE fuel line pilot, NRC pre-application, Launch Pad Round 2, and an NRC materials license held by its Oklo Isotopes subsidiary, formerly Atomic Alchemy[1]
Radiant	DOE Reactor Pilot, NRC pre-application, NRC Part 70 license application for its factory's fueling building (under review),[29] Janus OTA, Launch Pad Round 1
Antares	DOE Reactor Pilot, NRC pre-application, Janus OTA, Launch Pad Round 2
Aalo	DOE Reactor Pilot, NRC pre-application
Valar	DOE Reactor Pilot, DOE fuel line pilot,[30] Launch Pad Round 2
Deployable Energy	Launch Pad Rounds 1 and 2, NRC pre-application
Westinghouse	Janus OTA, NRC pre-application for the AP300

Eight of the ten Reactor Pilot companies also appear on the NRC's pre-application list.[31] Westinghouse's eVinci work is not counted: the NRC lists its eVinci pre-application as inactive,[31] and the CNSC lists its Canadian design review as on hold.[32]

Of the ten Reactor Pilot companies selected in August 2025, four later took Launch Pad slots, namely Radiant in Round 1 and Antares, Oklo and Valar in Round 2,[1] and two of those, Radiant and Antares, also won Janus OTAs.[18]

Stacking is the rational response when no single lane delivers a complete outcome. The DOE lane produces a demonstration. The DoD lane produces revenue from one customer. The NRC lane produces the right to sell to everyone else. A company that wants all three has to run all three, at an unbudgeted cost in management attention and engineering capacity that Chapter 5 examines as a draw on a thin pool of specialist staff.

Oklo's 2022 denial was about readiness

Oklo submitted a combined license application for the Aurora at Idaho National Laboratory in March 2020, docket 52-049. The NRC denied it on January 6, 2022.

The denial is usually described imprecisely. It was "for failure to supply information." The NRC found that Oklo had "repeatedly failed to provide substantive information" in response to staff requests. Four foundational aspects of the Aurora licensing basis had been flagged in 2020: the maximum credible accident, the safety classification of structures, systems and components, the scope of the quality assurance program, and the applicability of regulations. The fourth was closed by November 2020. Of the rest, the two that drove the denial were the maximum credible accident analysis and the safety classification of structures, systems and components.[33]

The NRC stated that it was "denying the application without prejudice, and Oklo is free to resubmit its application supplemented by additional information that was previously requested."[34]

Oklo then moved into NRC pre-application engagement under a new docket, completing a pre-application readiness assessment and submitting topical reports including one on principal design criteria. The design is now described as a liquid metal-cooled, metal-fueled fast reactor at a maximum power level of 75 MWe.[35] It also entered the DOE Reactor Pilot Program, breaking ground at INL in September 2025.[36]

Oklo's regulatory page does not mention the denial. It says instead that the company "made history by submitting the first custom combined license application for an advanced fission technology to the NRC," which is true of the 2020 application, docketed and then denied. The NRC's corresponding page shows pre-application activities only and lists no current Oklo combined license application.[35]

The 2022 lesson is narrower than "the fast lane isn't free," which is how it usually gets cited. In 2020 Oklo was in the standard lane, first, with a design nobody had licensed before, and the application was not ready. The lesson concerns application readiness, the AP300 finding of Chapter 1 seen from the other side: Oklo could not produce an adequate application, and Westinghouse chose not to.

More projects have customers than permits

The strongest argument against pathway choice being decisive comes with numbers. Third Way surveyed 22 active US projects in April 2026. Of those, 11 were intended as commercial. Seven of the 11 had secured offtake. Only two had NRC construction permits.[37]

More projects have a customer than have a construction permit. If regulatory pathway were the binding constraint, that ratio would run the other way.

Two qualifications belong with that count. Third Way's "secured offtake" is wider than this report's test. It requires a legally binding agreement, so a memorandum of understanding or letter of intent does not count, but it counts a power purchase agreement for any share of a project's output and also counts agreements to buy reactor units,[37] while this report asks specifically whether a hyperscaler has signed a binding long-term power purchase agreement for a new-build advanced reactor. Seven projects clearing the first bar and none clearing the second are consistent facts, not competing ones. And a ratio of stocks does not identify a critical path: more contracts than permits can mean permitting is the slower step rather than the looser one, which is the opposite reading of the same two numbers. The count below is evidence that pathway choice is not the only constraint, not evidence that it binds nothing.

Third Way's framing is that the projects closest to commercial deployment have generally done three things: "Secured commercial offtake," blended federal and private money "into project-specific financing pathways, allowing the signing of engineering, procurement, and construction (EPC) contracts," and "Engaged early, often, and collaboratively with the NRC."[37] Third Way counts regulatory *engagement* as one of three markers, which is a different claim from regulatory *pathway choice* being decisive.

Josh Freed of Third Way called both the July 4 deadline and the achievement of criticality "arbitrary," and said that criticality on that date "would just be more noise." He allowed that the program "has accelerated some test project timelines" while arguing that it "does not offer a clear pathway to grid connection". He also described it as "a diversion from adding meaningful new nuclear capacity."[38] The Breakthrough Institute's assessment is more balanced: "Success here won't deliver to the grid, but it can provide what the industry needs most: technical validation, regulatory insight, and investor confidence." Its position on NRC re-review is a requirement for how the pilots should work. The NRC "must re-review DOE artifacts, question them, and use them to inform commercial licensing," because "if the NRC is able to accept DOE's work wholesale to license a commercial plant, it is an indicator that the pilot was not used properly to prototype and test non-commercial systems."[39]

The safety critique runs alongside it. Edwin Lyman of the Union of Concerned Scientists, on DOE's rewrite of its reactor safety and security directives, called it "a massive experiment in the deregulation of novel, untested nuclear facilities," conducted "in the shadows, keeping the public in the dark."[40] He called the criticality race "essentially an exercise in public relations," and said of the accompanying cuts to regulation, "This is taking us back to the 1950s, and that is not progress."[15]

Lyman's organization has a long-standing position on nuclear regulation that predates this program, and his characterization is not endorsed here. The quotes matter because Chapter 8 argues that public standing is a commercial asset in this sector, and a regulator perceived as bypassed is a liability that can surface later and unpredictably.

Credit for fast-lane work is only proposed

The mechanism that would let DOE or Department of Defense authorization work count toward NRC commercial licensing is a proposed rule published April 2, 2026, with comments closed May 4. As of October 18, 2026 no final rule had issued.[41]

The credit it proposes is conditional. The NRC "would not need to repeat technical reviews previously performed by DOE or DOW, to the extent that those reviews cover the same scope as the related content in the NRC license application." Applicants must still identify how the authorization's attributes satisfy NRC regulations and address design changes. The rule contains no waiver of NRC licensing for commercial operation.[41]

The acceleration the fast lanes deliver is therefore legally undetermined. Every company in the DOE or Janus lane is betting on an unfinalized rule whose credit covers only overlapping review scope, with the NRC judging how much of the work transfers.

The American Nuclear Society's expert advisory group on the May 2025 executive orders flagged the risk directly. Developers "must not be placed in a position where they are pressured to pursue DOE or DOD authorization only to later find NRC licensing for their commercial facilities is also required."[42]

Developers are now asking Congress for the same thing. On September 2, 2026 the House Science Committee's Energy Subcommittee took testimony on advanced reactors from five witnesses, three of them chief executives of companies inside Chapter 2's twenty-four: Valar Atomics, Aalo Atomics and Antares Nuclear.[43] Aalo's Matt Loszak put three requests to the subcommittee. Make the Reactor Pilot Program a durable pathway carried through full-power testing, endurance, burnup and refueling. Ensure demonstration data generated under DOE oversight can be credited in NRC licensing. Continue rebuilding the domestic fuel cycle.[44]

The first two are this section's finding restated as a request. A company that has already reached criticality in the DOE lane is telling Congress that the lane stops short of what a commercial plant needs, and that the credit for the work done in it is not yet defined. The third belongs to Chapter 3.

The queue in one week

The clearest picture of how much of this sector's activity is regulatory rather than commercial comes from a single week. Between October 5 and October 9, 2026 the Federal Register carried the notice of issuance of TVA's Clinch River construction permit, notices of receipt for two separate phased construction permit applications each requesting a limited work authorization, Blue Energy's at Port of Victoria and Holtec's for Pioneer Units 1 and 2 at Palisades, and a draft environmental impact statement for Fermi America's four-unit AP1000 combined license at Carson County, Texas, on which the NRC staff's preliminary recommendation is to issue the license.[45] In the same week Terrestrial Energy submitted a topical report asking the NRC to confirm that building the non-nuclear half of its plant is not nuclear construction, which would let that half be built before any construction permit issues.[46]

Four licensing notices and a topical report in five days, only two of them newly received applications, and not one of them carries a named power purchaser. One entry, TVA's, is a

utility building for its own system, where a separate purchaser would not be expected; the pattern holds without it. The Fermi America draft environmental impact statement is the furthest advanced of them and is the first produced under the NRC's applicant-prepared pilot, in which the applicant drafts the statement under staff supervision. Chapter 7 reads the same fact from the buyer's side and finds nothing signed. Both readings describe one condition: permission is being pursued faster than demand is being contracted.

The finding

The regulatory pathway is a real strategic choice. The fast lanes lead to demonstrations, and no final rule yet defines how much a demonstration counts toward a commercial license.

The fast lanes do not buy time to revenue. They buy time to demonstration: evidence for investors and a defense customer, and a data package for a later NRC application whose value is still undefined.

The slow lane is no longer as slow as its reputation. Its tradeoff has shifted from schedule to application readiness, which is a commercial and staffing problem more than a regulatory one.

Third Way counts seven projects with customers and two with permits, which suggests pathway choice may not be the binding constraint at all.

Sources

Notes are numbered per chapter. Each carries a source-interest tag: `[regulator]` for government and agency documents, `[reporting]` for independent journalism and trade press, `[company]` for a subject describing itself, `[analyst]` for banks, consultancies and law firms that earn fees in the sector, and `[advocacy]` for organizations with a declared stake in the outcome. Every note in this chapter carries an Internet Archive capture of its principal source, so a reader can check what a page said on or near the date it was read. Thirty-five of the 46 were made September 18, 2026; the others date from January to October 2026, and some are recorded as a date only rather than a full capture timestamp. Sources added to a note on October 18, 2026 carry no capture.

1. [reporting] American Nuclear Society, Nuclear Newswire, "Second round of Launch Pad selections includes eight newcomers," August 25, 2026. ans.org, archived September 18, 2026 Corroborated by POWER Magazine, powermag.com, archived September 18, 2026 Round 2 is 13 projects across 12 companies; some secondary outlets report 12 projects. The ANS report gives no date for Deployable Energy or Aalo. The June 30 date for Deployable Energy is from U.S. Department of Energy, "U.S. Department of Energy Meets President Trump's Goal, Delivers Third Advanced Reactor Criticality," July 1, 2026, [regulator] energy.gov The release says Unity "achieved criticality late yesterday." Aalo's July 4 date is from American Nuclear Society, Nuclear Newswire, "Aalo Atomics achieves criticality on July 4," July 6, 2026, [reporting] ans.org The ANS report of August 25 is also the source of the renaming of Oklo's isotope subsidiary, which it calls "Oklo Isotopes, formerly Atomic Alchemy"; that subsidiary's NRC materials license is from American Nuclear Society, Nuclear Newswire, "Oklo provides updates on DOE, NRC approvals," March 19, 2026, [reporting] ans.org That report says Atomic Alchemy "has received a materials license from the NRC".

2. [regulator] Federal Register, "Risk-Informed, Technology-Inclusive Regulatory Framework for Advanced Reactors," 91 FR 15696, March 30, 2026, effective April 29, 2026. federalregister.gov, archived September 18, 2026 Note: ANS reported a Federal Register publication date of April 3, 2026; the Federal Register's own date of record is March 30. The effective date of April 29 is agreed across sources.

3. [reporting] American Nuclear Society, Nuclear Newswire, "NRC unveils Part 53 final rule," March 26, 2026. ans.org, archived September 18, 2026

4. [analyst] Morgan Lewis, "NRC launches fresh licensing framework for new reactors," April 10, 2026. morganlewis.com, archived September 18, 2026 Law firm client alert; used for the characterization of the financing flexibility, which is also visible in the rule text.

5. [regulator] U.S. Nuclear Regulatory Commission, Atomic Safety and Licensing Board, Memorandum and Order ruling on the intervention petition, Long Mott Generating Station, Docket 50-614-CP, ASLBP 25-991-01-CP-BD01, January 22, 2026, ADAMS ML26022A317. nrc.gov, archive lookup Source of the quoted wording of admitted Contention 3A, of the grant of intervention to San Antonio Bay Estuarine Waterkeeper, and of the rejection of the contentions on functional containment and on environmental impacts. A further contention was addressed in a separate nonpublic decision.

6. [regulator] U.S. Nuclear Regulatory Commission, "Long Mott Generating Station" application page and hearing advisory. nrc.gov, archive lookup Application filed March 31, 2025 and docketed May 12, 2025; environmental assessment and finding of no significant impact May 18, 2026; final safety evaluation targeted November 2026, with the hearing and permit decision listed as undetermined. The mandatory hearing date of September 22, 2026 and the October 6 close of written comments are from the agency's hearing advisory of September 14, 2026, nrc.gov This report could not establish from the public record whether Contention 3A has been resolved, and notes that the Federal Register notice of hearing of August 20, 2026 presents the proceeding at the mandatory stage. The four-unit configuration and the Dow ownership are from Dow, "Dow and X-energy submit construction permit application to the U.S. NRC," March 31, 2025, [company] <corporate.dow.com

7. [reporting] American Nuclear Society, Nuclear Newswire, "NRC news: FY 2026 fees finalized, facility licensing reviews launched," June 25, 2026. ans.org, archived September 18, 2026 The NRC's proposed rule gave $336 per hour for the professional rate and the final rule is reported at $337; the advanced reactor rate is $154 in both. The same report says "the new professional hourly rate is $19 higher than the previous year." The FY2025 pair of $148 and $318 is from note 8.

8. [regulator] U.S. Nuclear Regulatory Commission, "Advanced Reactor Fees." nrc.gov, archived September 18, 2026 The FY2025 reduced rate was $148 per hour, against a full-cost professional rate of $318, per the page as read again October 18, 2026; FY2026 is $154. Cite the year with the figure.

9. [regulator] U.S. Nuclear Regulatory Commission, "Licensing Efficiencies," ADVANCE Act implementation. nrc.gov, archived September 18, 2026 Agency reporting on its own performance; the underlying completions are independently reported in Chapter 1 notes 9 and 10.

10. [reporting] POWER Magazine, "DOE pilot program targets three nuclear test reactors for 2026 criticality under department authorization," June 25, 2025. powermag.com, archived September 18, 2026

11. [advocacy] Nuclear Innovation Alliance, "Review: recent DOE updates to its reactor authorization process," December 1, 2025. nuclearinnovationalliance.org, archived September 18, 2026 Source of the 45-day standard, which the review states as "DOE reviews of the NSDA, PDSA, and DSA are to be completed within 45 days of acceptance," and of the four phases of DOE-STD-1271-2025: agreement, preliminary design, final design and startup.

12. [regulator] U.S. Department of Energy, Reactor Pilot Program initial selections, August 12, 2025. energy.gov, archived September 18, 2026 DOE lists 11 projects; some reporting describes ten companies, since one company holds multiple projects.

13. [analyst] Orrick, Amy Roma, Cameron Hughes and Stephanie Fishman, "Beyond the NRC: Deploying Nuclear Reactors under DOE and DOW Oversight Authority," March 26, 2026. orrick.com, archived September 18, 2026

14. [analyst] Hogan Lovells, "How federal agencies are exercising reactor authority without the NRC," October 16, 2025. hlc.com, archived September 18, 2026

15. [reporting] NPR, "New nuclear reactors in America," June 29, 2026. npr.org, archived September 18, 2026 Source of both the Radiant statement and the Lyman quotations in the counter-case section.

16. [regulator] U.S. Department of Energy, "Department of Energy Announces Initial Selections for New Reactor Pilot Program," August 12, 2025. energy.gov, archived September 18, 2026 The release names ten companies and states DOE "will work with industry on these 11 projects."

17. [reporting] American Nuclear Society, Nuclear Newswire, "DOE selects first companies for nuclear launch pad," April 28, 2026. ans.org, archived September 18, 2026 Corroborated by POWER Magazine, powermag.com, archived September 18, 2026 [reporting].

18. [regulator] U.S. Army, "Army reaches agreement with private industry for nuclear micro-reactors," August 26, 2026. army.mil, archived September 18, 2026

19. [reporting] Federal News Network, "Army awards $2.2B in contracts for nuclear microreactors," August 26, 2026. federalnewsnetwork.com, archived September 18, 2026 Only Radiant's award amount is public; any per-vendor split of the remainder is unverified.

20. [reporting] POWER Magazine, "U.S. Army mobilizes $2.2B Janus Program to deploy more than 20 commercial microreactors," August 26, 2026. powermag.com, archived September 18, 2026 The figure of more than 20 reactors is a program aspiration across FY2027 to 2031; the August 2026 announcement names five initial sites.

21. [analyst] Orrick, "Beyond the NRC: Deploying Nuclear Reactors under DOE and DOW Oversight Authority," March 26, 2026. orrick.com, archived September 18, 2026 Source of the Executive Order 14299 number for the September 30, 2028 deadline, which POWER (note 20) attributes only to executive orders issued in May 2025, and of the AEA Section 91 and 110(b) basis, the mission-predominance test, the indemnification gap and the cost-overrun allocation.

22. [analyst] Hogan Lovells, "How federal agencies are exercising reactor authority without the NRC," October 16, 2025. hlc.com, archived September 18, 2026

23. [regulator] Canadian Nuclear Safety Commission, "Pre-licensing Vendor Design Review." cnsc-ccsn.gc.ca, archived September 18, 2026

24. [regulator] Canadian Nuclear Safety Commission, ARC Nuclear Canada Phase 2 executive summary, July 8, 2025. cnsc-ccsn.gc.ca, archived September 18, 2026 Corroborated by World Nuclear News, world-nuclear-news.org, archived September 18, 2026

25. [regulator] Canadian Nuclear Safety Commission, NB Power ARC-100 project page. cnsc-ccsn.gc.ca, archived September 18, 2026 CNSC gives the site preparation application date as June 30, 2023; some reporting says July 2023.

26. [regulator] Canadian Nuclear Safety Commission, Darlington New Nuclear Project page. cnsc-ccsn.gc.ca, archived September 18, 2026 "October 31, 2022: OPG submits an application to the CNSC for a licence to construct a reactor facility for the Darlington New Nuclear Project, along with supporting documentation." The CNSC moved the page; the path above is the current one.

27. [regulator] Government of Canada, "Commission authorizes Ontario Power Generation Inc. to construct 1 BWRX-300 reactor," April 2025. canada.ca, archived September 18, 2026 The CNSC and NRC duration comparison in the text is this report's own assembly from two dockets; neither regulator publishes it.

28. [regulator] U.S. Nuclear Regulatory Commission, "Clinch River Nuclear Site Application," milestone schedule. nrc.gov, archive lookup Source of the milestone dates: environmental report submitted April 28, 2025, preliminary safety analysis report May 20, 2025, schedule letter July 25, 2025, final safety evaluation report June 25, 2026, mandatory hearing August 13, 2026, and a construction permit decision targeted for fall 2026, with the safety review itself carrying a November 2026 date. Reading the June date against the November date as five months early is this report's comparison, not the agency's. The single unit, Docket 50-615, the nominal 300 MWe and 870 MWt ratings and the GE Vernova Hitachi design are from Federal Register, "Tennessee Valley Authority; Clinch River Nuclear Site, Unit 1; Notice of Hearing," July 7, 2026, federalregister.gov, archive lookup. The hearing was uncontested; no intervention petitions were filed. The application dates of April 28 and May 20, 2025 and the docketing date are from Federal Register, "Tennessee Valley Authority; Clinch River Nuclear Site, Unit 1; Construction Permit Application," 90 FR 31709, July 15, 2025, [regulator] govinfo.gov That notice states that "The application was docketed on July 9, 2025." An earlier draft gave August 4, 2025, which no cited source supports. Issuance on September 28, 2026 is sourced at Chapter 1 note 12. The seventeen-month figure is this report's arithmetic from the first application submittal to the issuance date, the same basis as the Darlington figure at notes 26 and 27, which runs from application on October 31, 2022 to license in April 2025, about twenty-nine months. Docketing to issuance at Clinch River is about fourteen and a half months; the CNSC record cited here gives no equivalent acceptance date for Darlington, so no docketing-basis comparison is made. Neither regulator publishes the comparison.

29. [regulator] U.S. Nuclear Regulatory Commission, "NRC Launches Accelerated Review of Radiant's Application for Special Nuclear Material License," press release 26-051, May 5, 2026. nrc.gov, archived May 21, 2026 The application, submitted February 25, 2026, covers the Fueling Building at the R-50 facility in Oak Ridge. An NRC meeting notice for July 22, 2026 describes it as an application under 10 CFR Part 70 "to possess special nuclear material and assemble fuel monoliths within the Fueling Building of its microreactor factory."

30. [regulator] U.S. Department of Energy, "Energy Department Selects Four Companies for Advanced Nuclear Fuel Line Pilot Projects," September 30, 2025. energy.gov, archive lookup Valar was selected "to support TRISO fuel fabrication for the Ward250 reactor deployment." No later status update was found.

31. [regulator] U.S. Nuclear Regulatory Commission, "Pre-Application Activities for Advanced Reactors." nrc.gov, archived April 30, 2026 As read on that date, the list includes eight of the ten Reactor Pilot companies: Aalo Atomics (docket 99902128), Antares Nuclear (99902149), Deep Fission, Last Energy, Natura Resources, Oklo, Radiant (Kaleidos, 99902106) and Terrestrial Energy. Atomic Alchemy and Valar Atomics are not listed. Deployable Energy appears under docket 99902155. Read again October 18, 2026, the live page (last reviewed October 2, 2026) still lists the same eight Reactor Pilot companies and Deployable Energy as active, lists the Westinghouse AP300 as active, and lists "Westinghouse eVinci" under Inactive Projects. The page deems a project inactive if no project activity occurs for one year. The archived copy predates that reading.

32. [regulator] Canadian Nuclear Safety Commission, "Pre-licensing vendor design review." cnsc-ccsn.gc.ca (page moved from the earlier /eng/reactors/power-plants/ path, still listing the eVinci review as "On hold" when read on October 19, 2026; archived at the earlier path: web.archive.org) Accessed September 21, 2026. The live page lists the Westinghouse eVinci review, Phase 2 from June 2023, as "On hold." The archived copy predates that reading and may not show the status.

33. [regulator] U.S. Nuclear Regulatory Commission, denial letter, "Oklo Inc.: Denial of the Aurora Combined Operating License Application for Failure to Supply Information," January 6, 2022. nrcpublicblog.files.wordpress.com, archived September 18, 2026

34. [regulator] Federal Register, "Oklo Power LLC; Oklo Aurora Combined License Application; Idaho National Laboratory," January 11, 2022. federalregister.gov, archived September 18, 2026

35. [company] Oklo Inc., regulatory page. oklo.com, archived September 18, 2026 Compare U.S. Nuclear Regulatory Commission, Oklo Aurora Powerhouse pre-application activities, docket 99902095, [regulator] nrc.gov, archived September 18, 2026 which shows pre-application activities and no submitted COL. The conflict is unresolved and no current Oklo COL is asserted in this report. The live regulatory page, read again October 18, 2026, carries the "made history" sentence and does not mention the denial. An earlier draft also attributed to the page a statement that Oklo remains the only advanced reactor company to have submitted a combined license application and the first to have one accepted for review; that statement is not on the live page and is not carried here.

36. [reporting] World Nuclear News, "Licensing of Oklo pilot reactor facilities advances," March 18, 2026. world-nuclear-news.org, archived September 18, 2026

37. [advocacy] Third Way, Josh Freed, Rowen Price, Alan Ahn and Matthew Parker, "Getting More for Your Money: The State of Play for US Nuclear in 2026," April 30, 2026. thirdway.org, archived September 18, 2026 Third Way advocates for clean energy deployment and is not a disinterested party on nuclear program design.

38. [reporting] American Nuclear Society, Nuclear Newswire, Josh Freed, "Fostering a nuclear landscape to power America's next 250 years," July 2, 2026. ans.org, archived September 18, 2026 The title is as the page carried it when read again October 18, 2026; the URL slug preserves an earlier headline, "Over before it's begun." Opinion piece, carried as argument rather than finding.

39. [advocacy] Adam Stein and Spencer Toohill, Breakthrough Institute, "Making DOE's Nuclear Reactor Pilot Program Work," October 2, 2025. thebreakthrough.org, archived September 18, 2026

40. [advocacy] Union of Concerned Scientists, statement by Dr. Edwin Lyman, director of nuclear power safety, January 28, 2026. ucs.org, archived September 18, 2026 Full wording: "This is a massive experiment in the deregulation of novel, untested nuclear facilities that could pose grave threats to public health and safety," and the Energy Department "has also done so in the shadows, keeping the public in the dark." Advocacy organization with a long-standing position on nuclear regulation; carried as argument, not finding.

41. [regulator] Federal Register, "NRC Reviews of Reactor Designs Previously Authorized by U.S. Department of Energy or Department of War," proposed rule, April 2, 2026, comments closed May 4, 2026. federalregister.gov, archived September 18, 2026 No final rule located as of this writing.

42. [reporting] American Nuclear Society Expert Advisory Group, review of the executive orders of May 23, 2025, quoted in POWER Magazine, “DOE pilot program targets three nuclear test reactors for 2026 criticality under department authorization,” June 25, 2025. powermag.com, archived September 18, 2026

43. [regulator] U.S. House Committee on Science, Space, and Technology, Subcommittee on Energy, hearing, “Powering the Nuclear Renaissance: Accelerating U.S. Leadership in Advanced Nuclear Reactors,” September 2, 2026. science.house.gov, archived September 17, 2026 Source of the hearing title, date and witness list. The five witnesses were Joe Hoagland of Oak Ridge National Laboratory, Isaiah Taylor of Valar Atomics, Matt Loszak of Aalo Atomics, Steven Shannon of North Carolina State University and Jordan Bramble of Antares Nuclear. The count of three companies inside Chapter 2’s twenty-four is this report’s, made against its own scope list.

44. [company] Matt Loszak, Chief Executive Officer, Aalo Atomics, written testimony before the Subcommittee on Energy, U.S. House Committee on Science, Space, and Technology, September 2, 2026. docs.house.gov The three requests are paraphrased in the order they appear in the statement. Testimony is a company describing itself and advocating for policy that would benefit it, which is why it carries the company tag; it is used here as evidence of what the company is asking for, not as evidence that the policy is correct.

45. [regulator] Federal Register, week of October 5 to 9, 2026. Clinch River construction permit and record of decision, October 5, 2026, 91 FR 63311, Docket No. 50-615, federalregister.gov ; Blue Energy, October 8, 2026, 91 FR 64409, Docket No. 99902137, federalregister.gov, archived October 16, 2026 ; SMR, LLC and Palisades SMR, LLC, Pioneer Units 1 and 2, October 8, 2026, 91 FR 64409, Docket Nos. 50-616 and 50-617, federalregister.gov, archived October 16, 2026 ; Fermi America, Project Matador AP1000 Units 1 to 4, draft environmental impact statement, October 9, 2026, 91 FR 64702, Docket Nos. 052-00051 to 052-00054, federalregister.gov, archived October 16, 2026 . Accessed October 11, 2026. The Clinch River permit itself issued September 28, 2026 and the Pioneer Part 1 application was accepted for docketing February 27, 2026, so for those two the October date is the notice and not the action; the Pioneer notice is the second of four consecutive weekly notices required by 10 CFR 50.43(a)(3). That the Fermi America statement is the first under the applicant-prepared pilot is not stated in the Federal Register notice. It is from World Nuclear News, “NRC seeks public comments on Project Matador environmental review,” March 25, 2026, [reporting] world-nuclear-news.org which says “Fermi America is the first private company to participate in this pilot.” The pilot’s method is also described in American Nuclear Society, Nuclear Newswire, “Project Matador joins EIS pilot program; NRC seeks public input,” March 24, 2026, [reporting] ans.org The Fermi America comment period closes November 23, 2026 and the staff’s recommendation is contingent on completion of the safety review.

46. [reporting] World Nuclear News, “Latest Terrestrial Energy topical report submission could lead to faster deployment,” October 9, 2026. world-nuclear-news.org, archived October 16, 2026 Source of the Thermal and Electric Facility topical report, of the request that the NRC confirm the facility is not nuclear construction, and of the statement that this is the third of “at least” three topical reports the company aims to submit during 2026. Neither the company nor the reporting states the filing date or the docket. A topical report is not a license application and approval would be referenceable rather than site-specific.

Chapter 5: The Missing Welders

In 2022, US universities awarded 211 nuclear engineering doctorates, the highest count in a survey series that began in 1966.[1] In July 2025, the Department of Energy's Energy Workforce Advisory Board concluded that achieving the administration's goal of quadrupling nuclear capacity over 25 years will require tripling the workforce.[2] That is the engineer story, and it is real.

It is also the wrong place to look for the constraint. Even the degree data is less encouraging than the doctoral record suggests, since bachelor's degrees fell 25 percent between 2012 and 2022.[3] The shortage most likely to stop a plant from being built is nuclear-qualified welders, machinists and inspectors, the trades that, on the most detailed assessment available, increasingly govern throughput, and it constrains every company in this report at the same time.

Doctorates are rising as bachelor's degrees fall

The Oak Ridge Institute for Science and Education surveys US university nuclear engineering programs for the Department of Energy, with doctorate data back to 1966 and enrollment data since 1971. Its most recent survey covers 35 programs, of which 31 returned degree data. The 2020 academic year was not surveyed, which is why no 2020 row appears below.

Year	Bachelor's	Master's	Doctorate	Total
2018	623	260	195	1,078
2019	622	316	194	1,132
2021	444	228	176	848
2022	454	275	**211**	940

Bachelor's degrees fell 25 percent between 2012 and 2022.[3] The drop from 623 in 2018 to 454 in 2022 is 27 percent in four years. Undergraduate enrollment was already down 13 percent from 2016 as of the 2018 survey.[4]

Doctorates in 2022 reached 211, the series record.[1] Two ORISE publications disagree: the February 2024 data brief gives 211 and 176 doctorates for 2022 and 2021, and 275 and 228 master's, where the earlier news release gives 208 and 174, and 267 and 223. The bachelor's figures agree across both. The tables here use the data brief, because it states that it updates the earlier figures with additional data from two programs, which makes it the controlling edition rather than a competing one. The news release figures are recorded here so the difference is visible. The two editions also disagree on graduate enrollment, where the news release gives about 1,590 students and the data brief about 1,625, and the same precedence applies.[5]

Enrollment points the other way. Doctoral degrees are at a record, but graduate *enrollment* is not. The 2022 survey puts it at about 1,625 students, four percent below 2019 and eight percent below 2018. Undergraduate enrollment is about 1,470, down 24 percent from 2016.[5], [1]

The total count hides both trends. Overall degrees in 2021 and 2022 were at their lowest in more than a decade,[1] against 1,132 in 2019.[6] The decline is concentrated in the undergraduate cohort. One qualifier applies: in the most recent year all three levels rose, with bachelor's up slightly and master's and doctorates each up 20 percent from 2021.[1] The decade trend is the finding, and one year of increases is not yet evidence of a reversal.

The longer record puts that decline in proportion. ORISE's fifty-year assessment of the survey shows three distinct eras, with the post-2001 peaks for master's and doctorates taken from later editions of the same survey.[7], [6], [5]

	Bachelor's	Master's	Doctorate
1970s peak	about 865 (1978)	over 550 (1977)	over 180 (1970)
Low point	120 (2001)	130 (2002)	about 65 (2002)
Post-2001 peak	655 (2013)	363 (2015)	211 (2022)
2022	454	275	211

Bachelor's degrees fell by roughly 86 percent between 1978 and 2001, then grew more than fivefold by 2013.[7], [8] The 2022 figure is nearly a third below that 2013 peak and nearly four times the 2001 low. Doctorates fell less, recovered further, and in 2022 set the series record, so the doctorate series has no intermediate peak to have fallen back from. The recent undergraduate decline is therefore a pullback within a long cycle, and the split between levels is the newer fact. Three cautions apply to the long series. Several figures before 2004 are given as rounded values in ORISE's own text, the survey covered 66 programs in 1966 and about 35 today, and the 2020 academic year was not surveyed.

The pipeline is inverting. An industry that needs people to staff a licensing submission, sit a control room, and sign a calculation package is producing proportionally more researchers and fewer entry-level engineers.

There is a benign explanation too. Doctoral enrollment responds to research funding, and research funding for advanced reactors has been abundant. Undergraduate enrollment responds to perceived job prospects, and for most of the 2012 to 2022 window the perceived prospects in American nuclear were terrible, for the reasons Chapter 1 described. If so, the undergraduate figures lag job prospects that have since improved. Either reading has the same weakness. The data is old.

The binding constraint, on the best available evidence, is not engineers. It is the trades: nuclear-qualified welders, machinists and inspectors.

The latest degree data is four years old

The most recent public ORISE data is from 2022.[3] Claims that enrollment is surging with the nuclear renaissance cannot be checked against it, because the renaissance began in earnest after this data was collected.

The next ORISE survey is the single most useful forthcoming datapoint on the workforce question, and Chapter 11 carries it as a watch item. The gap reflects a general problem: the sector is making twenty-year capital commitments against a labor supply it measures every few years and last measured four years ago.

The operating workforce is missing its under-30s

The nuclear sector employed 68,008 workers in 2023, 86 percent of them in power generation, with utilities accounting for 41,000.[9] Sixty percent of those workers are aged 30 to 54, and 23 percent are under 30 against 29 percent across the rest of the energy workforce, a six-point gap.[3]

The missing younger cohort adds to the familiar problem of an aging workforce and high retirement rates, which the Energy Workforce Advisory Board lists among its barriers.[2] The people who would replace retirees over the next fifteen years are underrepresented now, while the fleet is being extended, not retired, and new construction is being ordered on top.

One structural feature changes what the fix looks like. In 2023, 19 percent of nuclear energy workers were represented by a union or covered under a project labor or collective bargaining agreement, more than double the private sector rate of union representation.[9] The figure measures coverage, not membership, and it points to different entry routes. For a large part of this workforce, the pipeline is plausibly an apprenticeship, and apprenticeship capacity expands through a different mechanism and on a different timescale than university enrollment does.

Most of a tripled workforce will not be engineers

In July 2025, the Department of Energy's Energy Workforce Advisory Board concluded that achieving the administration's goal of quadrupling nuclear capacity over 25 years will require tripling the workforce.[2] Applied to the 2023 headcount of 68,000, tripling implies a workforce of roughly 204,000, or about 136,000 additional workers. Both figures are this report's arithmetic; the secondary account of the board's report used here gives neither a baseline headcount nor a role mix. Besides an aging workforce and high retirement rates, its named barriers are a shortage of qualified workers entering the industry and a lack of training infrastructure for technical jobs.[2]

The obvious comparison is tempting and unsupported. Setting 940 nuclear engineering degrees a year against the derived 136,000 would look like a crisis, but no source reviewed for this report gives a role-mix breakdown of the tripling requirement, and the 136,000 is a multiplication, not a published figure, so no such comparison is made here. Most of those people will not be nuclear engineers. They will be electricians, pipefitters, welders, operators, technicians and project managers, and their pipelines are not the ORISE survey.

Welders, machinists and inspectors set the pace

The most direct evidence comes from the most detailed supply chain assessment located for 2026, the Nuclear Scaling Initiative's landscape study of the domestic advanced nuclear supply chain, prepared by Solestiss for the initiative, which advocates for nuclear deployment. Its diagnosis of a demand-signal failure is used here in two ways, as evidence that the constraint is real and as the strongest form of the argument that the constraint disappears once orders arrive.

The landscape study finds that shortages of "nuclear-qualified machinists, welders, inspectors, nondestructive examination specialists, and experienced project managers" now "increasingly govern throughput, schedule, and execution risk."[10]

On that assessment, labor sets the pace of physical work, and money spent on capacity turns into output only as fast as the workforce allows. A forging facility can be funded faster than it can be staffed.

Jim Harrell of Zachry Nuclear says the nuclear-qualified welder, machinist and inspector shortage "compounds the fabrication bottleneck rather than sitting separately from it; both constraints have to ease together for factory throughput to actually increase."[11]

A large part of what looks like a supply chain constraint (Chapter 6) is a labor constraint wearing a supply chain's clothes. The Solestiss assessment names machining, welding, finishing, inspection and nondestructive examination as the steps that "frequently sit on the critical path," alongside the first-article heavy forgings that get the attention.[10]

The pattern matches Chapter 1. The 15,000-metric ton press gets photographed, but the binding question is whether a certified welder is available to work on what comes off it.

Two rival vendors and an operator hire the same engineering firm

As Chapter 1 showed, Amentum, an engineering services firm, is simultaneously engaged by Westinghouse on AP300 regulatory approval, by Rolls-Royce as SMR program delivery partner, and by EDF, and leads a joint venture holding an owner's engineer contract with a maximum value of $406 million for the UK's first SMRs, which are Rolls-Royce SMR units.[12] The EDF relationship is the only one of the three with a disclosed value. In January 2026 Amentum announced contracts worth up to $730 million across three frameworks: ten-year professional services agreements with Hinkley Point C, EDF Nuclear Operations and EDF Nuclear Services, and a five-year project management resources framework.[13]

This does not explain the AP300 delay, which has a commercial explanation in Westinghouse's own words (see Chapter 1). What the Amentum pattern establishes is narrower. Specialist nuclear engineering capacity is a shared, finite, rented resource, and two competing reactor vendors and the UK's largest nuclear operator all drawing on the same firm is direct evidence of how thin that market is. It is a fact about market structure, not a proven causal mechanism.

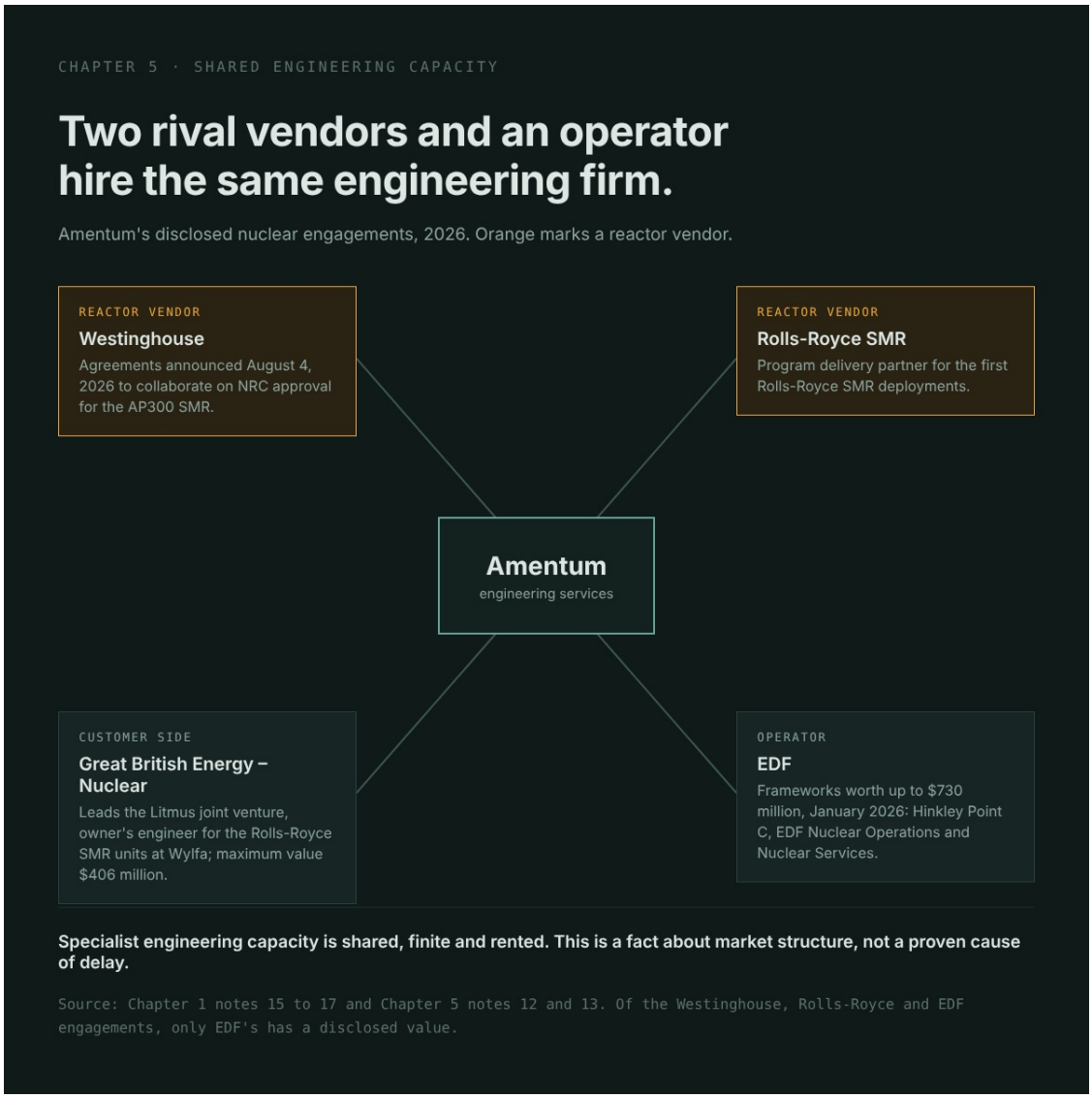


Figure 5.1. Two competing reactor vendors and an operator draw on the same engineering firm.

Some programs now train for the trades

Two developments cut against the gloom.

NuCAMP is a workforce program wearing a manufacturing program's name. The consortium Kairos Power launched in August 2026 includes Oak Ridge National Laboratory, the University of Tennessee, IACMI and Barnard Construction, and also Roane State Community College, Chattanooga State Community College and Oak Ridge Schools.[14] Putting community colleges and a school district in a consortium about precast concrete and additive manufacturing shows an organization that has worked out the trades are the constraint.

The August 2026 National Security Science and Technology Strategy lists, among efforts with non-Federal partners, "facilitate partnerships between educational institutions, including community colleges, and industry to create new certifications, credentialing, and

competency models for emerging fields, including AI infrastructure, quantum, biotechnology, and advanced nuclear reactor construction and operation." Naming advanced nuclear construction and operation explicitly puts federal policy behind the same conclusion.[15]

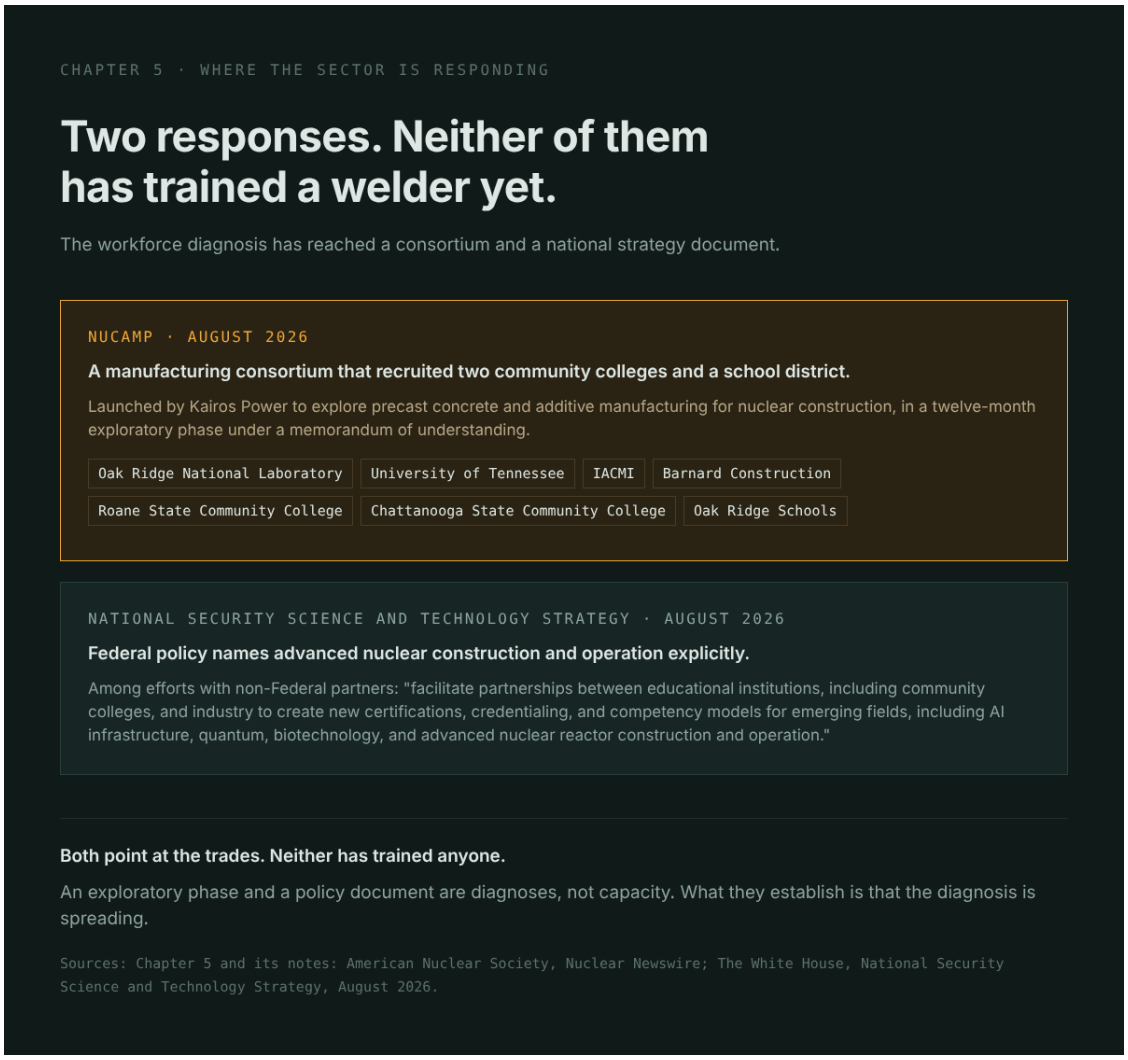


Figure 5.2. The response to the trades shortage so far is a consortium and a strategy document, not trained workers.

Neither is a solution yet. A twelve-month exploratory phase and a policy document do not produce welders, but they indicate that more organizations now see the trades as the constraint.

Parallel regulatory tracks draw on the same people

The Army's Janus program (see Chapter 4) adds one more demand on the same labor pool by assigning five vendors to five military installations. The Army says directly that the deployments are not simultaneous. Dr. Jeff Waksman, principal deputy assistant secretary of the Army for Installations, Energy and Environment, at an August 26 media roundtable: "We don't expect all five of these companies are going to turn on a reactor in 2028. In fact, they definitely will not. But we do believe we have a very practical pathway to delivering at least one

of these reactors on by September 30, 2028, which was the date set in the executive orders." Radiant and Antares target 2028; BWXT begins construction in late 2028 for operation in the early 2030s; the General Atomics and Westinghouse Government Services schedules are undisclosed.[16] The draw is still larger than five units, because Radiant's award alone covers 15 deployments by 2030, in the same late-decade window as every commercial deployment target in this report.

The multi-lane pursuit in Chapter 4 also has a labor cost that nobody prices. A company running a DOE authorization, an NRC pre-application, a Part 70 materials license and a Janus other transaction agreement concurrently is spending senior technical staff on four regulatory processes at once. They are the people who would otherwise be finishing a design certification application. Westinghouse chose not to spend that capacity on the AP300 (see Chapter 1). Smaller companies are spending theirs across four lanes.

That tax cannot be sized here, but specialist labor in this sector is demonstrably shared and finite, so running four regulatory processes as a hedge, because none delivers a complete outcome alone, is not free.

Orders could summon the workforce, but slowly

The strongest argument against this chapter is that the labor constraint is endogenous, meaning it responds to demand. There are not enough nuclear welders because there has not been enough nuclear welding.

The Nuclear Scaling Initiative's own diagnosis supports this. It frames the supply chain problem as a self-reinforcing market paralysis rather than a physical ceiling, and says explicitly that the paralysis is "not merely a market failure" but is reinforced by stop-start policy signals, slow deployment of public funding and a lack of decisive down-selection. Suppliers will not make long-lead capital investments without credible multi-unit demand signals, while offtakers will not commit without cost certainty and a proven supply chain.[10] It names the absence of "aggregated, multiunit order books sufficient to justify supplier investment" as the first of three conditioning constraints, and concludes that "order books are a prerequisite, not an outcome, of supply chain scale."

Clean Air Task Force makes the point more forcefully, relaying a Chinese claim rather than making a finding of its own, and it is not a second voice: "China announced that it now has the industrial capacity to build as many as 50 reactors simultaneously," which CATF attributes to decades of deliberate investment in nuclear manufacturing, workforce development and standardized deployment programs.[17]

The case is credible, and two observations qualify it.

First, it describes where the market ends up and says nothing about how long getting there takes. Even if an order book would call forth the workforce, it arrives on training timescales. The Nuclear Scaling Initiative describes these roles as "labor-intensive, slow to train, and subject to intense competition from other industrial projects," and the deployment targets in this sector cluster in 2028 to 2030.[10]

Second, it does not address the degree data. Undergraduate nuclear engineering enrollment fell through a decade when the demand signal was already turning. If the pipeline responded as briskly as the endogeneity argument requires, the 2022 figures would look different. The data is old enough, though, that this observation is weaker than it sounds, and the next survey may overturn it.

The finding

The binding constraint, on the best available evidence, is not engineers. It is the trades: nuclear-qualified welders, machinists and inspectors.

The engineering pipeline is inverting. Bachelor's degrees fell 25 percent between 2012 and 2022 while doctorates reached a record in a series going back to 1966, though over the long view since the 1970s the undergraduate decline is a pullback within a cycle. The industry needs the cohort that is shrinking.

The operating workforce has a missing generation, with 23 percent under 30 against 29 percent across the rest of the energy workforce, against the Energy Workforce Advisory Board's finding that the workforce must triple.

On the most detailed assessment located, trades labor governs throughput, schedule and execution risk, which caps how fast committed money can turn into physical work. Orders may ease that constraint, but only on training timescales, and most of a tripled workforce will come from occupations the degree survey does not measure.

The sector is also relying on four-year-old data. The next ORISE survey will give the first real evidence of whether the degree pipeline is already recovering.

Sources

Notes are numbered per chapter. Each carries a source-interest tag: `[regulator]` for government and agency documents, `[reporting]` for independent journalism and trade press, `[company]` for a subject describing itself, `[analyst]` for banks, consultancies and law firms that earn fees in the sector, and `[advocacy]` for organizations with a declared stake in the outcome. Most notes carry an Internet Archive capture, most of them made September 18, 2026, so a reader can check what a page said on or near the date it was read. Notes for sources added in the days before the freeze date largely do not; the back matter states what is outstanding.

1. [regulator] Oak Ridge Institute for Science and Education, "ORISE report shows overall number of nuclear engineering degrees decreases to lowest level in more than a decade," 2024. orise.orau.gov, archived September 18, 2026 Covers degrees awarded September 1, 2020 through August 31, 2022. This release gives 34 US universities; the survey page and data brief give thirty-five nuclear academic programs. The reconciliation to 35 programs at 34 institutions is this report's, not ORISE's. ORISE is operated for the Department of Energy.

2. [reporting] Roll Call, "Worker shortage looms over new US nuclear power focus," November 5, 2025, reporting the July 2025 report of the Department of Energy's Energy Workforce Advisory Board. rollcall.com, archived September 18, 2026 This account carries no baseline headcount and no role-mix breakdown of the tripling requirement, which is why neither is asserted here. The board's July 2025 report itself was not obtained for this report, so the absence is the secondary account's and not necessarily the board's.

3. [regulator] Oak Ridge Institute for Science and Education, "Nuclear Engineering Enrollments and Degrees Survey." orise.orau.gov, archived September 18, 2026 Most recent survey covers academic years 2020 to 2022 with enrollments for Fall 2022. Source of the 25 percent decline in bachelor's degrees between 2012 and 2022.

4. [regulator] U.S. Department of Energy, "ORISE report shows number of nuclear engineering doctoral degrees spike to highest level in 52 years." energy.gov, archived September 18, 2026 Source of the 2018 figures and the 2018 enrollment changes against 2016.

5. [regulator] Oak Ridge Institute for Science and Education, *Nuclear Engineering Enrollments and Degrees Survey, 2022 Data*, Brief 84.1, February 2024. orise.orau.gov, archived September 18, 2026 Gives 2022 as 454 bachelor's, 275 master's and 211 doctorates, and 2021 as 444, 228 and 176. These are the figures used in the table; the earlier ORISE news release gives 208 and 174 doctorates and 267 and 223 master's for the same two years, and the data brief is used here as the later publication of the same survey. Thirty-five programs surveyed, thirty-one returning degree data.

6. [regulator] Oak Ridge Institute for Science and Education, *Nuclear Engineering Enrollments and Degrees Survey, 2019 Data*, Brief 82. orise.orau.gov, archived September 18, 2026 Source of the 2019 breakdown: 622 bachelor's, 316 master's, 194 doctorates.

7. [regulator] Oak Ridge Institute for Science and Education, *Nuclear Engineering Enrollments and Degrees: A 50-Year Trend Assessment, 1966 to 2015*, March 2017. orise.orau.gov, archived February 7, 2026 Source of the 1970s peaks ("nearly 865" bachelor's in 1978, "over 550" master's in 1977, "over 180" doctorates in 1970), the lows (120 bachelor's in 2001, 130 master's and about 65 doctorates in 2002), and the 66 programs reporting in 1966. These are stated in the report's text as rounded values read from its charts.

8. [regulator] Oak Ridge Institute for Science and Education, *Nuclear Engineering Enrollments and Degrees Survey, 2013 Data*, Brief No. 72. osti.gov, archived July 9, 2025 Source of the 2013 figures: 655 bachelor's, 362 master's, 147 doctorates.

9. [regulator] U.S. Department of Energy, "5 Workforce Trends in Nuclear Energy," August 28, 2024, reporting 2023 data from the U.S. Energy and Employment Report. energy.gov, archived September 18, 2026 This source renders the under-30 comparison as a relative one, "23% fewer workers under the age of 30 than the overall energy workforce," and publishes no 29 percent figure; the 23 and 29 percent shares used in the text are from note 3.

10. [analyst] Solestiss for the Nuclear Scaling Initiative, *Landscape of U.S. Domestic Advanced Nuclear Energy Supply Chain*, March 2026. nuclearscaling.org, archived September 18, 2026 The Nuclear Scaling Initiative advocates for nuclear deployment; the report's diagnosis of a demand-signal failure is used here in both directions, as evidence of the constraint and as the strongest form of the argument against it.

11. [reporting] Jim Harrell, Zachry Nuclear, quoted in *Chemical Processing*, "Small modular nuclear projects advance amid supply chain challenges," September 8, 2026. chemicalprocessing.com, archived September 18, 2026

12. [company] Amentum, "Amentum-Led Joint Venture Secures $406 Million Contract as Owner's Engineer for UK's First Small Modular Reactors," April 2026. amentum.com, archived September 18, 2026 See Chapter 1 for the Westinghouse and Rolls-Royce engagements.

13. [company] Amentum, "Amentum Expands UK Nuclear Energy Specialist Services Portfolio with $730 Million Major Contracts Win," January 27, 2026. amentum.com, archived September 18, 2026 Up to $730 million (GBP 540 million) across three frameworks: a ten-year professional services agreement with Hinkley Point C, a ten-year agreement with EDF Nuclear Operations and EDF Nuclear Services, and a five-year project management resources framework. Distinct from the $406 million Wylfa owner's engineer award in note 12, which has a different client and a different scope.

14. [reporting] American Nuclear Society, Nuclear Newswire, "Kairos Power, others launch NuCAMP to develop nuclear workforce," August 20, 2026. ans.org, archived September 18, 2026 Initial phase is a twelve-month exploratory effort; funding amount is not disclosed.

15. [regulator] The White House, *National Security Science and Technology Strategy*, August 2026. whitehouse.gov, archived September 18, 2026

16. [reporting] POWER Magazine, "U.S. Army mobilizes $2.2B Janus Program to deploy more than 20 commercial microreactors," August 26, 2026. powermag.com, archived September 18, 2026 Source of the Army's statement that the five vendors will not all operate a reactor in 2028 and of the per-vendor schedules. The Waksman quotation is from the August 26 Army media roundtable, reproduced verbatim from the article text. The article carries an editor's note recording that it was substantially updated with roundtable reporting after first publication.

17. [advocacy] Clean Air Task Force, "The missing link in America's nuclear energy future: standardization and scale," July 21, 2026. catf.us, archived September 18, 2026 Clean Air Task Force is a co-founder of the Nuclear Scaling Initiative that commissioned the Solestiss assessment cited in this report, and this piece relays that assessment, so it does not corroborate it independently.

Chapter 6: The Factory Is Mostly a Frame

In December 2025, Aalo began shipping test modules from its Austin factory to the INL site. At Oak Ridge, Radiant is building a manufacturing campus with a stated target of 50 reactors per year. These are the milestones the sector celebrates.

The count behind them is thinner. Chapter 2 found that three of 24 US and Canadian developers have disclosed both a facility they control and a production rate. MIT's model of the next AP1000 assumed an indirect cost share of 51 percent. Worked against Georgia Power's realized Vogtle costs, indirect costs make up roughly 68 to 76 percent of total overnight capital cost. What broke the last generation of American nuclear projects was not the price of the components. It was the assembling of them into a plant, on a site, in the field.

No factory has changed that yet, and MIT modeling, relayed in a national laboratory review, suggests small reactors carry higher onsite labor per megawatt than large ones. The industrial base behind the factories is also short, most likely downstream of the forging press, in machining, welding, inspection and nondestructive examination.

Vogtle's overruns came from the field

The Vogtle figures come from MIT's assessment of the next AP1000's overnight capital cost. The model assumes an indirect cost share of 51 percent, the figure the reference cost database sets for a median-experience plant, and projects about 40 percent for a tenth unit. Worked against Vogtle's realized costs, indirect costs accounted for roughly 68 to 76 percent of the total. Site construction management alone reached $4,600 per kilowatt of electrical capacity, a 3.2 times increase over the model's own estimate.[1]

US on-site construction labor productivity has declined by a factor of two since the 1980s baseline the cost models were built on, across nuclear and non-nuclear projects alike. Against the same $1,425 per kilowatt estimate behind the 3.2 figure, MIT treats a fourfold rise in construction management cost as a conceivable assumption, a factor of two from productivity multiplied by a factor of two from new regulatory issues, which puts its assumption just above the 3.2 times actually realized.[1]

Duration compounds it. Vogtle's construction ran about 120 months against roughly 60 months projected for follow-on units, and MIT notes that beyond 60 months "the indirect cost starts to grow more rapidly."[1] Past that threshold, schedule risk and cost risk become a single risk.

Idaho National Laboratory's 2025 review adds the craft-side mechanism: both Vogtle and V.C. Summer "suffered acute shortages of qualified craft workers, resulting in productivity losses and schedule slippage."[2] That is Chapter 5's labor argument, in the cost data.

Vogtle's total cost is reported at least seven different ways, sometimes twice inside one document. INL's own 2025 figure is approximately $31 billion in 2024 dollars, excluding financing and after contractor settlement credits; the same review relays an approximately $35

billion figure from Shirvan's 2024 work, in 2023 dollars, including Westinghouse's bankruptcy-exit payments.[2] MIT's March 2022 report gives about $28 billion on July 2021 data and, in a footnote, about $32 billion as of February 2022.[1] POWER's April 2025 analysis gives a final cost of $36 billion in one place and "exceeded $35 billion for construction and financing" in another, and 2026 reporting puts the final cost at $36.8 billion.[3] No Vogtle cost figure should be used without its date and basis.

Vogtle's module shop failed on quality

Modularity was part of what went wrong at Vogtle. INL's review states that first-of-a-kind issues with the AP1000's novel design, "such as its steel containment vessel, modular construction approach, and module fabrication quality," required significant rework.[2]

In 2013 the NRC found that a "chilled work environment for raising and addressing safety concerns exists" at Shaw Modular Services, the former name of the CB&I-operated Lake Charles facility fabricating Vogtle submodules, with 27 percent of workers reporting they feared retaliation for raising quality concerns. The project monitor, William Jacobs, concluded the facility "has not demonstrated the ability to fabricate high-quality CA20 submodules … that meet the design requirements at a rate necessary to support the project schedule." Submodules shipped with improper welds and required rework on site.[4]

Lake Charles is the last American factory to have fabricated nuclear structural modules at production scale, and it failed on quality and workforce, not on concept. It was not the first attempt. Offshore Power Systems, begun in 1970 by Westinghouse and Tenneco, then the owner of Newport News Shipbuilding, set out to produce a series of identical floating reactors at a factory on Blount Island, near Jacksonville, under a generic manufacturing license and with mass production techniques. The NRC issued that license, for a maximum of eight floating plants, on December 17, 1982, and Westinghouse abandoned the enterprise in 1984 without producing a plant.[4] Quality did not kill it. Public Service Electric and Gas, which had ordered four of the plants, canceled them in 1978 and cited slack demand as "the only reason," and the NRC's historian concludes that "a novel technological solution could not overcome public distrust and economic, technical and regulatory uncertainty."[4] Two American factory attempts, two different failure modes. Whether that reassures depends on whether the next attempt manages supplier quality better.

What broke the last generation of American nuclear projects was not the price of the components. It was the assembling of them into a plant, on a site, in the field.

Few factories have produced anything yet

Below are the three developers in Chapter 2's factory count and other manufacturing efforts, including Kairos Power, which Chapter 2 places outside the factory count but which has produced the most fully documented physical manufacturing test in the set.

Radiant is constructing a 300,000 square foot manufacturing, fueling and storage campus at Oak Ridge on former Manhattan Project sites, with a stated capacity target of 50 reactors per year, construction beginning early 2026 and first mass-produced delivery in 2028.[5] The NRC is reviewing its Part 70 license on an expedited schedule targeting completion December 18, 2026, about 55 percent faster than a standard review.[6] It has demand attached: up to $750 million from the Army for 15 units by 2030. The company's own figures differ, though. Against the headline target of 50 reactors per year, its chief executive has described "over a dozen per year" within a few years of 2028.[5]

At **Kairos Power**, a 26-foot precast concrete shielding structure was built at Oak Ridge in December 2025, and a February 25, 2026 release reported its performance testing complete; the test used an iridium-192 source to measure radiation transmission through walls, joints and seams.[7] For the bioshield structures planned for Kairos reactors, Oak Ridge National Laboratory and its partners produced reusable composite molds by large-format additive manufacturing: conventional steel molds can take six to eight weeks to fabricate, and the laboratory says the team designed, printed and delivered the composites in about two weeks. Kairos rehearsed its foundation method on a non-nuclear engineering test unit, a full-scale test pier and 70 piers, before installing Hermes 1's 51 safety-related drilled piers, and reported crews reaching as many as six piers a day on that rehearsal work.[8]

The structure is a non-nuclear mockup, with no fuel, no salt and no electricity: real manufacturing progress, short of proof that the full-scale problem is solved. The same reporting names the code obstacle: structures assembled from multiple components "must be shown to perform like monolithic concrete structures."[8]

NuScale's VOYGR modules were to be manufactured by Doosan Enerbility, which placed long-lead material orders in December 2022 and began forging in 2023 for the Carbon Free Power Project, with scope covering upper reactor pressure vessels for six modules and over 2,000 metric tons of material. That project was terminated in November 2023, and no 2026 update on VOYGR module manufacturing was located. Doosan, together with Korean financial investors, has made an equity investment of nearly $104 million in NuScale.[9] In April 2022 NuScale signed a collaboration agreement with the US Reactor Forging Consortium of North American Forgemasters, Scot Forge and ATI Forged Products, as a domestic forging complement.[10]

Aalo announced a 40,000 square foot Austin factory in 2024, began shipping test modules from it to the INL site in December 2025, and has since published a phased plan treating that facility as phase one, with a 400,000 square foot phase and a phase above 4,000,000 square feet beyond it, rated at "1 GW/y per 1,000,000 sqft." The phases carry no dates. Separately, the same page says procurement for Aalo's "first million sqft Gigawatt Factory" begins in 2026, and states a goal "to enable the West to deploy a gigawatt of nuclear capacity per year by 2030."[11] The million-square-foot factory does not correspond to any of the three named phases, and no unit has yet been produced at either larger scale. **Antares**, the third company in Chapter 2's count,

says it is building out a 145,000 square foot facility in Torrance, California, "capable of producing 10 units per year"; the figure comes from a company-contributed article on its December 2025 Series B, which attaches no date to the rate.[11] Last Energy publishes a technology page describing factory-kit microplants with a roughly 114 square foot reactor module footprint and no factory location, size or assembly duration.[12]

No factory has yet shown lower costs

Nobody knows yet whether factories will cut cost. In ITIF's words, "Because SMRs have not yet been produced in a factory, we have only educated guesses about cost savings."[13] Only two commercially operating SMRs exist globally, in Russia and China, providing no factory cost data. On the study's more optimistic hypothetical, a 10 percent learning rate, the cost of electricity falls by around two-thirds and SMRs become competitive at 256 deployed units, implying sustained deployment growth above 15 percent annually for three decades. The study also charts a slower 4 percent curve.

The result the factory thesis most needs to answer comes from Stewart and Shirvan's TIMCAT cost modeling, as summarized in INL's 2024 review of prior work. Modular construction "was found to be very effective in reducing construction schedule; however, no benefit on cost and schedule was observed for FOAK plant," and, most pointedly, "SMRs were still projected to realize on average higher onsite labor per MW than large reactors." INL's own framework takes from the same body of work a 20 percent reduction in construction duration where modular civil techniques are used, and assumes modularity does not change direct cost.[14] This is not an independent check on the MIT assessment behind the Vogtle figures above. Koroush Shirvan wrote that assessment, co-developed TIMCAT and co-authored the INL review, so the Vogtle multiples and the SMR labor finding are one line of evidence, not two.

The factory bet is that production volume eventually overcomes that labor penalty. It has a real mechanism and has not been won yet.

No public naval reactor production data was located for this research. The DOE-sponsored IIT and Argonne study of factory-built reactor vessels states that its team did not have access to the naval reactor program's database. It cites learning rates of 80 to 90 percent in naval shipbuilding, aerospace and electronics, and its literature review also drew on aircraft, power generation, semiconductor, food and renewable-energy manufacturing.[14] Its central finding, though, rests on reactor experience: the SMR economy "is essentially driven by the degree of learning transfer ascribed to the GW-scale industry". Serial-production claims that lean on shipbuilding or electronics analogies are therefore weaker than the study they would cite, which ties factory savings to how much of the large-reactor fabrication record carries over.

Much of the supply chain constraint sits downstream of the forge

The most rigorous 2026 assessment of whether the industrial base can supply reactor factories opens by separating two constraints: "The United States does not face a nuclear energy technology constraint. It faces an industrial capacity constraint." Its core finding is a "self-reinforcing market paralysis": suppliers will not make long-lead investments without credible

multiunit demand, and offtakers will not commit without cost certainty, schedule confidence and a proven supply chain.[15]

Forging capacity is thin but may not bind

The World Nuclear Association's inventory of ultra-large forging presses is lopsided. Doosan in Korea operates a 17,000 metric ton press handling 540 metric ton ingots. China First Heavy handles 715 metric ton ingots. Japan Steel Works operates two 14,000 metric ton presses at 650 metric tons. Russia's OMZ Izhora, 600 metric tons.

The United States appears three times, and small. ATI operates a 15,000 metric ton press that handles 175 metric ton ingots, Lehigh a 10,000 metric ton press at 270 metric tons, and North American Forgemasters a 10,000 metric ton press at 170. The largest American ingot capacity in the inventory is therefore Lehigh's, not ATI's, and it is exactly half of Doosan's 540 metric tons. The WNA's assessment: "Nothing in North America currently approaches these enterprises."[16]

China's heavy manufacturing plants can make about ten sets of pressure vessels and steam generators a year, projected to rise to twenty; Japan Steel Works is expanding by 2028.[16] JSW has confirmed it will double nuclear component production capacity against FY2025 by FY2028 at its Muroran plant. Sales in its Material and Engineering Products business, which includes the nuclear components, are projected to rise about 71 percent, from JPY 39.7 billion in FY2025 to JPY 68.0 billion in FY2028.[17]

That makes forging look like the bottleneck, a reading contested in the most important disagreement in this literature.

The Solestiss assessment for the Nuclear Scaling Initiative puts the emphasis elsewhere: "the most acute manufacturing bottlenecks increasingly lie downstream rather than in first-article heavy forgings alone. Machining, welding, finishing, inspection, and nondestructive examination frequently sit on the critical path."[15]

This report cannot resolve that disagreement. The downstream view is the better-evidenced one, it matches Chapter 5's labor finding exactly, and the market appears to agree. BWXT's July 2026 acquisition of Precision Components Group added more than 500,000 square feet of US heavy manufacturing capacity and 450 employees in large-envelope machining, heavy weldments, pressure vessels and ASME-certified fabrication.[18] That is capital moving into precisely the segment the downstream view names.

No current count of the qualified suppliers exists

No 2025 or 2026 source gives a current number of ASME N-stamp certificate holders or NQA-1 qualified suppliers, in the United States or globally. The raw material for one exists. ASME maintains a public Certificate Holder Search, and an ASME certification briefing given by the inspection firm HSB on December 5, 2024, hosted by Idaho National Laboratory's reactor innovation center, charts the number of companies holding certificates from 1980 to 2020 without printing the values.[19] The most recent published count located is Sandia's analysis of the certificate database from 1989 to 2020. It reports 683 N-stamp certificates in the ASME database as of June 2020, across all certificate types and statuses, terminated ones included, and cautions that because one vendor may hold several, "one should not infer from the listed 683

certificates that there are 683 individual vendors." It concludes that US vendors still obtain more N-stamps than any other country and that the US nuclear component manufacturing industry is "alive and well, although there have been some consolidations".[19] That is a more mixed picture than the contraction narrative the sector usually offers. The statement that suppliers holding nuclear certifications "have declined significantly over the past decade due to low demand" is attributed by the trade press not to the June 2025 journal paper cited alongside it but to the World Nuclear Association's supply chain outlook, a commercial data product that was not obtained for this research.[20]

Any specific current count of qualified nuclear suppliers should be treated as unverified. Sandia's figure is six years old and counts certificates rather than companies. The gap is in current publication rather than in the record: Sandia compiled its 2020 count by hand from ASME's public directory, which makes a current count a question someone could answer rather than one nobody can.

The qualification clock, by contrast, is documented: developing and implementing a nuclear management system takes eight to eighteen months on average, and the time from the start of the project to the accrediting organization's survey runs from nine months to a year and a half, with certificates valid three years.[21] Two parts of that timeline cannot be shortened: the program has to run before it can be audited, and lead auditor qualification requires training, participation in at least five quality assurance audits within the preceding three years, one of them a nuclear audit within the prior year, and a passed examination.[22] The same source puts the whole exercise at nine to twelve months for a manufacturer already holding ISO 9001, and twelve to eighteen from scratch. The dollar cost of qualification is not published in any source located.

Transformers have public lead times; turbines do not

Large power transformers are the one component with public hard lead times: 128 weeks average, and 144 weeks for generator step-up units as of Q2 2025, against a projected 30 percent deficit for power transformers in 2025.[23] On the supply side, Wood Mackenzie counts nearly $1.8 billion in new North American transformer manufacturing investment, while POWER's own tally of commitments since 2023, led by Hitachi Energy and including Siemens Energy, Eaton and Prolec GE, comes to nearly $2 billion; the article prints both without reconciling them. The Crane restart shows what the lead time looks like in practice. Its 500,000-pound transformer, built by Hyundai in South Korea at a cost of $9.88 million, arrived on August 17, 2026 by ship, rail and heavy hauler, the first of three. Constellation's chief generation officer described it as the unit "that's going to connect the plant to the grid and to the transmission wires you see across the countryside."[24]

A rare dissent appears in the same reporting. Patrick Tarver of Bolt Electrical: "There is not a shortage." He says that for a standard substation power transformer, once the initial engineering drawings are approved, he can have a unit delivered within 12 to 14 months, across all voltage classes, and argues procurement structures rather than manufacturing capacity create the bottleneck, adding "It's all exaggerated to drive pricing."[23] POWER printed both views without resolving them.

On nuclear-specific turbine generators, no 2025 or 2026 lead time or backlog figure was found. Gas turbine backlog data circulates widely and is not a substitute.

For other components, the problem is how few suppliers there are. In specialty alloys, nuclear-grade graphite, large forgings and other qualified subcomponents, the supplier base is "limited and globally concentrated." By segment, the same assessment finds that in the fuel cycle "one or two qualified suppliers often serve the entire market," and that heavy manufacturing is limited to a small number of globally qualified firms, "often two to five, and in some cases reliant only on allied suppliers."[15] In one documented instance, Curtiss-Wright's original contract to supply sixteen reactor coolant pumps for the first four AP1000 reactors began in 2007, and deliveries stretched to 2015 and 2016.[25]

Federal loans are small against the build

DOE announced up to $17.5 billion in conditional supply chain loans in June 2026, structured as up to five loans each supporting two AP1000 reactors at one site, ten units total. Each project requires $1 billion of upfront equity, half from Westinghouse and half from the utility partner, before DOE funds are drawn. The stated purpose is advance purchase of long-lead items, claimed to accelerate deployment by as much as three years.[26]

Westinghouse has signed letters of intent with seven potential partners with identified sites, none disclosed.[27] Edwin Lyman of the Union of Concerned Scientists put the scale problem on the record. The loans are "a drop in the bucket compared to the likely total project cost for ten AP1000 reactors," which he estimates could approach $200 billion, and "none of these potential projects is backed up with an actual contract for construction."[28]

His second point is the Solestiss assessment's market paralysis in a single case, and Chapter 1's finding in supply chain terms. A supplier will not build capacity without an order book, an order book requires committed projects, and committed projects require offtake that does not exist yet.[15]

Capacity may grow once orders arrive

No source examined here argues that US nuclear supply chain capacity is currently adequate. The strongest challenge to the constraint case holds that capacity is endogenous to demand, meaning it grows when orders arrive, so the binding constraint is the absence of standardized multi-unit order books and not any physical ceiling. That reading is less a counter-position than half of the Solestiss finding, which puts market paralysis at the center. What Solestiss denies is that orders alone would clear it: the paralysis "is not merely a market failure but is reinforced by stop-start policy signals, slow deployment of public funding, and a lack of decisive down-selection."[15]

Clean Air Task Force makes the case most forcefully, relaying a Chinese claim, not a finding of its own, and it is not an independent source here: "China announced that it now has the industrial capacity to build as many as 50 reactors simultaneously," which CATF attributes to decades of deliberate investment in nuclear manufacturing, workforce development and standardized deployment programs. Its historical precedent is the SNUPPS standardization

program, which saved customers “over $200 million dollars (over $650 million in 2026 dollars).”[29]

The strongest empirical support for that reading comes not from CATF but from supplier behavior, and from a company announcement rather than an independent finding. In December 2025 Doosan committed to a new SMR fabrication facility in Changwon with capacity for approximately 20 Xe-100 reactors annually at full production, alongside a binding reservation agreement with X-energy for main power system steel components for 16 units.[30]

The Nuclear Scaling Initiative’s own recommendation follows the same logic: an order book of 10 to 30 reactors, on the evidence that AP1000 orders reduced the price of certain key materials by as much as 25 to 30 percent.[31]

The finding

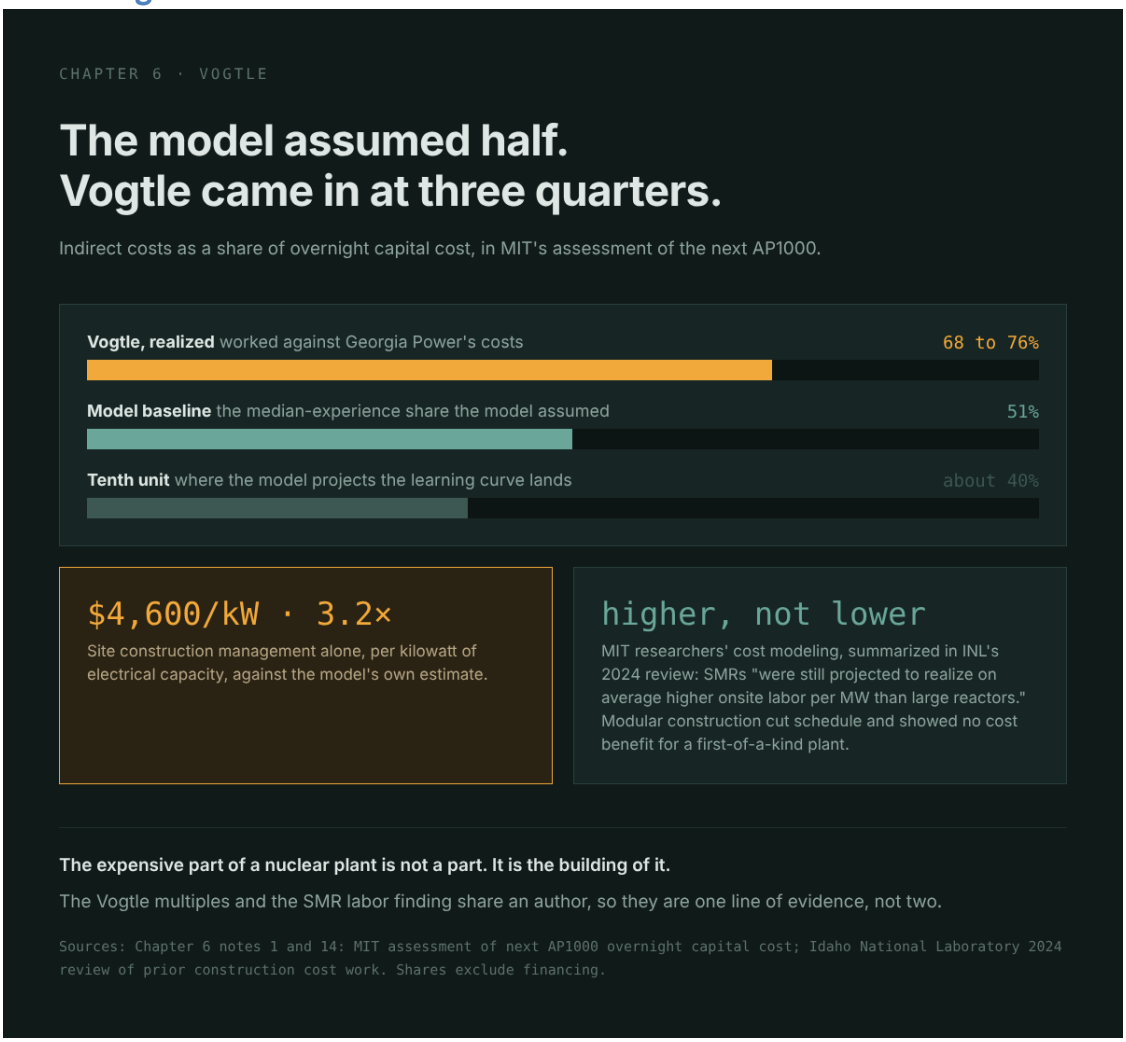


Figure 6.1. Vogtle’s indirect costs worked out to 68 to 76 percent of overnight cost, against the 51 percent MIT’s model of the next AP1000 assumed and the 40 percent it projects for a tenth unit.

The expensive part of a nuclear plant is building it, not any component in it, and only three of 24 US and Canadian developers have disclosed both a facility they control and a production

rate. In MIT's assessment of the next AP1000, indirect costs run 68 to 76 percent on Vogtle's realized costs against the 51 percent the model assumed, construction management rose 3.2 times, and US construction labor productivity had halved since the models were calibrated.

The factory answer remains unproven, which is different from disproven. It has produced one tested concrete structure, a first shipment of test modules, several buildings under construction, and a modeling result, from MIT researchers and relayed in INL's review, suggesting SMRs may carry higher onsite labor per megawatt than large reactors. That result and the Vogtle cost analysis share an author, so they count as one line of evidence.

The industrial supply chain is a genuine constraint, and the most credible assessment places it not only at the first-article forging but, more often, in the machining, welding, inspection and nondestructive examination that follow it. That is Chapter 5's labor constraint under a different name. A current count of qualified suppliers, the single number that would let anyone size this problem, has not been published since Sandia's June 2020 snapshot of 683 certificates, which counts certificates rather than companies.

Chapter 1 said risk accumulates wherever attention is not. The forging press gets photographed. The certified welder, the inspector and the supplier qualification audit do not, and they are where schedules actually slip.

Sources

Notes are numbered per chapter. Each carries a source-interest tag: `[regulator]` for government and agency documents, `[reporting]` for independent journalism and trade press, `[company]` for a subject describing itself, `[analyst]` for banks, consultancies and law firms that earn fees in the sector, and `[advocacy]` for organizations with a declared stake in the outcome. Most notes carry an Internet Archive capture, most of them made September 18, 2026, so a reader can check what a page said on or near the date it was read. Notes for sources added in the days before the freeze date largely do not; the back matter states what is outstanding.

1. [reporting] Koroush Shirvan, MIT-ANP-TR-193, *Advanced Nuclear Power Program Overnight Capital Cost of the Next AP1000*, March 2022. web.mit.edu, archived September 18, 2026 Academic assessment; figures are modeled from Vogtle actuals.

2. [regulator] Idaho National Laboratory, INL/RPT-25-84701, *Potential Cost Reduction in New Nuclear Deployments Based on Recent AP1000 Experience*, June 12, 2025. sai.inl.gov, archived September 18, 2026 The report does not quantify rework rates or productivity factors.

3. [reporting] POWER Magazine, "What Was Learned from Building New Nuclear Reactors?", April 1, 2025. powermag.com, archived September 18, 2026 Author Don Grace served as Vogtle Construction Monitor 2017 to 2024. The article gives both "the final cost of $36 billion" and "exceeded $35 billion for construction and financing." The $36.8 billion final cost is from Inside Climate News, Ryan Krugman, "Two Years After Completion, Plant Vogtle Still Looms Over the Nuclear Debate," May 10, 2026, [reporting] insideclimatenews.org It gives "a final cost of $36.8 billion" without stating the basis. MIT's $28 billion (July 2021 data) and $32 billion (February 2022, footnote 17) are at note 1. Figures across sources run from $28 billion to $36.8 billion; the spread reflects different dates and different treatment of financing and settlements.

4. [reporting] *Engineering News-Record*, "CB&I Plant That Feeds Vogtle Project Faces NRC Scrutiny," October 8, 2013. enr.com, archived September 18, 2026 The article names the facility Shaw Modular Services, "the former name of the Lake Charles site," and prints the Jacobs quotation with the ellipsis shown in the text. Offshore Power Systems: [regulator] U.S. Nuclear Regulatory Commission, Manufacturing License No. ML-1, Offshore Power Systems, Floating Nuclear Plants 1-8, Docket No. STN 50-437, issued December 17, 1982, nrc.gov , source of the issue date and the maximum of eight plants; [regulator] Thomas Wellock, NRC Historian, "Floating Nuclear Power Plants: A Technical Solution to a Land-based Problem (Part I)," nrc.gov , source of the generic manufacturing license and mass production techniques, and "Floating Nuclear Power Plants: Waves of Uncertainty (Part II)," nrc.gov , source of the 1978 PSEG cancellation, the 1984 abandonment and the concluding quotation; [advocacy] Rod Adams, Atomic Insights, "Offshore Power Systems: Big Plants for a Big Customer," August 1, 1996, updated July 21, 2020, atomicinsights.com , source of the 1970 start, the Blount Island site, the Newport News Shipbuilding partnership, the identical-reactor concept and the statement that

the project "failed to produce a single plant." The NRC historian names Westinghouse's partner as Tenneco, which it says left the partnership in 1975. The two accounts agree once ownership is read in: Newport News Shipbuilding was then a Tenneco subsidiary, per [reporting] Maritime Reporter, September 1971, p. 19, magazines.marinelink.com , which reports that Westinghouse and Tenneco "have announced plans for jointly building platform-mounted nuclear power plants" and that "a Tenneco subsidiary, Newport News Shipbuilding and Dry Dock Company, is the nation's largest shipbuilder." These four sources accessed October 18, 2026.

5. [company] Radiant Industries, "Tennessee factory," October 13, 2025, and Radiant press release via BusinessWire, August 26, 2026. radiantnuclear.com, archived September 18, 2026 and radiantnuclear.com (the same release as distributed by Business Wire is archived: web.archive.org) Accessed September 13, 2026. The 50 reactors per year target and the chief executive's "over a dozen per year" both originate with the company and are not reconciled by it.

6. [reporting] *Nuclear Engineering International*, "US fast-tracks microreactor factory," May 13, 2026. neimagazine.com, archived September 18, 2026

7. [company] Kairos Power, "Kairos Power completes performance testing on precast concrete shielding structure," February 25, 2026. kairospower.com, archived September 18, 2026

8. [reporting] *Engineering News-Record*, "Kairos Power pushes to make nuclear construction repeatable," August 26, 2026. enr.com, archived September 18, 2026

9. [reporting] World Nuclear News, "Doosan starts forging components for NuScale SMR," May 5, 2023. world-nuclear-news.org, archived September 18, 2026 The article says the forging was for the first module of the Carbon Free Power Project and that Doosan's equity investment was made "together with Korean financial investors." No 2026-dated update on VOYGR module manufacturing status was located. The project's termination is from World Nuclear News, "Idaho SMR project terminated," November 9, 2023, [reporting] world-nuclear-news.org , which reports that UAMPS and NuScale "mutually agreed to terminate" it. Accessed October 18, 2026.

10. [reporting] World Nuclear News, "NuScale collaborates with US forging companies," April 22, 2022. world-nuclear-news.org Source of the agreement and the consortium's three members. [advocacy] American Public Power Association, "Robust supply chain bolsters NuScale's small modular reactor plans," June 27, 2023. publicpower.org, archived September 18, 2026 This 2023 article carries NuScale's claim of engaging approximately 40 qualified pressure vessel fabricators worldwide, the only count of suppliers, as distinct from certificates, located in this research. It does not mention the forging consortium. It is three years old, company-sourced, and predates the cancellation of NuScale's flagship project later that year.

11. [company] Aalo Atomics, "Announcing our new factory HQ in Austin, Texas," August 21, 2024, and "Aalo Gigawatt Factory," aalo.com, archived September 18, 2026. aalo.com, archived September 18, 2026 The phase footprints and the gigawatt-per-year ratio are the company's own published targets, unverified by any third party. The phases carry no dates; the 2026 procurement line for a million-square-foot factory and the 2030 goal are on the same page, which was re-read October 18, 2026. The Antares facility and rate are from POWER Magazine, "Antares Raises $96 Million in Series B Funding to Accelerate Nuclear Microreactor Development," December 3, 2025, [company] powermag.com , contributed content written by the company's communications team and edited by POWER. Accessed October 18, 2026. Test module shipments to the INL site are reported at nucnet.org, archived September 18, 2026 [reporting].

12. [company] Last Energy, technology page. lastenergy.com, archived September 18, 2026 Undated; carries no factory location, on-site assembly duration or cost figure.

13. [advocacy] Robin Gaster, Information Technology and Innovation Foundation, *Small Modular Reactors: A Realist Approach to the Future of Nuclear Power*, April 14, 2025. itif.org, archived September 18, 2026

14. [regulator] Idaho National Laboratory, *Quantifying Capital Cost Reduction Pathways for Advanced Nuclear Reactors*, INL/RPT-24-7767, June 2024, by Bolisetti, Abou-Jaoude, Hanna and Larsen (INL), Zhou (ANL) and Shirvan (MIT). inldigitallibrary.inl.gov, archived September 18, 2026 Distinct from the 2025 INL AP1000 lessons report at note 2. The two quotations in the text are from the report's Section 2, "Background on Previous Work," where they summarize the TIMCAT work of Stewart and Shirvan; the report's references for that work include Stewart and Shirvan 2022a, 2022b, 2022c and 2023, and Shirvan 2022, which is the MIT report at note 1. The 20 percent duration lever and the direct-cost assumption are the report's own (Table 5), justified by Stewart et al. 2022a. The naval reactor and allied-industry statements in the text are from [reporting] Xuan Chen, Arnold Kotlyarevsky, Andrew Kumiega, Jeff Terry and Benxin Wu, Illinois Institute of Technology, and Stephen Goldberg and Edward A. Hoffman, Argonne National Laboratory, *Small Modular Nuclear Reactors: Parametric Modeling of Integrated Reactor Vessel Manufacturing Within A Factory Environment*, Volume 1, August 2013, energy.gov , and Volume 2, energy.gov . Accessed October 18, 2026. Volume 1's executive summary names naval shipbuilding, aerospace and electronics; Volume 2's literature review lists aircraft, naval, conventional power generation, semiconductor, food and solar and wind manufacturing.

15. [analyst] Solestiss for the Nuclear Scaling Initiative, *Landscape of U.S. Domestic Advanced Nuclear Energy Supply Chain*, March 2026. nuclearscaling.org, archived September 18, 2026

16. [advocacy] World Nuclear Association, *Heavy Manufacturing of Power Plants*, updated July 24, 2026. world-nuclear.org, archived September 18, 2026

17. [advocacy] Japan Atomic Industrial Forum, July 21, 2026. jaif.or.jp, archived September 18, 2026

18. [company] BWXT, "BWXT completes acquisition of Precision Components Group," July 6, 2026. investors.bwxt.com, archived September 18, 2026

19. [regulator] David R. Farley, Sandia National Laboratories, SAND2020-14254, *Global Trends of ASME "N-Stamp" Certifications for Nuclear Component Vendors*, published August 17, 2021, covering 1989 to 2020. sandia.gov, archived September 18, 2026 The abstract page does not contain the counts. The full report is at OSTI, OSTI ID 1813661, osti.gov It gives the 683 total as of June 2020, the vendor caveat and the "alive and well" conclusion quoted in the text, and says the database was compiled by clicking through each certificate in ASME's directory. ASME's register: [advocacy] ASME, "Certificate Holder Search," caconnect.asme.org The briefing: [company] HSB (The Hartford Steam Boiler Inspection and Insurance Company), Mike Lockwood, "ASME Nuclear Certification Overview," December 5, 2024, nric.inl.gov Its chart "40-Year Nuclear Certificate Holder Trend (1980 - 2020)" plots the number of companies holding certificates, with data through April 30, 2019, and prints no values.

20. [reporting] *Chemical Processing*, “Small modular nuclear projects advance amid supply chain challenges,” September 8, 2026. chemicalprocessing.com, archived September 18, 2026 The June 2025 *Progress in Nuclear Energy* paper cited within it was not independently obtained.

21. [advocacy] Organization of Canadian Nuclear Industries, *Roadmap to Becoming a Nuclear Qualified Supplier*, October 31, 2021. ocni.ca, archived September 18, 2026

22. [reporting] Tennessee Manufacturing Extension Partnership, University of Tennessee Center for Industrial Services, NQA-1 guidance. tmep.cis.tennessee.edu, archived September 18, 2026 Page carries no publication date.

23. [reporting] POWER Magazine, “Transformers in 2026: Shortage, Scramble, or Self-Inflicted Crisis?”, January 2, 2026. powermag.com, archived September 18, 2026 Source of both the 128 and 144 week lead times, of both the Wood Mackenzie $1.8 billion and POWER’s nearly $2 billion investment totals, and of the dissenting view that no shortage exists; POWER presents both without resolving them.

24. [reporting] Pennsylvania Capital-Star, “Transformer delivery brings Three Mile Island restart one step closer to reality,” August 17, 2026. penncapital-star.com, archive lookup Source of the weight, the $9.88 million cost, the route from South Korea, the first of three, and the quoted words of Constellation’s Bryan Hanson. The Hyundai manufacturer is from The Philadelphia Inquirer, “Three Mile Island nuclear plant on track to reopen next year,” June 15, 2026, [reporting] inquirer.com, archived June 24, 2026.

25. [reporting] Elliot Marsh, published on *Neutron Bytes*, “The Reactor Isn’t the Bottleneck. The Forge Is,” August 24, 2026. neutronbytes.com, archived September 18, 2026 Independent industry blog rather than primary reporting; the reactor coolant pump figures should be corroborated before load-bearing use.

26. [regulator] U.S. Department of Energy, “Department of Energy announces American nuclear supply chain loans,” June 23, 2026. energy.gov, archived September 18, 2026

27. [company] Westinghouse, “Westinghouse announces Department of Energy partnership to jumpstart large-scale nuclear supply chain,” June 23, 2026. info.westinghousenuclear.com, archived September 18, 2026 Partners and sites are undisclosed.

28. [reporting] *Utility Dive*, “DOE offers $17.5B loans to help build 10 large nuclear reactors,” June 24, 2026. utilitydive.com, archived September 18, 2026 The Union of Concerned Scientists holds a long-standing position on nuclear economics; the $200 billion estimate is Lyman’s and is not independently corroborated here.

29. [advocacy] Clean Air Task Force, “The missing link in America’s nuclear energy future: standardization and scale,” July 21, 2026. catf.us, archived September 18, 2026 Clean Air Task Force is a co-founder of the Nuclear Scaling Initiative that commissioned the Solestiss assessment cited in this report, and this piece relays that assessment, so it does not corroborate it independently.

30. [company] X-energy and Doosan Enerbility, “X-energy, Doosan Enerbility announce 16-unit reservation agreement and capacity expansion,” December 18, 2025. businesswire.com, archived September 18, 2026

31. [reporting] American Nuclear Society, Nuclear Newswire, “NSI report addresses supply chain bottlenecks,” March 23, 2026. ans.org, archived September 18, 2026

Chapter 7: Read the Instrument, Not the Headline

The headlines about hyperscaler nuclear deals have come in a steady run, but the deals behind them are not the same deal. Microsoft signed a 20-year contract for power from the Three Mile Island Unit 1 restart. Meta bought the clean energy attributes of the Clinton plant. Google stands behind a PPA that Kairos signed with TVA. Amazon anchored an equity round in X-energy.

Nine different legal forms travel under the one label of nuclear deals, and they transfer very different amounts of risk. None of them is a binding long-term power purchase agreement between a hyperscaler and a new-build advanced reactor. Hyperscaler money has recapitalized existing plants through restarts, uprates and recontracting. For new build, it has bought equity and options. Only two advanced reactors in the United States have both a named buyer for their power and construction started: Kairos Power's Hermes 2, selling to TVA, and TerraPower's Natrium at Kemmerer, whose power purchase agreement is with US SFR Owner LLC rather than TerraPower itself and is not yet effective. Both buyers are utilities.[1] Neither is further along than that sentence allows. Kairos's documented first nuclear concrete was for Hermes 1, the low-power demonstration reactor, and it broke ground on Hermes 2 in April 2026; TerraPower announced the start of construction in April 2026 on receiving its permit, having previously described the earlier phase as non-nuclear support facilities. The tracker at note 1 describes both as having broken ground on nuclear-side construction. Neither company's own release uses that phrase or the narrower term safety-related.

On this report's reading, behind that pattern sits the loop Chapter 1 described. Lenders will not finance a first plant without a signed contract, and buyers are reluctant to sign until cost and schedule are proven. The gap between announced gigawatts and contracted gigawatts is the largest unexamined number in this sector and the most concrete form of that constraint. It reflects sequencing, not bad faith, and the sequence makes sense once each contract is read for what it actually commits.

Nine legal forms travel under one label

The scope here is fission. Fusion agreements, such as Google's July 2025 investment and offtake agreement for 200 MW from Commonwealth Fusion Systems' planned plant in Virginia, are outside it.[2]

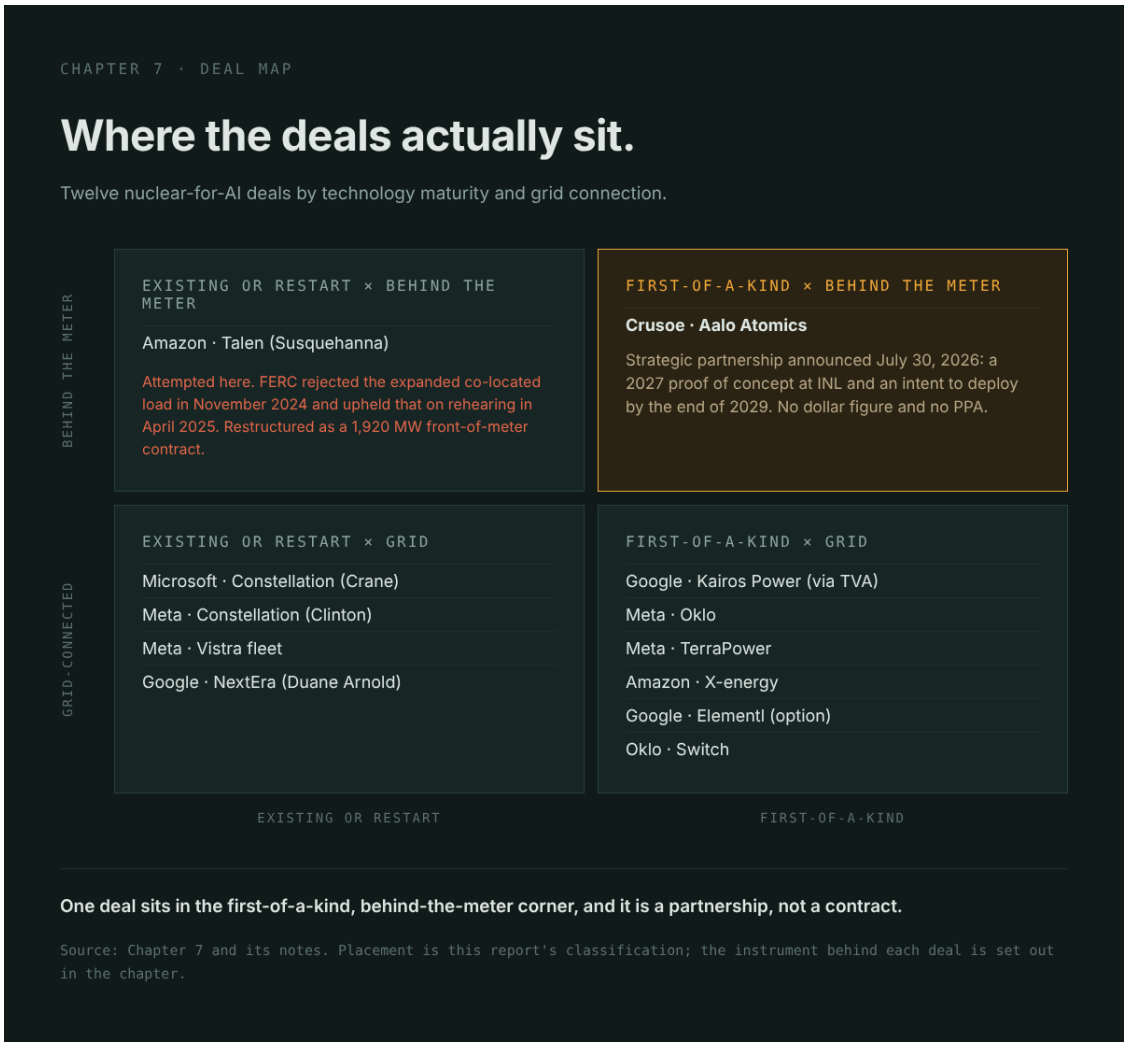


Figure 7.1. Twelve nuclear-for-AI deals by technology maturity and grid connection. One sits in the first-of-a-kind, behind-the-meter corner, and it is a partnership.

A signed PPA against an existing or restarting plant. Microsoft and Constellation's 20-year agreement for the Crane Clean Energy Center, the Three Mile Island Unit 1 restart, roughly 835 MW, originally targeted for 2028 and since accelerated to 2027.[3] Amazon and Talen at Susquehanna, 1,920 MW through 2042 with extension options.[4] Google and Fortum at Loviisa in Finland, 22 years from 2028 for up to half the plant's capacity.[5] Meta and Vistra, 20-year PPAs for 2,609 MW, of which 2,176 MW comes from the operating Perry and Davis-Besse plants in Ohio and 433 MW from uprates at those two plants and Beaver Valley in Pennsylvania, phasing in through 2034.[6] Those 433 MW acquired federal financing on October 5, 2026, when the Department of Energy made a conditional loan commitment of $4.2 billion to Vistra for uprates and modernization at Perry, Davis-Besse and Beaver Valley, with an option to finance future uprates at Comanche Peak. It is a conditional commitment and not a closed loan: Vistra must still satisfy technical, legal, environmental and financial conditions before definitive documents.[7] The public financing is going to the uprates, which is to say to the capacity a hyperscaler has already contracted. Amazon and Constellation at Calvert Cliffs, 690 MW over twenty years from an operating 1,790 MW plant in Maryland, of which about 190 MW is new

capacity from an uprate arriving between 2030 and 2032.[8] These are signed contracts for physical power from plants that exist, uprates included. On the Google agreement the buyer makes this report's argument in its own words. Google titled its announcement "Why we're backing America's existing nuclear plants" and gave the reason as speed: "the fastest new megawatt is often the one that can be provided by existing infrastructure," and an uprate is "happening years quicker than building one from the ground up".[9] Google and Constellation, on October 6, 2026, across two instruments: a twenty-year power purchase agreement for 890 MW of uprate capacity at eleven Constellation units across six sites in Illinois, Pennsylvania and New Jersey, against more than $4.3 billion of Constellation investment with the first uprate expected by 2028, and a separate fifteen-year energy supply agreement for a further 2,700 MW. That second instrument is not counted here. Constellation describes it as covering "an additional 2,700 MWs in PJM's fleet" and as keeping its "operating generation assets" delivering energy and capacity; the release does not say that capacity is nuclear, and Constellation's PJM fleet is not exclusively nuclear.[10] Counting it would put a figure of unknown technology inside a nuclear total. On the same reasoning, Google's share of the Duane Arnold restart is not disclosed: NextEra says Google buys power from the 615 MW plant and that CIPCO, a minority owner, "will purchase the remaining portion of the plant's output", without quantifying either share.[11] So the US contracts of this kind come to about 6.9 GW of disclosed capacity, or up to about 7.6 GW if the whole of Duane Arnold is attributed to Google; both totals are this report's arithmetic, and the deal-by-deal components are listed above. Oracle's subscription, announced October 2, 2026, to part of the output of the existing Point Beach plant in Wisconsin is not counted either: no capacity has been disclosed, and the arrangement awaits approval by the state's Public Service Commission.[11] The equivalent figure for new-build advanced reactors is zero. Two days added about 1.6 GW to that first number and nothing at all to the second: 690 MW at Calvert Cliffs on September 30 and the 890 MW uprate agreement on October 6. Calvert Cliffs adds a mechanism to the list. Constellation says Amazon's commitment is what gives it "the revenue certainty to relicense the plant for another 20 years," so this money is now extending the operating fleet's life and not only buying its output.[8]

A PPA for clean energy attributes, not physical energy. Meta and Constellation at Clinton, 20 years from June 2027. In the issuer's own language, "Meta is purchasing the plant's clean energy attributes", and Constellation describes it as "a market-based solution that essentially replaces the ZEC program".[12] It was widely headlined as a nuclear power deal. Economically, it replaces a subsidy for an existing merchant reactor.

A utility PPA with a hyperscaler standing behind it. Google, Kairos and TVA at Hermes 2. There are three instruments, and only one is a PPA. Kairos sells to TVA, TVA is the counterparty, Google receives clean energy attributes through the TVA system, and a separate order book agreement, which is the term the parties use, frames up to 500 MW by 2035. Kairos's own statement: "TVA is the first U.S. utility to sign a PPA to buy electricity from an advanced, GEN IV reactor".[13] The common framing that Google signed a nuclear PPA is wrong.

Development funding with an offtake right. Meta and TerraPower, announced January 9, 2026, is on TerraPower's description "Meta's largest support of advanced nuclear technologies to date", and the largest hyperscaler commitment to new-build advanced reactors this report located, and it belongs here, outside any PPA column. Meta is funding at least two 345 MW Natrium units and holds "rights for energy from up to six other Natrium units," for up to 2.8 GW baseload and about 4 GW with storage, with initial units as early as 2032. No source

describes it as a power purchase agreement. Vistra's own release calls its same-day arrangements with Meta 20-year PPAs; the trade coverage of the announcement applies no such label to the TerraPower arrangement, which it describes as funding plus rights to energy.[6], [14] The instrument is development capital plus an option. Meta takes real risk on the funding but is not committed to buy power.

A non-binding framework. Holtec, Entergy and Hyundai Engineering and Construction announced a memorandum of agreement on August 5, 2026, described by the parties as non-binding, to evaluate customer demand, candidate sites and commercial structures for dual-unit SMR-300 projects across Entergy's territory in Mississippi, Louisiana, Texas and Arkansas, aimed at large-load industrial and data center customers. No site, date, price or offtake was named, and none has been announced for the Pioneer units Holtec is licensing at Palisades.[15] Oklo's 12 GW master power agreement with Switch, its 1.2 GW arrangement with Meta, TVA's 6 GW agreement with ENTRA1. On the last, the parties describe ENTRA1 developing and owning assets and selling to TVA "through future power purchase agreements," and call it "an important first step."[16]

A lease for compute, not a contract for power, and not yet closed. Fermi America's Project Matador campus in Carson County, Texas, pairs four AP1000 units under licensing with on-site gas, solar and battery storage, and sells floor space rather than electricity. Fermi Campus 1 LLC and TensorWave TEX1, LLC signed what Fermi announced on August 10, 2026 as a binding lease, for 222 MW of total facility power in phase one on a fifteen-year term with about $6.5 billion of expected revenue. Binding is not the same as effective, and it had not closed. A first amendment of September 22, 2026 moved the closing date from September 30 to October 31, 2026, with four conditions outstanding: work letters and guaranties, an operations schedule and service-level agreement, board approvals, and "securing project-level financing sufficient to fund construction of the leased premises." At that date Fermi was still negotiating a guaranty of lease obligations with an investment-grade counterparty. On October 13, 2026 it announced a credit support agreement with AMD supporting the phase one lease, which it described as a key milestone toward securing project financing. Fermi's release does not say that AMD guarantees the tenant's payments, and no closing of the lease had been announced as of October 18, 2026.[17] An earlier arrangement shows what that risk looks like when it lands: a non-binding letter of intent of September 2025 with an unnamed investment-grade tenant, valued at about $150 million, was terminated in December 2025 when its exclusivity expired, and the share price fell as much as 46 percent.[18] This is the nearest thing in the dataset to demand contracted against new nuclear, and it is a tenancy agreement whose own effectiveness still turns on the financing question this chapter is about.

Funding and rights against reactors that do not exist. Meta's January 9, 2026 announcements cover up to 6.6 GW across three counterparties, and two of them are new build. The TerraPower arrangement appears under the previous heading as well; it is the clearest instance of both forms, and the two entries isolate different features of one instrument. With TerraPower, Meta funds two Natrium units of about 690 MWe with delivery as early as 2032 and holds rights to energy from up to six more, about 2.1 GW, targeted around 2035; the announcement does not call it a power purchase agreement, and no site is identified for any of the units, initial or later; TerraPower says only that the parties will target identification of a site for the initial dual unit in the coming months.[19] With Oklo, a 1.2 GW arrangement in southern Ohio carries an executed prepayment agreement giving Meta a mechanism to prepay for power

and fund deployment, and the company says it will use that funding to secure nuclear fuel. No source calls the prepayment binding. Separately, and as a generic disclosure rather than a statement about this agreement, the company's annual report describes its agreements to purchase power with potential customers as contingent and non-binding, in the passage quoted in full later in this chapter.[20] These are the closest things in the record to a hyperscaler financing new reactors, and the instrument in each case is funding plus a right, not an obligation to buy at a price. A right to energy from a plant that has no site, no construction permit and no final investment decision prices nothing and obliges nobody to build.

An option without an obligation. Google's strategic agreement with Elementl Power commits early-stage development capital for three sites of at least 600 MW each, "with the option for commercial off-take once complete."[21] Amazon funds the initial feasibility phase at Energy Northwest and holds the right to purchase electricity, which as one analysis notes, "presumably, doesn't force Amazon to purchase the electricity".[22]

Equity, prepayment and guarantee. Amazon's Climate Pledge Fund anchored X-energy's Series C-1, which closed upsized at $700 million in February 2025. Amazon's own contribution is not disclosed.[23] NVentures, Nvidia's venture arm, joined TerraPower's $650 million raise, in which Bill Gates and Hyundai were among the existing investors.[22] Meta's Oklo arrangement "provides a mechanism for Meta to prepay for power and provide funding to advance project certainty."[24] Nvidia's structure with SB Energy for the OpenAI campus in Ohio is a $1.5 billion investment plus a residual value guarantee capped at $105 billion for the initial 4.25 gigawatt deployment. The guarantee covers the gap between guaranteed minimum lease values and what SB Energy recovers on specified default events, and OpenAI has agreed to reimburse Nvidia for amounts actually paid.[25] That guarantee backs a data center campus, not a reactor. It belongs in this list because it shows the scale of instrument these buyers now use.

Hyperscaler money has recapitalized existing plants through restarts, uprates and recontracting. For new build, it has bought equity and options.

Company filings describe contingent, non-binding pipelines

The most important disclosure on this subject comes from Oklo's own annual report.

> "We have entered into contingent, non-binding agreements related to the purchase of power with potential customers, which may not result in binding agreements".
>
> "Many of these agreements are non-binding and the underlying contracts may not come to fruition".[26]

Oklo's announced pipeline sums to roughly 13.2 GW, being the 12 GW Switch master power agreement plus the 1.2 GW Meta campus; the figure is this report's arithmetic, not a company disclosure. Its revenue for the quarter ended June 30, 2026 was $1.21 million, against a half-year

net loss of $81.6 million and about $3.0 billion in cash and marketable securities. The quarterly filing discloses no quantified backlog or binding commitments.[27] That leaves thirteen gigawatts announced, summed from its own announcements, against $1.21 million of quarterly revenue, its own reported figure.

X-energy makes the same qualification in different words. Its pipeline of 144 reactors and about 11.5 GW is stated "assuming each customer exercises its contingent rights in full."[28]

The clearest confirmation that new build is not being contracted comes from the one company that reports its contracted nuclear volume. Constellation reported 920 MW of new long-term nuclear PPAs at an 18.5-year average tenor in Q2 2026, of which 890 MW came from existing generation and 30 MW from the Dresden uprate. None came from new build.[29] That 890 MW is a different quantity from the 890 MW of uprate capacity in the October 2026 Google agreement above, and the two should not be added. The Q2 figure is contracted volume from generation already running; the October figure is capacity that does not exist yet and arrives from 2028.

Utilities, not hyperscalers, are buying new build

Hyperscalers want carbon-free firm power at scale, on a timeline set by model training cycles. Their revealed preference is existing megawatts (restarts, uprates and recontracting) because those deliver inside the decade. Their advanced reactor positions are equity and options, the instruments a buyer chooses when it wants exposure to a technology more than power from it.

Neoclouds behave differently, as Chapter 1's Aalo and Crusoe example shows. Announced July 30, 2026, it is a strategic partnership with a 2027 proof of concept at INL, an intent to deploy by end of 2029, no dollar figure and no PPA.[30] Crusoe had already made energy its strategy: a 900 MW campus in Abilene with on-site generation for Microsoft in March 2026, roughly 750 MW of gas engines from Bergen Engines in June (about 438 MW under contract, the rest under a letter of intent), a 1 GW campus with Lancium in Childress, Texas, and 5 GW of battery-backed AI UPS with ON.energy in July.[31] A neocloud has a different balance sheet and a different tolerance for being first, which is why the first behind-the-meter arrangement in this dataset came from one rather than from a hyperscaler.

Defense is Chapter 9's subject. Its relevance here is that it is the only buyer class with binding, funded contracts for new-build advanced reactors at its own sites. Janus is up to $2.2 billion of milestone-based agreements across five vendors and five installations.[32]

Utilities are the buyer class the sector stopped talking about and the only commercial one that has actually signed for new-build advanced nuclear. TVA signed for Hermes 2. PacifiCorp, which trades as Rocky Mountain Power in Utah, Wyoming and Idaho, signed for Natrium under a 40-year PPA executed in 2025 that becomes effective only once the commission approvals the contract names are in hand, among them approval of a related water use agreement, which is a condition precedent, and a waiver of competitive bidding rules. Three of those approvals have since been granted, in Oregon on April 29, 2026 with a reconsideration request resolved on August 18, in Idaho on May 22, 2026 and in Utah on June 1, 2026. A California application was still active on October 11, 2026, the last date its docket was checked, and no Wyoming approval requirement for this agreement could be established. The contract

does not publish the full list, so the report does not state that the set is now complete.[1], [33] These are the two projects under construction. TVA is also the clearest case in the dataset of permission without a customer. On September 28, 2026 it received an NRC construction permit for a BWRX-300 at Clinch River, and its own announcement of that permit says no construction date has been announced and that the utility "continues negotiations with industry partners to ensure responsible cost sharing and financial accountability throughout design and construction." Its interim chief executive, Mike Skaggs, stated the condition directly: "Our priority is ensuring the people of the Valley do not shoulder the costs of first-of-a-kind technology that benefits the nation and world."[34] No power purchase agreement attaches to that unit. The federal permission is in hand and the question of who pays is open.

This reverses the sector's usual story, in which the buyer changed from utilities to hyperscalers. On the construction evidence, the buyer for new build has not changed at all.

Developers without a reactor sit between buyer and vendor: they arrange sites, finance and customers, and leave the reactor design to someone else. Elementl Power is the developer behind Google's three-site option described above.[21] Blue Energy plans a 2.5 GW plant at Victoria, Texas: about 1 GW from two gas turbines in 2030, then about 1.5 GW from up to five GE Vernova Hitachi BWRX-300 reactors from 2032, to "initially power a nearby data center", subject to a final investment decision in 2027.[35] The data center is not named, and no offtake has been announced. It has nonetheless started licensing. The NRC noticed receipt of Blue Energy's Part 1 phased construction permit application on October 8, 2026, filed September 15, including a limited work authorization request under 10 CFR 50.10(d), two exemption requests, an environmental report and financial and technical information, with the full construction permit application due no later than 18 months after the Part 1 submittal, which is about March 2028. The notice is a receipt and not a docketing decision.[36] A company with no named buyer is a month into the permission it needs and has asked to begin site work. The Nuclear Company and Brookfield have announced a partnership to form a new company specializing in Westinghouse reactor technology, which Brookfield has selected as project manager for the two partially built AP1000 units at V.C. Summer in South Carolina, and the parties "expect to progress toward definitive documentation in the coming months".[37] Alva Energy builds nothing new. It proposes to add 200 to 300 MW to existing reactors through uprates, financed by working "directly with large-scale power consumers", hyperscalers among them.[38] None of the four has announced a binding power contract. Of the four, only Alva sells what hyperscalers have actually bought so far: more output from plants that already run, as in the Meta and Vistra uprates.

The ratepayer question surfaces in Georgia and Texas

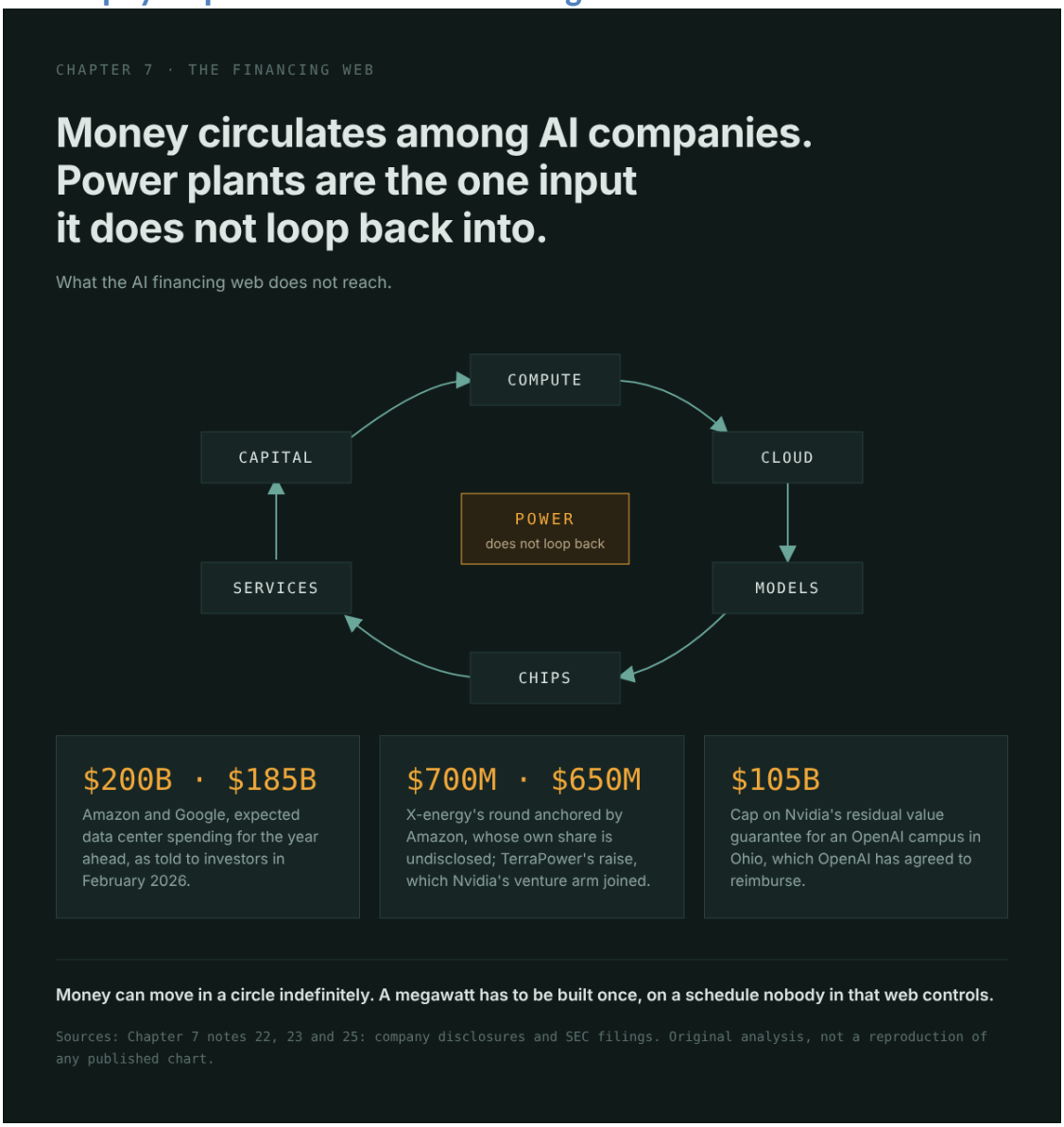


Figure 7.2. Money circulates among AI companies. Power plants are the one input it does not loop back into.

Georgia Power's contract to serve OpenAI's Project Camellia is the sharpest instance of the ratepayer tension tracked throughout this report. The project adds roughly 3.2 GW of new demand, about the output of three Vogtle reactors, on 1,400 acres in Effingham County, against a $20 billion OpenAI investment.

Public Service Commission staff approved it on August 26, 2026. Staff filed a joint statement with Georgia Power instead of an objection, so the contract never reached a commissioner vote.[39] Under the framework, staff may file an objection, and even then "the contract shall be approved if the commission takes no action within 30 days after the staff's filing".[40] The contract itself was filed fully redacted as a trade secret, with Georgia Power agreeing to publish a summary within ten days. It is the seventh such contract approved under a PSC framework,

adopted on January 23, 2025 and effective February 1, that requires customized contracts for loads of 100 MW or more, with a 30-day staff review window. One account dates the rule to April 2025; the primary source gives the January date, which is used here.[39]

The critics are on the record by name. Maggie Shober of the Southern Alliance for Clean Energy, writing under her own byline: "However, the PSC staff cannot have enough time and information to evaluate whether a data center is paying its fair share under a fully redacted contract in just 30 days and without a new cost of service study." Liz Coyle, executive director of Georgia Watch, in a written statement: "The letter to commissioners is full of 'ifs' that leave open the possibility that incremental costs could be shifted to other ratepayers in future proceedings." Bob Sherrier of the Southern Environmental Law Center, who is reported as seeing the deal as a step forward, still says: "This is about more than OpenAI. It exposes that there are big problems with the data center contracts."[39]

None of that is an argument that the deal is bad for ratepayers. It is an argument that nobody outside the filing can tell. That is a different complaint, and a specific, quantified case for the deal does not answer it.

Georgia Power projects incremental large-load revenue delivering roughly $950 million per year in customer savings from 2029, $2.847 billion in total customer benefit across 2029 to 2031, and typical family savings raised from $102 to $180 a year.[39] The regulator raises the open question itself. Tom Bond, the PSC's Director of Utilities: "If a data center leaves, or a group of data centers leaves, do we have the tools to protect customers?" he said. "That's what we're trying to address with this."[40] The generation serving the contract is not disclosed, which is what the redaction means in practice. No nuclear purchase has been announced for it, so the largest data center power contract of 2026 is not on the record as having bought a reactor.

Texas took the opposite approach in public. On August 3, 2026, Governor Abbott directed verification of every data center in ERCOT's large load interconnection process before it may proceed. The queue stands at more than 474 GW across more than 1,800 projects, roughly 90 percent of it data centers, which ERCOT puts at more than five times the grid's record for peak demand. The audit requires information on the tax breaks a project will receive, its power use and generation, its water use and cooling operations, its efforts to reduce impacts on local communities, and the ownership of the facility. On September 21 he went further, directing the state environmental agency to halt permits sought by data centers until ERCOT completes its audit, which ERCOT expects to report by December 10, 2026.[41] Georgia approved its contract behind redactions, and Texas ordered verification of its queue in public. In both, the underlying question of who bears the cost of data center load is unresolved, and Chapter 8 takes it up as the political problem it has become.

Hyperscalers are signing for new build, in gas

The zero has a counterpart. Hyperscalers do sign long-term contracts for new generation built to serve them, when it can deliver inside the decade. In June 2026 Microsoft signed a 20-year power purchase agreement with a Chevron subsidiary for Project Kilby, a 2.67 GW gas plant co-located with a data center campus in West Texas and supplied with Permian gas. Chevron called the agreement "an important milestone toward" its final investment decision, expected by the end of 2026, and anticipates first power in 2028.[42] In August 2026 Amazon confirmed it

owns GW Ranch in Pecos County, where a 7.65 GW air permit for gas generation has been issued for the GW Ranch project, which Pacifico Energy is developing, larger than any gas plant operating in the United States. The plant is designed to run off the ERCOT grid, at least initially, with first power scheduled for the first quarter of 2027.[43]

Neither is a nuclear precedent, and Kilby has not reached a final investment decision. Both show what the buyer will sign when a plant can deliver this decade: a 20-year contract for new capacity it takes directly. Nuclear has its own version of that logic and it does not run through a new reactor. The 190 MW at Calvert Cliffs is new capacity arriving between 2030 and 2032 from a plant that already exists, needing no construction permit and carrying no first-of-a-kind risk.[8] That is the same delivery window as the first permitted small modular reactor in Chapter 11's calendar. In March 2026 seven companies, among them Amazon, Google, Meta and Microsoft, signed a White House pledge to "build, bring, or buy the new generation resources and electricity needed to satisfy their new energy demands".[44] The pledge names no fuel. The first large answers are gas.

Nuclear built to serve a data center directly has also met an obstacle these gas plants have not. In November 2024 FERC rejected an amended interconnection agreement that would have raised the load co-located at Talen's Susquehanna plant, serving Amazon's data center, from 300 MW to 480 MW, and it upheld the rejection on rehearing in April 2025.[45] Talen and Amazon then restructured into the 1,920 MW front-of-meter contract described above.[4] Neither Texas gas plant is a behind-the-meter arrangement at an existing nuclear plant, so no interconnection agreement of that kind is at issue. GW Ranch is designed to run off the ERCOT grid; no source says the same of Kilby, which Chevron describes only as delivering electricity directly to Microsoft.

Investors are discounting the announced pipeline

X-energy is the clearest recent test of public market sentiment. It priced its IPO at $23.00 on April 23, 2026 and reported net proceeds of approximately $1.1 billion on 50.9 million shares, the underwriters' option included. It peaked at $37.10. It closed at $14.93 on September 11, 2026, roughly 35 percent below the IPO price and 60 percent below the peak.[46]

Over the same period its revenues and grant income grew to $98.0 million in the first half of 2026, up 132 percent year on year, with much of that activity funded under the DOE Advanced Reactor Demonstration Program. Total net loss for the half was $271.6 million, of which $59.1 million was attributable to X-energy itself; mark-to-market losses on warrant liabilities ran $114.5 million across the six months. It holds $1.9 billion of liquidity and zero debt.[46] With revenue up 132 percent and the stock down 35 percent from issue, investors are assigning little value to the announced pipeline.

One capital market signal arrived in the same window and points the other way from the announcements. Holtec Nuclear Corporation postponed its US initial public offering on September 17, 2026, citing weak new-issue sentiment and, in the company's words, "a perfect storm of adverse developments," with data center uncertainty named among them. Eight days later it withdrew the registration statement altogether, telling the Securities and Exchange Commission that it "no longer wishes to conduct a public offering of securities at this time."[47] A

company restarting one reactor and licensing two more withdrew from the public markets for reasons it attributed partly to the demand this report finds uncontracted.

The sector's financing stack is unusual. This report found no project-finance loan closed for any US advanced reactor. Private money has gone to companies, mostly as equity. The only private lending found is corporate: in August 2026 Valar Atomics paired a $1 billion Series B led by Sequoia with a $200 million credit facility led by Erebor Bank and J.P. Morgan, after $110 million of debt in its spring round.[48] Reporting put the new valuation at about $6 billion, triple the spring round.[49] None of the disclosures ties that debt to a plant. The only project-level debt is federal, and none of it is going to a new advanced reactor: $1.9 billion closed for the Duane Arnold restart in September 2026 with Google as the primary customer, $1 billion for Crane, a sixth disbursement for Palisades, and up to $17.5 billion conditional for AP1000 supply chain.[11] Measured per kilowatt, the three federally financed restart loans rank in reverse order of plant size. Duane Arnold's loan works out to about $3,090 per kilowatt of capacity, against about $1,900 for Palisades and $1,200 for Crane, and at 615 MW it is the smallest of the three. It is also the one where the site was taken apart. Its cooling towers, generator output transformer and in-scope transmission lines were removed after the 2020 shutdown, and the restart scope includes new cooling towers and restoration of the in-scope transmission lines.[50] Two cautions belong with the comparison. These are loan ceilings, not project costs, and the Palisades figure is a loan guarantee, not a direct loan. No source located for this report ties the size of the loan to the removals, so the arithmetic describes the financing without explaining it.

The emerging stack around US nuclear is therefore sponsor equity, plus strategic equity, plus corporate credit, plus federal loans, plus customer prepayment, plus residual-value guarantees. For new advanced reactors specifically, the federal loans have not yet arrived and the largest guarantee backs a data center, so what is actually in place is equity and prepayment. Conventional bank and bond project debt is absent, which is what Chapter 1's bankability analysis predicts when there is no offtake contract to lend against.

Skeptics and defenders both have real evidence

The case that these commitments are not real. Carnegie's assessment splits announced volume into roughly 6.9 GW that these arrangements "could provide" by the early 2030s from existing or near-term reactors, and roughly 6.1 GW of direct partnerships by the mid-2030s, which it says separately are "contingent on technologies that have not yet been commercialized." It concludes that if every hyperscaler-backed nuclear project succeeds, the result covers "less than 20 percent of projected demand through 2035," while planned 2026 solar alone could supply more than three times the potential nuclear contribution through the mid-2030s. In Carnegie's words, "Nuclear is a marathon. Signing up for the marathon does not move the sprint's finish line."[51]

The capital mismatch argument is blunter. X-energy's Amazon-anchored round closed at $700 million[23] and Nvidia's venture arm joined a $650 million raise for TerraPower, against an estimated $9.4 billion for a 345 MW Natrium plant, while Amazon and Google alone told investors in February 2026 that they expected to spend up to roughly $200 billion and $185

billion on data centers in the year ahead. These nuclear equity commitments are a fraction of one percent of what those two companies expect to spend on data centers in a single year.[22]

The case that they are real, and that the PPA frame understates them. Four plants that faced closure, restart costs or subsidy dependence are now contracted into the 2040s under private contracts. Talen states the Amazon PPA "will significantly decrease Talen's market risk and minimize its reliance on the Federal nuclear production tax credit." Constellation describes the Meta agreement as ensuring "long-term operations of the plant without ratepayer support." Fortum states that without the lifetime extension investment program the Loviisa plant "could not continue operations beyond 2030", that the agreement "gives Fortum the long-term revenue certainty it needs to continue operating" the plant to the end of its licenses in 2050, and that roughly EUR 700 million of the capital expenditure needed to run the plant to 2050 remains pending investment decision.[52] These contracts transfer risk, with financial consequences that appear in Constellation's guidance as more than 20 percent base earnings growth through 2029.[29]

The instruments also sit outside the PPA frame deliberately. A PPA prices power from an asset, which makes it the wrong tool for a reactor that does not exist. For a first-of-a-kind reactor the binding constraint is development capital and schedule risk, so buyers are deploying prepayment, development capital with an offtake option, equity, and guarantees. Judged as PPAs, each looks weak. Judged as what they are, each transfers real risk. Nvidia's $105 billion residual value guarantee, though it backs a data center and is a cap on contingent obligations that OpenAI has agreed to reimburse rather than a funded commitment, is a larger exposure than any nuclear PPA.

Where the bullish case is weakest. It is almost entirely an argument about existing reactors, as Constellation's 920 MW with zero new build shows. The affirmative evidence establishes that hyperscaler demand has recapitalized the existing US nuclear fleet. It does not establish that this demand has financed a single new advanced reactor.

What stands between a new reactor and a hyperscaler contract

No hyperscaler has said why it has not signed. What follows is a reading of the evidence across the report's chapters, not a reason any buyer has given.

Timing. Hyperscalers need power on the schedule of their computing buildout, inside this decade. The earliest new advanced reactor with a named buyer, Kairos at Hermes 2, is targeted for 2030; PacifiCorp's filing gives commercial operation for Kemmerer Unit 1 in fall 2031 while its own regulatory modeling assumes 2032,[33] and the first Natrium units Meta is funding are for as early as 2032.[19] Existing plants, restarts and uprates deliver sooner, and that is where hyperscaler money has gone.

Cost and schedule. A first-of-a-kind reactor has no cost history against which to price a twenty-year contract. The last generation of American projects ran years late and billions over budget, and MIT modeling, relayed in a national laboratory review, suggests small reactors may need more on-site labor per megawatt, not less (Chapter 6). The published benchmark ranges show the size of the gap a first contract has to close. Lazard's July 2026 estimates of unsubsidized levelized cost, in dollars per megawatt-hour:

Technology	Unsubsidized LCOE
Onshore wind	37 to 99
Utility-scale solar	40 to 98
Gas combined cycle	51 to 129
Solar plus storage	61 to 156
Gas peaking	144 to 276
Nuclear, new build	175 to 255

Lazard, *Levelized Cost of Energy+*, version 19.0, July 2026. Ranges are unsubsidized and read from the chart on the report's printed page 7.[53]

Advanced reactors are absent from that table because Lazard does not put them in it. The same chart carries two illustrative single-point estimates, marked as not comparable with the ranges above: a nuclear restart at about $71 per megawatt-hour, drawn from the announced Crane, Duane Arnold and Palisades projects, and a small modular reactor at about $214, built from disclosed capital costs at Clinch River, Darlington and Natrium. Lazard calls the second "highly illustrative and not directly comparable to other technologies presented herein given expected commercial operation dates of 2030 and beyond".[53]

Two things follow. The established technologies have prices a buyer can sign against, and the advanced reactors have an estimate, dated 2030 and beyond, that the analyst publishing it declines to treat as comparable. A buyer being asked to commit for twenty years is being asked to price that gap. And the restart figure, at about a third of a new build and below the cost of a gas peaker, is the quantified form of what Google said in its own words on October 6. The cheapest nuclear megawatt on Lazard's chart is one that already exists.

The instrument. A power purchase agreement prices output from a plant. Before the plant exists, what a buyer can usefully offer is development capital, an option or equity, and that is what hyperscalers have offered.

Fuel. Twelve of the twenty-four developers depend on HALEU, which is rationed, and the enrichment capacity meant to replace Russian supply arrives after the 2028 import cutoff (Chapters 2 and 3).

Permission. The data centers that would use the power are losing local support quickly, which adds its own risk to any site a contract would name (Chapter 8).

The loop. Lenders will not finance a first plant without a signed contract, and buyers are reluctant to sign until cost and schedule are proven (Chapters 1 and 5). Someone has to go first.

None of this says the demand is false. Together, these explain why hyperscaler capital has arrived as equity and options rather than as contracts. They are also the list of what would have to change before the first contract is signed.

The finding

Hyperscaler money has recapitalized the existing nuclear fleet, but no hyperscaler has yet signed a binding long-term power purchase agreement for a new-build advanced reactor.

On the existing fleet, the skeptics are wrong. The evidence is roughly 6.9 GW that Carnegie assesses these arrangements could provide by the early 2030s, four plants rescued from closure

or subsidy dependence, federal loans closed, and contracted revenue visible in company guidance.

On new-build advanced nuclear, the skeptics are right on the current record. Two projects have site work under way, both with utility offtakers, though no public source confirms that nuclear safety-related construction has begun on either. Every hyperscaler advanced-nuclear figure is non-binding, optional or contingent by the issuers' own language, and Oklo's SEC filings say so in those words.

The most defensible reading is that capital is arriving in sequence, not that the commitments are false. The order makes sense. Recontract the existing fleet, fund restarts with federal debt, take equity and prepay positions in developers, and only then sign binding new-build offtake. The first three have happened. The fourth has not.

The buyer did change, which answers the question Chapter 1 asked. What the new buyer has not yet done is sign the contract that lets a new reactor get built.

Sources

Notes are numbered per chapter. Each carries a source-interest tag: `[regulator]` for government and agency documents, `[reporting]` for independent journalism and trade press, `[company]` for a subject describing itself, `[analyst]` for banks, consultancies and law firms that earn fees in the sector, and `[advocacy]` for organizations with a declared stake in the outcome. Fifty of this chapter's 53 notes carry an Internet Archive capture, so a reader can check what a page said on or near the date it was read. Of the 78 captures cited, 34 were made September 18, 2026 and 17 on September 21, 2026; the rest date from December 2025 to October 2026. Sources added to notes in the days before the freeze date largely carry none; the back matter states what is outstanding.

1. [advocacy] Nuclear Innovation Alliance, US Nuclear Energy Project Tracker update, May 7, 2026. nuclearinnovationalliance.org, archived September 18, 2026 "Two advanced reactors with commercial offtake have now broken ground on nuclear side construction in the United States": Kairos Hermes 2, 50 MW, with a TVA PPA; TerraPower Natrium, up to 500 MW, with Rocky Mountain Power.

2. [reporting] World Nuclear News, "Google signs up for power from future fusion plant," July 1, 2025. world-nuclear-news.org, archive lookup Describes "an investment and offtake agreement with Commonwealth Fusion Systems for 200 MW of power from its first ARC commercial fusion plant which is to be built in Virginia."

3. [company] Constellation Energy, "Constellation to launch Crane Clean Energy Center," September 20, 2024. constellationenergy.com, archived September 18, 2026 Contract price is not disclosed in any public source. World Nuclear News, "Crane Clean Energy Centre on track for ahead-of-schedule restart," June 26, 2025. [reporting] world-nuclear-news.org, archived December 9, 2025 Source of the acceleration: the unit "could restart as early as 2027," against the 2028 target first announced.

4. [company] Talen Energy, "Talen Energy expands nuclear energy relationship with Amazon," June 11, 2025. ir.talenenergy.com, archived September 18, 2026

5. [company] Fortum, inside information release, "Fortum and Google partner to drive sustainable growth in Finland, sign nuclear power purchase agreement," September 9, 2026. fortum.com, archived September 18, 2026 Filed as inside information under the Market Abuse Regulation. Some secondary coverage describes Google acquiring a 50 percent stake; the issuer describes a capacity share under a PPA with no equity, and the issuer text is used here.

6. [company] Vistra Corp., "Vistra and Meta Announce Agreements to Support Nuclear Plants in PJM and Add New Nuclear Generation to the Grid," January 9, 2026. investor.vistracorp.com, archive lookup Source of the 2,609 MW total, the 2,176 MW from existing operations at Perry and Davis-Besse, the 433 MW of uprates across all three plants, the 20-year term and the phase-in through 2034. Reporting at note 14 gives "more than 2.1 GW" and places the uprates at the Ohio plants; the company's own figures are used here.

7. [reporting] Utility Dive, "DOE intends to loan Vistra $4.2B for nuclear fleet improvements," October 6, 2026, reporting a Department of Energy announcement of October 5, 2026. utilitydive.com, archived October 12, 2026 Source of the $4.2 billion figure, the conditional-commitment characterization, the Office of Energy Dominance Financing as the lending office, the three plants and the

Comanche Peak option, the 433 MW of uprates, and the conditions outstanding before definitive documents. The 433 MW is the same uprate capacity contracted to Meta at note 6, which is why the financing and the offtake are discussed together here.

8. [company] Constellation Energy, "Constellation and Amazon Announce 20-Year Power Purchase Agreement at Calvert Cliffs," September 30, 2026. constellationenergy.com, archive lookup Source of the 690 MW contracted, the twenty-year term, the 1,790 MW plant rating, the approximately 190 MW of new capacity arriving between 2030 and 2032, the statement that the output "will continue flowing to the PJM regional grid," the relicensing language and the figure of more than $3 billion in Maryland infrastructure investment. Both parties benefit from the agreement being read as a commitment to nuclear generation. The contracted volume, the term and the plant rating are matters of record; what the companies say the contract enables is their own characterization.

9. [company] Amanda Peterson Corio, Global Head of Data Center Energy, Google, "Why we're backing America's existing nuclear plants," October 6, 2026. blog.google, archived October 16, 2026 Source of the title and of both quoted passages. The post gives no timeline or availability date for new-build advanced reactors; its only forward date, before the end of 2032, applies to the uprate projects. Google's separate plan with Kairos Power and TVA to deploy advanced reactors in Tennessee is described in the same post without a schedule. This is an interested party explaining a purchase it has just made, and the explanation happens to be the finding of this chapter.

10. [company] Google and Constellation Energy, "Google and Constellation Announce Landmark Agreement to Bring 890 MW of New Nuclear Capacity to PJM Grid as Part of Long-Term Power Deal," October 6, 2026. googlecloudpresscorner.com, archived October 12, 2026 Source of the twenty-year term, the 890 MW of uprate capacity, the eleven units across six sites, the more than $4.3 billion of Constellation investment, the first uprate expected by 2028, and the separate fifteen-year energy supply agreement for 2,700 MW. The release does not use the word "binding." A third instrument, a strategic framework to "evaluate opportunities to develop new clean generation, storage and demand response" with near-term effort prioritized in PJM, carries no megawatt figure, no term and no commitment to build, and is therefore not counted here as an arrangement of this kind. Corroborated by Utility Dive, "Constellation, Google deal will bring 890 MW of new nuclear to PJM," October 6, 2026, [reporting] utilitydive.com, archived October 16, 2026 . The release calls the 890 MW "entirely new" capacity, which is accurate as added output and should not be read as new-build generation.

11. [reporting] *Utility Dive*, "NextEra, DOE loan, Duane Arnold nuclear restart," September 8, 2026. utilitydive.com, archived September 18, 2026 Crane loan from NucNet, nucnet.org, archived September 18, 2026 Neither of those sources covers the other two items in the same sentence. The Palisades disbursement is from U.S. Department of Energy, "DOE Approves Sixth Loan Disbursement to Restart the Palisades Nuclear Plant," September 16, 2025, [regulator] energy.gov , giving $155,944,659 as the sixth disbursement to Holtec since the September 2024 financial close. The AP1000 supply chain commitment is from American Nuclear Society, Nuclear Newswire, "DOE announces $17.5B in conditional loans for AP1000 builds," June 23, 2026, [reporting] ans.org . Oracle's Point Beach arrangement is from BizTimes Milwaukee, Andrew Weiland, "User of Port Washington data center commits to absorb $300 million in rising costs for Point Beach Nuclear Plant," October 2, 2026, [reporting] biztimes.com Accessed October 18, 2026, which reports that Oracle will subscribe to "a portion of the existing electricity generation" at the plant, gives no megawatt figure, and says the arrangement is subject to approval by the state's Public Service Commission. Urban Milwaukee, republishing Wisconsin Watch, "We Energies Makes Deal to Power Oracle Data Center with Nuclear Energy," October 5, 2026, [reporting] urbanmilwaukee.com Accessed October 18, 2026, puts the share at 10 to 20 percent of the plant's generation, a range rather than a contracted figure, so it is not counted.

12. [company] Constellation Energy, "Constellation, Meta sign 20-year deal for clean, reliable nuclear energy in Illinois," June 3, 2025. constellationenergy.com, archived September 18, 2026

13. [company] Kairos Power, "Google, Kairos Power, TVA collaborate to meet America's growing energy needs," August 18, 2025. kairospower.com, archived September 18, 2026 Corroborated by American Public Power Association, publicpower.org, archived September 18, 2026 PPA term length and price are not disclosed.

14. [reporting] *Utility Dive* reporting on Meta's January 9, 2026 nuclear agreements. utilitydive.com, archived September 18, 2026 This coverage does not apply the label power purchase agreement to the TerraPower arrangement, which it describes as funding plus rights to energy. The 2.8 GW baseload and about 4 GW with storage figures, and the delivery of initial units as early as 2032, are from TerraPower's own release at note 19 and not from this coverage. It describes the Vistra arrangements as agreements to purchase power rather than as PPAs; the PPA label on those is Vistra's own, at note 6.

15. [reporting] World Nuclear News, "Entergy to consider deployment of Holtec's SMR-300," August 2026. world-nuclear-news.org Source of the memorandum of agreement of August 5, 2026 between Holtec, Entergy and Hyundai Engineering and Construction, of its description as non-binding, of the four states named and of the large-load industrial and data center target. The absence of any announced offtake for the Pioneer units at Palisades is a negative finding from the NRC project record and the company's own releases rather than a stated fact.

16. [reporting] POWER Magazine, "TVA, ENTRA1 sign agreement for 6 GW, six-plant nuclear SMR collaboration," September 2, 2025. powermag.com, archived September 18, 2026

17. [company] Fermi Inc., "Fermi and TensorWave Agree to Extend Closing Date to October 31," September 22, 2026, via StockTitan. stocktitan.net Source of the parties as Fermi Campus 1 LLC and TensorWave TEX1, LLC, the First Amendment to the Data Center Lease and Services Agreement, the 222 MW of total facility power for phase one, the fifteen-year initial term, the approximately $6.5 billion of expected total revenue, the move of the closing date from September 30 to October 31, 2026, the four quoted closing conditions and the continuing negotiation of a guaranty with an investment-grade counterparty. Fermi's own announcement of August 10, 2026 is headed "Fermi Announces Binding Lease Agreement with TensorWave," investor.fermiamerica.com , and calls it a turnkey data center lease; the September release states that its effectiveness is conditional on the closing conditions being satisfied or waived. Both are true, and the distinction between a binding instrument and an effective one is the point of this entry. Expansion rights beyond the initial facility are referred to in the release's forward-looking statements without a megawatt figure; trade reporting puts the total at up to 650 MW across two further data centers, per Data Center Dynamics, [reporting] datacenterdynamics.com, archived October 16, 2026 . The AMD agreement is from Fermi Inc., "Fermi Signs Credit Support Agreement with AMD and Announces Partnership," October 13, 2026, via Newswire, [company] newswire.com Accessed October 18, 2026, which describes the agreement as "supporting a lease for phase one of Fermi's Project Matador energy and AI buildout" and calls it a key milestone toward securing project financing. The release names TensorWave only in its forward-looking statements,

which still list satisfaction of the conditions "to the closing of the TensorWave lease" among the risks. Data Center Dynamics, "Fermi and AMD sign credit support deal for build-out of Project Matador campus in Amarillo, Texas," October 14, 2026, [reporting] datacenterdynamics.com Accessed October 18, 2026, describes AMD as "acting as a guarantor as Fermi seeks to secure financing for its initial data center build-out"; that is the publication's characterization, not a term of the agreement.

18. [reporting] Data Center Dynamics, "Fermi share price craters as tenant pulls back from $150m Texas data center deal," December 2025. datacenterdynamics.com, archived October 16, 2026 Source of the non-binding letter of intent of September 2025 with an unnamed investment-grade-rated tenant, its approximate $150 million value, its termination in December 2025 on expiry of the exclusivity period, and the share price fall of as much as 46 percent. The tenant was never named, so the counterparty's own account of the termination is not available.

19. [company] TerraPower, "TerraPower announces deal with Meta," January 9, 2026. terrapower.com Source of the funding for two Natrium units, the rights to energy from up to six more, the delivery dates and the absence of an identified site for any of the units, initial or later. The release does not use the phrase power purchase agreement. Reported alongside the Vistra and Oklo components of the same announcement by POWER, "Meta locks in up to 6.6 GW of nuclear power through deals with Vistra, Oklo and TerraPower," [reporting] powermag.com .

20. [company] Oklo Inc., quarterly report on Form 10-Q for the period ended June 30, 2026, for the characterization of the agreements to purchase power as non-binding. sec.gov The prepayment agreement is described in the company's own announcement of the 1.2 GW southern Ohio agreement with Meta of January 2026, corroborated by counsel to the transaction, Orrick, "Oklo, Meta Announce Agreement in Support of 1.2 GW Nuclear Energy Development in Southern Ohio," [reporting] orrick.com . Neither the announcement nor the 10-Q characterizes the prepayment as binding, and that word is not used here. This filing labels as non-binding the Equinix, Diamondback and Prometheus letters of intent; the generic non-binding characterization of power purchase agreements with potential customers is in the 10-K at note 26. The prepayment and the offtake are separate instruments inside one announcement, and conflating them in either direction misstates the commitment.

21. [advocacy] American Public Power Association, "Google signs strategic agreement to develop locations for advanced nuclear projects," May 7, 2025. publicpower.org, archived September 18, 2026

22. [advocacy] Molly Langabeer and M.V. Ramana, *Bulletin of the Atomic Scientists*, "Data centers powered by next-gen nuclear? Don't fall for big tech's PR hype," July 20, 2026. thebulletin.org, archived September 18, 2026 Advocacy-adjacent analysis; carried as argument, with its figures checked against company disclosures where possible.

23. [company] X-energy, "X-energy Closes Upsized $700 Million Series C-1 Financing Round," February 6, 2025, Business Wire. businesswire.com, archive lookup The release states the closing of "its upsized Series C-1 financing round of $700 million" and names Amazon's Climate Pledge Fund among the investors, alongside an affiliate of Citadel founder Ken Griffin, affiliates of Ares Management, NGP and the University of Michigan. Amazon's individual contribution is not disclosed in this release or in the October 2024 announcement that preceded it, which gave the round as approximately $500 million. The $500 million figure still circulates widely and is the announced size of the round, not Amazon's commitment.

24. [company] Oklo Inc., "Oklo, Meta announce agreement in support of 1.2 GW nuclear energy development in southern Ohio," January 9, 2026. oklo.com, archived September 18, 2026 The release names no legal instrument, no dollar amount, no term and no termination conditions.

25. [reporting] Data Center Knowledge, "Nvidia backs OpenAI's Ohio data center buildout with $105B guarantee," August 19, 2026, citing Nvidia's 8-K filed August 17, 2026. datacenterknowledge.com, archived September 18, 2026

26. [company] Oklo Inc., Form 10-K for fiscal year 2025. sec.gov, archived September 18, 2026

27. [company] Oklo Inc., Form 10-Q for the period ended June 30, 2026. sec.gov, archived September 18, 2026

28. [company] X-energy, second quarter 2026 results, August 13, 2026. investors.x-energy.com, archived September 18, 2026

29. [reporting] Investing.com, reporting Constellation's Q2 2026 presentation, August 6, 2026. investing.com, archived September 18, 2026

30. [reporting] POWER Magazine, "Aalo, Crusoe plan 2027 INL demonstration pairing nuclear power and AI data center load." powermag.com, archived September 18, 2026 Corroborated by Crusoe, crusoe.ai, archived September 18, 2026 [company]. Neither party has published a dollar figure or a power purchase agreement.

31. [company] Crusoe, "Crusoe Announces New 900 MW AI Factory Campus in Abilene, Texas to Support Microsoft AI Infrastructure," GlobeNewswire, March 27, 2026. globenewswire.com, archive lookup Bergen Engines, "Bergen Engines Signs Approx. 750MW U.S. Power Agreement with Crusoe," June 3, 2026, [company] bergenengines.com, archived June 12, 2026, which gives "approximately a 438MW contract and 310 MW letter of intent". Crusoe and Lancium, "Crusoe and Lancium Announce 1.0 Gigawatt AI Data Center Campus in Childress, Texas," July 15, 2026, [company] crusoe.ai, archive lookup. Crusoe, "Crusoe and ON.energy to Deploy 5 GW of AI UPS at Multiple Hyperscale Campuses," July 21, 2026, [company] crusoe.ai, archive lookup.

32. [regulator] U.S. Army, "Army reaches agreement with private industry for nuclear micro-reactors," August 26, 2026. army.mil, archived September 18, 2026 See Chapter 9.

33. [company] PacifiCorp, "Application for Approval of Water Use and Conveyance Agreement and Request for Waiver of Competitive Bidding Rules," Public Utility Commission of Oregon docket UM 2408, October 21, 2025. edocs.puc.state.or.us, archived September 21, 2026 PacifiCorp states that it has executed a 40-year power purchase agreement with US SFR Owner, LLC, a TerraPower subsidiary, for the output of Kemmerer Unit 1, and that the agreement, while fully executed, becomes effective only once the commission approvals defined in the contract are received, including approval of the water use agreement, which is a condition precedent, and a waiver of competitive bidding rules. The approvals obtained since are: Oregon, Order No. 26-146 of April 29, 2026 in this docket, approving the water use agreement and granting the competitive bidding waiver, with a request for reconsideration resolved by Order No. 26-304 of August 18, 2026; Idaho, Order No. 37049 of May 22, 2026 in Case No. PAC-E-25-20, waiving the commission's solicitation requirements, [regulator] puc.idaho.gov ; and Utah, Docket No. 25-035-55, order of June 1, 2026, [regulator] pscdocs.utah.gov . A California application under Public Utilities Code section 851, A.25-10-007, was still active on October 11, 2026, the last date its docket was checked; the proceeding's service list, consulted again on October 18, 2026, was last changed July 31, 2026, ia.cpuc.ca.gov [regulator]. No Wyoming approval requirement for this agreement could be established: the agreement does not appear in Rocky Mountain Power's own index of its Wyoming dockets, and no Wyoming condition is asserted

here. The Oregon and California orders are cited by order and docket number because no stable public document URL for either could be confirmed. Because the contract does not publish the full list of approvals it names, the report states which have been granted rather than that the set is complete. This is a filing by the utility describing its own contract, which is why it is tagged [company].

34. [company] Tennessee Valley Authority, "TVA First U.S. Utility to Receive Construction Permit for BWRX-300 Advanced Nuclear Reactor," September 29, 2026, PR Newswire. prnewswire.com, archive lookup Source of the first-utility and second-permit characterizations, of the statement that no construction date has been announced, and of the quoted passages from Mike Skaggs. The issuance is corroborated by Exchange Monitor, "NRC issues construct permit to TVA for Clinch River SMR project," September 29, 2026, [reporting] exchangemonitor.com which reports that the Commission "granted the Tennessee Valley Authority (TVA) a construction permit Tuesday," and by NucNet, September 29, 2026, [reporting] nucnet.org, archive lookup, which calls it "only the second commercial advanced reactor construction permit ever issued in the US" and the first for a BWRX-300. The NRC had published no release and had not updated its project page when this was written. The issue date is from Federal Register, "Tennessee Valley Authority; Clinch River Nuclear Unit 1; Construction Permit and Record of Decision," October 5, 2026, [regulator] federalregister.gov That notice states that "The Construction Permit No. CPAR-2 was issued on September 28, 2026" and records a Record of Decision of the same date. The company and trade-press items above are dated September 29, the day the issuance was made public.

35. [company] Blue Energy, "Blue Energy, GE Vernova Hitachi Sign Agreement to Launch Next Phase of Texas Gas-Plus-Nuclear Project," August 13, 2026. blueenergy.co, archive lookup Source of the 2.5 GW total, the two gas turbines in 2030, up to five BWRX-300 units from 2032, the unnamed nearby data center and the 2027 final investment decision. No power purchase agreement or offtake is described. The same release was issued by GE Vernova. Blue Energy submitted the first part of an NRC construction permit application for the first unit on September 16, 2026.

36. [regulator] Federal Register, "Blue Energy Global, Inc.; Blue Energy Center-Port of Victoria Nuclear Unit 1; Phased Construction Permit Application-Limited Work Authorization," October 8, 2026, 91 FR 64409. federalregister.gov, archived October 16, 2026 Docket No. 99902137. Source of the September 15, 2026 filing date, the limited work authorization request under 10 CFR 50.10(d), the two exemption requests, the environmental report and the 10 CFR 50.33 and 50.34 information, and of the statement that later notices will address docketing acceptability. The notice names the applicant inconsistently, as "Blue Energy Global, Inc." in the title and "Blue Energy, Inc." in the discussion. American Nuclear Society reporting gives the filing date as September 16; the Federal Register date is used here.

37. [company] The Nuclear Company, "Brookfield and The Nuclear Company Partner to Form New Company to Accelerate Nuclear Development in the U.S.," May 4, 2026. thenuclearcompany.com, archived July 14, 2026 Describes "two partially constructed AP1000 units near Jenkinsville, S.C." and makes development contingent on regulatory approvals, definitive agreements and a final investment decision. Santee Cooper, the state-owned utility, is described as supporting the company's role; no offtake is named.

38. [company] Alva Energy, launch announcement, February 12, 2026, as republished in POWER Magazine, "Nuclear Power Group Alva Energy Launches with $33 Million in Funding." powermag.com, archived May 17, 2026 Source of the 200 to 300 MWe per reactor and the financing model with large power consumers "including hyperscalers." No customer contract is announced.

39. [reporting] *Atlanta Journal-Constitution*, "Georgia Power deal to power OpenAI data center near Savannah is approved," August 27, 2026. ajc.com, archived September 18, 2026 Corroborated by Southern Alliance for Clean Energy, cleanenergy.org, archived September 18, 2026 [reporting] and Georgia Power, georgiapower.com, archived September 18, 2026 [company]. Georgia Power dates the approval August 26; reporting dates it August 27, likely a filing versus publication difference. The Shober sentence is quoted from the Southern Alliance for Clean Energy piece cited above, which carries her own byline and is dated August 17, 2026 with an update of August 28, rather than from a reporter's rendering of it. The Coyle and Sherrier quotations remain sourced to the AJC report, and both were confirmed against that page by a human reader on September 18, 2026, because it serves obfuscated text to anything but a browser and no mechanical check could reach them.

40. [reporting] *The Current*, "PSC boosts safeguards in Georgia Power's massive contract with OpenAI," August 27, 2026. thecurrentga.org, archived September 18, 2026 Source of the Tom Bond quotation, which does not appear in the Atlanta Journal-Constitution coverage cited at note 39. The 30-day no-action rule quoted in the text is from the same outlet's earlier report, Mary Landers, "Georgia Power extends deadline for PSC to consider its contract with OpenAI," The Current, August 13, 2026, [reporting] thecurrentga.org .

41. [reporting] *Texas Tribune*, "Texas data center project audit," August 3, 2026. texastribune.org, archived September 18, 2026 Corroborated by *Utility Dive*, utilitydive.com, archived September 18, 2026 Whether the pause had been lifted as of this writing could not be confirmed. The September 21, 2026 directive to the Texas Commission on Environmental Quality is from [analyst] Willkie Farr & Gallagher, "Texas Governor Halts Data Center Permits Pending ERCOT Audit: What Developers, Investors, and Lenders Need to Know," October 5, 2026, willkie.com Accessed October 19, 2026, which quotes the letter as directing the agency to "halt permits sought by data centers" and sets no end date beyond the audit, which ERCOT expects to report on or before December 10, 2026.

42. [company] Chevron, "Chevron Signs 20-Year Power Agreement with Microsoft for West Texas Data Center," June 22, 2026. businesswire.com, archive lookup Source of the 20-year power purchase agreement, the 2.67 GW figure, Permian gas, the final investment decision expected by the end of 2026 "subject to the completion of other necessary conditions", and first power anticipated in 2028. The release does not publish the agreement's conditions. Location near Pecos is from Data Center Knowledge, June 23, 2026, [reporting] datacenterknowledge.com, archive lookup.

43. [company] Pacifico Energy, "Pacifico Energy Secures 7.65 GW Power Generation Permit for GW Ranch Project," Business Wire, January 26, 2026. businesswire.com, archive lookup Source of the 7.65 GW air permit. The off-grid design and the first-quarter 2027 first power date are from Pacifico Energy, "GW Ranch," [company] pacificoenergy.com, archived August 12, 2026, which says the plant "does not draw from or add load to the ERCOT grid". Amazon's ownership is from ENR, "Amazon Discloses Ownership of GW Ranch," August 11, 2026, [reporting] enr.com, archive lookup. The comparison with US gas plants and "at least initially" are from Cleanview, August 7, 2026, [reporting] newsletter.cleanview.co, archived August 25, 2026, which calls it what "could be the largest natural gas power plant ever built in the United States" and says it would be disconnected from the Texas grid "at least initially." An AFP report of the same day was cited here at a Yahoo Finance address that no longer resolves, live or archived, and is no longer cited.

44. [regulator] The White House, "Ratepayer Protection Pledge," March 4, 2026. whitehouse.gov, archive lookup Signatories per the accompanying fact sheet: Amazon, Google, Meta, Microsoft, OpenAI, Oracle and xAI.

45. [regulator] Federal Energy Regulatory Commission, order rejecting the amended interconnection service agreement, 189 FERC ¶ 61,078, Docket ER24-2172, November 1, 2024. ferc.gov, archived December 13, 2025 "In this order, we reject the Amended ISA." The co-located load figures of 300 MW and 480 MW appear in the order's own opening paragraph, and are corroborated by Utility Dive, November 4, 2024, [reporting] utilitydive.com, archived September 3, 2026. The April 10, 2025 rehearing order, Docket ER24-2172-002, upheld the rejection by the same 2-1 vote, per RTO Insider, April 11, 2025, [reporting] rtoinsider.com, archive lookup.

46. [company] X-energy, IPO pricing release, April 23, 2026, and Q2 2026 results, August 13, 2026. x-energy.com, archived September 18, 2026 The pricing release gives the base offering as 44,254,659 Class A shares at $23.00; the Q2 2026 results and the Form 10-Q for the period ended June 30, 2026 state that the company issued and sold 50.9 million shares for net proceeds aggregating approximately $1.1 billion, and that is the figure used here. Trading levels from StockAnalysis, [reporting] stockanalysis.com, archived September 18, 2026 showing a close of $14.93 on September 11, 2026.

47. [company] Holtec International, company statement on the postponement of the Holtec Nuclear Corporation initial public offering, September 17, 2026. holtecinternational.com, archived September 30, 2026 Source of the postponement, its date, the quoted phrase "a perfect storm of adverse developments," and the attribution of part of the cause to data center uncertainty. The withdrawal is from [company] Holtec Nuclear Corporation, "Request for Withdrawal of Registration Statement on Form S-1," File No. 333-297395, filed on Form RW, September 25, 2026. sec.gov The letter requests withdrawal under Rule 477 because the company "no longer wishes to conduct a public offering of securities at this time," and records that the registration statement was never declared effective and that no securities were issued or sold under it. This is the issuer explaining a decision against its own interest, which is the circumstance in which a company statement carries most weight; the weighting of causes is still the company's. Holtec International and Holtec Nuclear Corporation are distinct entities and both the postponement and the withdrawal are the latter's.

48. [company] Valar Atomics, "Announcing our $1B Series B Led By Sequoia," August 4, 2026. valaratomics.com, archived August 29, 2026 Source of the $1 billion Series B led by Sequoia Capital and the "$200 million credit facility led by Erebor Bank, as administrative agent, and J.P. Morgan, alongside Crescent Cove and Hercules Capital". The release does not state the facility's purpose. The earlier $110 million of debt, alongside $340 million of equity at a $2 billion valuation, is from The Next Web, "Valar Atomics raises $450M at $2B valuation to power AI with small nuclear reactors," April 1, 2026, [reporting] thenextweb.com, archive lookup.

49. [reporting] TechCrunch, "Sequoia's Shaun Maguire leads $1B round for nuclear startup Valar Atomics," August 3, 2026. techcrunch.com, archived August 8, 2026 Reports Bloomberg's figure of a $6 billion valuation, which the company did not disclose. Corroborated by The Next Web, August 3, 2026, [reporting] thenextweb.com, archived August 9, 2026.

50. This report's arithmetic, dividing each federal loan ceiling by the plant capacity stated in the source: $1.9 billion over 615 MW for Duane Arnold, per note 22; $1.52 billion over 800 MW for Palisades, from POWER Magazine, "DOE Finalizes $1.52B Palisades Loan for First-Ever U.S. Nuclear Plant Recommissioning," September 30, 2024, [reporting] powermag.com, archived September 14, 2026, which describes a loan guarantee; and $1 billion over 835 MW for Crane, from U.S. Department of Energy, "Energy Department Closes Loan to Restart Nuclear Power Plant in Pennsylvania," November 18, 2025, [regulator] energy.gov, archived September 7, 2026. The removals are from U.S. Nuclear Regulatory Commission, "Duane Arnold Energy Center Environmental Presentation," August 7, 2025, ADAMS ML25219A021, [regulator] nrc.gov, archived September 21, 2026 which lists the mechanical draft cooling towers, the generator output transformer and in-scope transmission lines as removed, and new cooling towers and restoration of the transmission lines among planned changes. Corroborated by World Nuclear News, "NextEra updates NRC on Duane Arnold plans," August 13, 2025, [reporting] world-nuclear-news.org, archived January 13, 2026 which adds that the main power block buildings remain intact. The NRC presentation gives the plant's output as 610 MWe; the loan documents use 615 MW. Accessed September 21, 2026.

51. [advocacy] John Pendleton and Mackenzie Schuessler, Carnegie Endowment for International Peace, "Beyond the hype: assessing hyperscaler nuclear commitments against US energy realities," June 2, 2026. carnegieendowment.org, archived September 18, 2026

52. [company] Talen Energy, June 11, 2025, ir.talenenergy.com, archived September 18, 2026 ; Constellation Energy, June 3, 2025, constellationenergy.com, archived September 18, 2026 ; Fortum, September 9, 2026, fortum.com, archived September 18, 2026 All three are issuer descriptions of their own contracts, used here for what each company says the contract does for its own balance sheet.

53. [analyst] Lazard, *Levelized Cost of Energy+*, version 19.0 (LCOE) and 11.0 (LCOS), July 2026. lazard.com, archive lookup Source of every figure in the table, all unsubsidized, and of the two illustrative single-point estimates. Those two are plotted as markers on the same chart under "Other Illustrative Analyses," the restart carrying Lazard's footnote 7 and the small modular reactor its footnote 8; neither is published as a range. The orange diamonds on that chart, including $87 on the gas peaking row and $31 on the nuclear row, are marginal cost midpoints for existing plants and not levelized costs. The values here were read from the chart itself. Lazard is an investment bank that advises and finances in the energy sector, which is why this note carries the analyst tag rather than the reporting tag. The restart and small modular reactor rows are labeled illustrative in the report itself, the restart row reflecting sites where "existing sites, interconnections and infrastructure can be leveraged".

Chapter 8: Welcome Reactors, Unwelcome Data Centers

Gallup's March 2025 survey found 61 percent of Americans favor nuclear energy, one percentage point below the all-time high of 62 percent recorded in 2010.[1] On the national question, nuclear is winning.

A reactor built to serve a data center, though, needs permission twice: once for itself and once for the facility it powers. Nuclear is winning its public argument. Data centers are losing theirs. On identical polling wording, local opposition to a data center being built nearby rose from 42 percent to 75 percent in twelve months, and the loss already shows in blocked capital, state legislation and campaign advertising. The earlier constraints in this report were physical, industrial or contractual. This one is political, and on the current evidence it is tightening faster than any of them.

The backlash blocks the one transaction that binds the two industries, a data center buying power from a reactor. What follows documents both trajectories, then makes an argument that is labeled as such, because the documentation is well evidenced and the argument is a recommendation.

Nuclear is winning the abstract argument

The composition of that support matters as much as the number. Republicans 74 percent, independents 64 percent, Democrats 46 percent. Republicans rose 12 points and independents 8 points since 2023. Democratic support has exceeded 50 percent only four times since tracking began in 1994. The only year opposition exceeded support was 2016, when 54 percent opposed.[1]

The recovery is real, large and asymmetric. Nuclear became a majority position by winning Republicans and independents, not by persuading the coalition that opposed it in the first place.

A global survey shows how far that support rests on belief rather than information. The Nuclear Confidence Project, conducted in December 2025 among 26,545 people in 34 countries by Radiant Energy Group, a nuclear research and advisory firm, found that 44.9 percent think nuclear is a no- or low-carbon source, against 64.3 percent for solar and for wind. Nuclear also ranked third of the three on perceived reliability.[2] On the IPCC's median lifecycle estimates, nuclear and wind emit about the same per kilowatt-hour and both emit far less than utility-scale solar.[3] In countries that have phased out nuclear or strongly considered it, the survey finds the pattern reversed on cost: in Taiwan, 59.9 percent said more nuclear would lower their energy costs, against 30.5 percent for wind and 34.9 percent for solar.[2] The survey comes from an interested party, and the figures are its own.

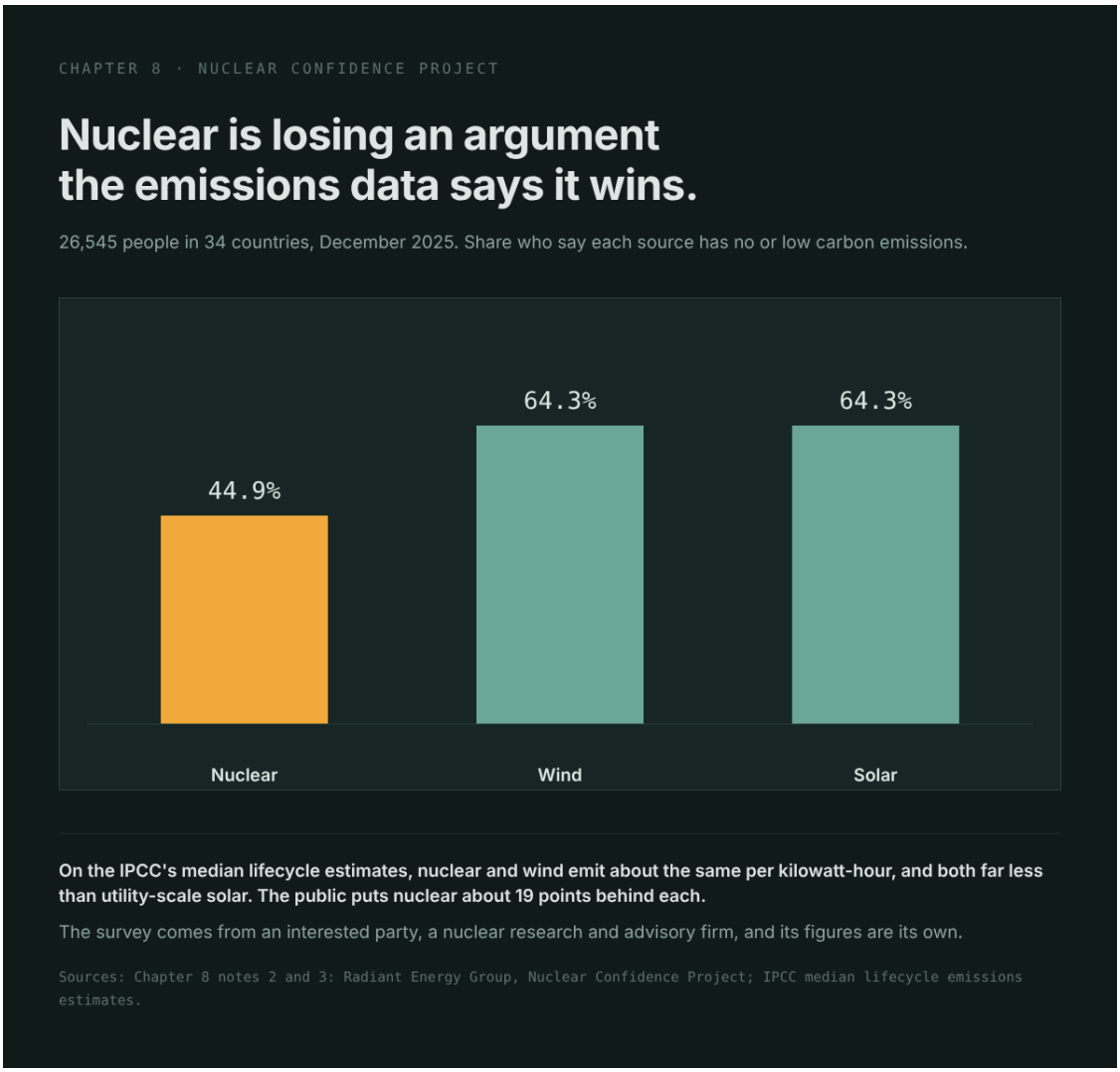


Figure 8.1. In a 34-country survey by a nuclear advisory firm, nuclear trails solar and wind by about 19 points on perceived carbon emissions.

> **Nuclear is winning its public argument. Data centers are losing theirs.**

Local opposition to data centers jumped in one year

The cleanest evidence comes from one pollster asking the same question a year apart. Embold Research, for Heatmap, asked registered voters whether they would support or oppose a data center being built near where they live. In fieldwork of August 22 to 29, 2025, 44 percent supported and 42 percent opposed. In fieldwork of August 8 to 13, 2026, 75 percent opposed, and more than six in ten strongly.[4]

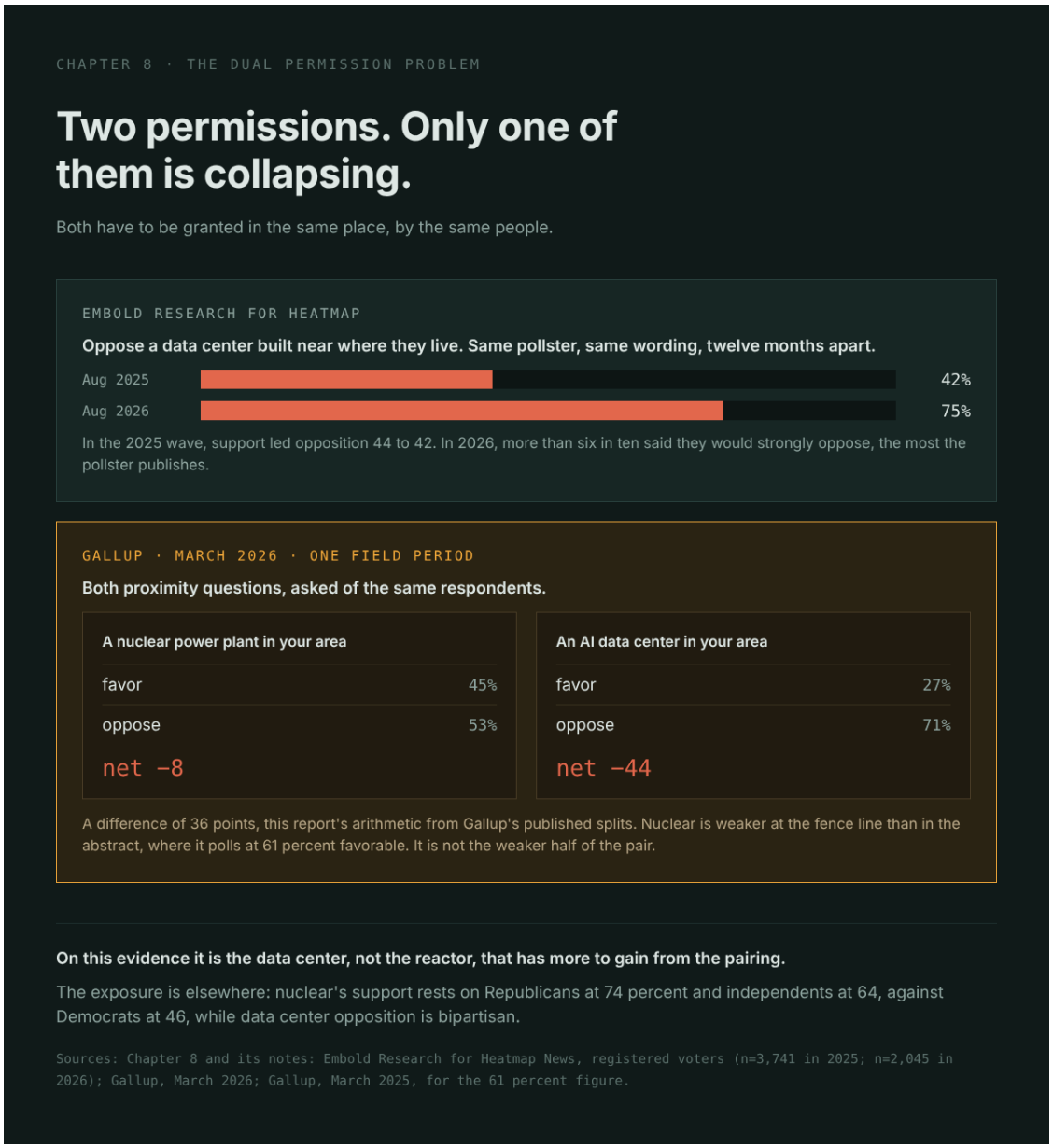


Figure 8.2. Local opposition to a nearby data center rose from 42 to 75 percent in a year. Asked the same way, a local nuclear plant nets minus 8 and a local data center minus 44.

Gallup's March 2026 fieldwork corroborates the shift with a different question, finding 71 percent opposed to an AI data center in their local area and 27 percent in favor.[5] An Economist and YouGov survey, fieldwork August 28 to 31, 2026, found 63 percent opposed to data center construction in their community.[6]

Four pollsters in the same year therefore put local opposition between 57 and 75 percent, with the August Embold wave at the top of that band and the June Reuters and Ipsos wave, given below, at the bottom. The sub-figure inside it needs stating carefully, because it is widely quoted at a precision its source does not carry. Heatmap publishes only that "more than six in 10 Americans say they would strongly oppose such a proposal." The figure of 61 percent that

circulates for this wave comes from secondary reporting rather than from the pollster, and neither Embold nor Heatmap has published a topline table or crosstabs for it.[4] On the strongly-opposed share Embold is an outlier, and this chapter's own sources are what show it. Gallup put strong opposition to a local AI data center at 48 percent in March 2026, and the Economist and YouGov at 46 percent in August.[5], [6] More than six in ten means at least 61 percent, which is thirteen points above the first and fifteen above the second. A share that high is attainable in some populations: the UMBC Poll, released October 8, 2026, asked Maryland likely voters, "In general, would you [support or oppose] a new data center being built near your community?" and found 63 percent strongly opposed, 14 percent opposed, 13 percent in support and 3 percent strongly in support.[7] But that is one state, likely voters rather than adults, and a four-point scale. The 75 percent total is corroborated in direction and roughly in level. The strongly-opposed share is not the national figure.

On national policy, a Reuters/Ipsos survey in June 2026 found 64 percent disagreed with the statement that it is mainly a good thing to build data centers at a rapid pace, and 77 percent said they were worried AI would make electricity more expensive. The same survey put opposition to a data center being built in the respondent's own community at 57 percent, which is the bottom of the band above.[8] The second question asked about AI, not data centers, and is not restated here as a data center finding.

The capital consequences arrived as fast. Data Center Watch's Q1 2026 report found at least 75 projects worth approximately $130 billion blocked or delayed between January and March 2026 alone. It also recorded opposition activity across 49 states, more than 300 state data center bills filed in the first six weeks of the year, and statewide moratorium proposals in 14 states from both parties.[9] Those were proposals. By the autumn they were being enacted: in the single week of October 5 to 9, 2026, moratoriums or restrictive zoning passed in Anne Arundel County in Maryland, Oakland and Mendocino County in California, Raleigh in North Carolina, Old Town in Maine and Allen Township in Ohio, first readings advanced in Grand Junction in Colorado and Hillsboro in Oregon, Lexington in Kentucky extended its own through October 2027, and in the same period the Cheyenne and Arapaho Tribes approved a three-year moratorium on tribal lands by a vote of 261 to 83, held on October 3. Memphis postponed its vote, and police then cleared the chamber after protesters chanted.[10]

The $130 billion and the 49 states are that organization's count. Data Center Watch does not disclose its ownership, sponsorship or funding anywhere on its site, which lists only a contact address, and no independent source carrying either figure was found. They are used because they were the only systematic tally of blocked projects located for that period, and the polling and legislative record corroborate their direction. The totals have not been verified. A trade outlet repeated the count in October 2026 while reporting Amazon's response to the backlash, which widens its circulation without improving its provenance. The figure the chief executive of Amazon Web Services gave on that occasion was a different one: more than 100 data center moratoriums under consideration nationally.[11]

For scale, the same organization's earlier edition found $64 billion blocked or delayed across 142 activist groups in 24 states, with opposition among elected officials running 55 percent Republican and 45 percent Democrat.[12] Its research period was eleven months, May 2024 to March 2025.

A newsroom has since produced a larger tally on a different measure, and the two should not be run together. Heatmap Pro reported on October 6, 2026 that at least $260 billion of data center investment was canceled during 2026 after sustained local opposition, that about $130 billion of it was canceled in the three months ending September 30, that roughly $1 trillion now faces sustained or meaningful local opposition, and that about half of all projects meeting local backlash this year were ultimately canceled.[13] Two cautions. Heatmap measures cancellation, where Data Center Watch measures blocked or delayed, so the counts are not interchangeable; and the two $130 billion figures in this chapter are different quantities, one blocked or delayed from January to March and one canceled from July to September. Heatmap says its own figures are likely an undercount, because only about 60 percent of data center projects disclose the size of a planned investment, and that they exclude projects stalled by the state-level moratoriums in Texas and New York. What the Heatmap number does improve is provenance. It comes from a newsroom that publishes its method and its caveats, which the tally at note 9 does not.

The totals are not cleanly comparable, because the earlier edition researched eleven months and then described its activity as occurring over "the last two years," an inconsistency in the source itself. Still, a single quarter of 2026 produced a larger total than an edition covering somewhere between eleven and twenty-four months.

Data centers are now a campaign issue

The 2026 midterms have made data centers a campaign issue across party lines, which should worry anyone treating this as a normal siting fight. In Ohio, Democrat Sherrod Brown has run advertising calling the Republican incumbent "the face of data centers." In Texas, Democrat Gina Hinojosa attacked Governor Abbott as too sympathetic to data centers, and Abbott subsequently endorsed an audit of data center development. In Pennsylvania, Democratic Governor Josh Shapiro moved from support to restriction after Republican opposition and signed an executive order imposing new authorization rules. A *Washington Post* analysis found Republicans more negative toward data centers than Democrats, with both groups turning more negative between 2024 and 2026.[14]

An issue moving both parties the same way will not resolve through one side winning.

Both parties' governors reach for the same tools

Georgia's redacted contract and Texas's interconnection audit (see Chapter 7) belong to a wider wave with a consistent shape.

Texas, June and August 2026. Abbott first directed regulators to ensure data centers pay for their own electric infrastructure costs, with 2027 priorities including repeal of sales tax exemptions, water-efficient cooling requirements, and siting rules.[15] In August he went further, ordering an audit of the projects in ERCOT's Batch Zero large-load study, roughly 250 to 300 of them against a queue of more than 1,800, covering tax incentives, public financial assistance, electricity demand, on-site generation, water sourcing and reuse, cooling technologies, community impacts and ownership. ERCOT announced the same day that it would not meet the August 7, 2026 notification deadline in the Batch Zero process and would seek a good-cause exception from the state commission, while still aiming to complete the study by its original April deadline.[16]

Arizona, June 2026. A three-year pause on the data center sales tax exemption through June 2029, enacted as a compromise after the governor initially sought complete elimination.[15]

Illinois, June 2026. Governor Pritzker directed a pause on data center tax incentives from July 1, and urged residential ratepayer protections, water permitting and clean air standards for the fall veto session.[15]

Virginia, unresolved. The Senate proposed a data center impact fee in place of eliminating the sales tax exemption; the House proposed an accountability study.[15]

Ohio paused data center credits.[15]

Governors of both parties are arriving at the same instruments: make data centers pay their own infrastructure cost, stop exempting them from sales tax, regulate their water, protect residential ratepayers.

The permission problem is mostly a power problem

Here is why these two trajectories belong in one chapter rather than two. A data center needs firm power at a scale existing grids cannot supply without new generation or transmission, both slower to build than the data center. In Chapter 7's interconnection queue figures, that means more than 474 gigawatts pending in ERCOT alone across more than 1,800 projects, roughly 90 percent of it data centers, more than five times the grid's record peak demand.

The objections are almost all about what the facility draws from the community: higher utility bills, water consumption, tax abatements, grid strain. On this report's reading of the objections catalogued in those surveys, only the noise and land-use complaints concern the building itself. The permission problem and the power problem are therefore largely the same problem, and a generation source that solves the power problem without touching the grid or the water supply also solves a large part of the permission problem.

Here the chapter moves from finding to argument. On this report's reading, behind-the-meter nuclear is the firm, carbon-free source best placed to meet three of the objections at once. It adds no load to the grid. It can run closed-loop without incremental municipal water draw, which is a claim about the reactor's own cooling and a conditional one: closed-loop and dry cooling are design choices carrying a cost and efficiency penalty rather than properties of being behind the meter, and the data center's own cooling demand is unchanged by where its power comes from. And it does not put upward pressure on local retail rates, because it never enters the local retail market.

That is the commercial thesis underneath the report. The data center needs the permission. The reactor needs the customer Chapter 7 showed it does not have.

Eight terms for earning local consent

What follows is argument, not finding. It is this report's recommendation for the terms on which a data center should expect to earn local consent, and readers should weigh it as such. Several of the items match what states are already moving toward or requiring. Two have no evidence behind them, and this section says which is which.

1. Bring your own power. Behind-the-meter generation, not a queue position. *Evidenced as policy direction:* Texas's August 2026 audit examines on-site generation alongside electricity demand.[16]

2. No incremental draw on municipal water. Closed-loop cooling. *Evidenced as policy direction:* Texas's 2027 priorities include water-efficient cooling requirements, Illinois's governor urged water permitting, and the Texas audit examines water sourcing and reuse.[15], [16]

3. No public tax concessions. *Evidenced as policy direction:* Arizona paused its exemption, Illinois paused incentives, Ohio paused credits, Texas has proposed repeal, Virginia is debating an impact fee in place of exemption.

4. Pay your own interconnection and infrastructure cost. *Evidenced as policy, now ordered:* Abbott directed regulators to ensure data centers pay for their own electric infrastructure costs in June 2026.

5. No effect on local retail power prices, demonstrable rather than asserted. *Evidenced as the central public concern:* 77 percent of respondents said they were worried AI would make electricity more expensive. Chapter 7's Georgia case shows the problem of proof in its sharpest form. The contract that would let anyone verify the claim is redacted.

6. Give back in ways the community itself values and chooses: schools, workforce training, emergency services, local infrastructure.

7. Surround the facility with a public good. A park, not a berm and a fence.

8. No non-disclosure agreement that keeps the host community out of its own decision. *Evidenced as the live failure, from this report's own material:* Chapter 7's Georgia case is a contract for 3.2 GW filed fully redacted as a trade secret, approved by staff without reaching a commissioner vote, under a 30-day review window. Maggie Shober's objection puts it in one sentence: PSC staff "cannot have enough time and information to evaluate whether a data center is paying its fair share under a fully redacted contract in just 30 days and without a new cost of service study." Its second half, the missing cost of service study, names a deficiency separate from the redaction. One hyperscaler has since moved on the practice itself. On October 2, 2026, Garman said AWS had stopped it: "We no longer use nondisclosure agreements with the government agencies we work with on our projects." Three limits apply. The commitment names government agencies rather than community groups or intervenors. It is forward-looking: Amazon says it does not plan to revisit agreements already signed, on the view that most no longer apply once a project becomes public. And it does not reach the Georgia case, where the instrument was a redacted filing at a utility commission rather than an NDA.[11]

Item 8 is the one item in this list with a demonstrated failure behind it rather than a projected one. It went wrong in one of the largest data center power contracts of 2026, in a state with an

elected utility commission. A confidentiality regime that keeps ratepayers from learning what they pay removes the evidentiary basis on which consent could be given or refused. It is also the cheapest of the eight to concede, because commercially sensitive pricing can be redacted without redacting the cost allocation.

The test is whether a ratepayer, without litigation, can determine that a given facility is paying its own way. In Georgia the answer is no, and the redaction is the reason.

Items 6 and 7 are recommendations without an evidence base.

Community benefit agreements exist and carry real numbers. In Cedar Rapids, Google is contributing $400,000 for the next fifteen years and QTS $18 million over eighteen, on the Brookings account, which does not say whether the Google figure is annual or cumulative. Trade reporting describes the QTS package differently and in more detail: a twenty-year, 75 percent rebate on franchise fees collected by Alliant Energy, a separate twenty-year tax increment rebate at 70 percent, and up to $18 million over twenty years to a city-owned Community Betterment Fund.[17] The accounts differ on the term, eighteen years against twenty, and the trade version shows more than one rebate instrument running at once. Amazon's northern Indiana investment includes STEM programs for K-12 schools. Meta's El Paso facility came with an 80 percent property tax abatement over 35 years.[18]

What does not exist is evidence that any of this changes outcomes. The most substantial available analysis of data center community benefit agreements offers no data on whether they resolve opposition or alter approval decisions.[18] Most of these examples also pair contributions with large tax abatements, the opposite of item 3, which suggests current practice buys consent rather than earning it.

Items 6 and 7 therefore argue that the sequence should run the other way: pay full cost first, then contribute. That argument is not proven and is presented as a position.

Every promise needs measurement and recapture

Each of the eight items is a promise. None says how anyone would know it was kept, and that gap is not hypothetical.

Texas is the worked example, because it has the machinery other states are now building. Its data center sales tax exemption carries job, wage, investment and facility-size conditions, and it carries a recapture provision: a certified facility found out of compliance repays the sales tax it was excused.[19] So the clawback is not the missing piece. It exists, and it has been used. One company surrendered its certification and was assessed $5.6 million in back sales and use taxes.[20]

The measurement is the missing piece. Of 138 certified projects, 20 have been through the five-year compliance review, and six of those 20 failed it, on job counts or facility size.[19], [20] The two accounts differ on the denominator: the Tribune describes 20 audited with six out of compliance, while Good Jobs First reports six found compliant and six noncompliant, which leaves eight without a published determination. On the Tribune's denominator the failure rate is three in ten; on the completed determinations it is one in two.

The two available accounts of the 118 unreviewed projects do not agree. The subsidy-accountability organization Good Jobs First describes the 20 as the projects that have reached the five-year review mark, which would make the other 118 not yet due. The *Texas Tribune* headlines the same figures as audits lagging.[19], [20] The published material does not settle which is right. The review interval matters either way. In five years the facility is built, the hiring is whatever it turned out to be, and the officials who granted the exemption have often left office.

The amount at stake keeps growing. The exemption is projected at roughly $3.3 billion for the 2028 to 2029 biennium, against $14.6 million in 2014 to 2015.[20] A verification regime built when the exemption cost $14.6 million now polices one projected at $3.3 billion.

The condition this report would attach to the whole list is a single one. Every item carries a defined measurement, a published annual disclosure against that measurement, and a recapture that triggers on the miss. In substance, that means annual review in place of five-year review, and public disclosure in addition to filing.

The status of this, stated plainly. The recapture machinery is evidenced and operating. The annual interval is argument. No evidence available to this report shows that annual disclosure changes behavior, and the same absence of outcome data that undermines community benefit agreements applies here with equal force. What can be said without argument is narrower: a five-year review that has reached 20 of 138 projects, with six failures among them, is not a control, and nothing in this chapter should be read as suggesting it is.

Three serious objections, and a timing problem

Three arguments cut against this chapter, and the third matters most.

Nuclear's favorability is weaker at the fence line than in the abstract, and the gap can be measured. Gallup asked both proximity questions in the same March 2026 field period. For a nuclear power plant in the respondent's area, 45 percent favor and 53 percent oppose. For an AI data center in the area, 27 percent favor and 71 percent oppose.[5]

A majority opposes a local reactor, so "nuclear is winning" describes the abstract argument, not the siting one. The same figures test whether pairing a reactor with a data center spends nuclear's standing. On net favorability nuclear stands at minus 8 and the data center at minus 44, a 36-point difference measured by one pollster in one field period on matched questions. The figure is this report's arithmetic from Gallup's published splits. On this evidence the pairing does not obviously spend it, and the data center has more to gain.

The asymmetry in nuclear's coalition could become a liability. Support is held up by Republicans at 74 percent and independents at 64, with Democrats at 46, while data center opposition is bipartisan and growing on both sides. Pairing a Republican-coded energy source with a broadly disliked industry does not obviously produce a durable combination.

Behind-the-meter nuclear does not exist yet at commercial scale. No hyperscaler has signed a binding PPA for a new-build advanced reactor, and the one behind-the-meter arrangement in the dataset is a strategic partnership with a 2027 proof of concept (see Chapter

7). A solution that arrives in 2030 cannot resolve a political problem being decided in the 2026 midterms and the 2027 legislative sessions.

That is the chapter's honest limit. The permission problem runs on electoral time and the nuclear answer on construction time, and nothing in this report suggests those clocks can be made to match.

The finding

National support for nuclear power is near its all-time high, but a reactor serving a data center needs permission twice, and local permission for the data center is the one in sharpest doubt.

That support rests on a coalition that is Republican and independent rather than broad. Local opposition to data centers went from 42 percent to 75 percent in twelve months on identical wording, with two other pollsters in the same year at 63 and 71 percent, and 77 percent worried that AI will raise electricity prices. Blocked and delayed capital went from $64 billion over eleven months to $130 billion in a single quarter, across 49 states, on the count of an organization that does not disclose its funding. A newsroom tally on a different measure puts cancellations at $260 billion across 2026, about half of that in the third quarter alone, with roughly $1 trillion of investment facing sustained or meaningful opposition. The moratorium proposals in 14 states have started becoming moratoriums.

The objections are overwhelmingly about what a facility takes from its community, and the largest, power and water, are answerable by generation that never touches the grid, the second of them only where the plant and the data center are both cooled without a municipal draw. The behind-the-meter reactor that would answer them has not been contracted yet.

Chapter 1 said the celebrated milestone is rarely where the risk sits. In this sector the celebrated milestone is a gigawatt announcement, and the risk sits in a county commission meeting.

Sources

Notes are numbered per chapter. Each carries a source-interest tag: `[regulator]` for government and agency documents, `[reporting]` for independent journalism and trade press, `[company]` for a subject describing itself, `[analyst]` for banks, consultancies and law firms that earn fees in the sector, and `[advocacy]` for organizations with a declared stake in the outcome. Most notes carry an Internet Archive capture, most of them made September 18, 2026, so a reader can check what a page said on or near the date it was read. Notes for sources added in the days before the freeze date largely do not; the back matter states what is outstanding.

The prescription section of this chapter is explicitly labeled as the author's argument rather than a sourced finding, and the evidentiary status of each item is stated inline.

One feature of this chapter's sourcing should be stated rather than left for a reader to notice. Nine of the chapter's twenty notes open with `[reporting]` and six with `[advocacy]`, with three `[analyst]`, one `[regulator]` and one `[company]`. That is a single `[regulator]` note, in a chapter resting substantially on executive actions, a state comptroller's compliance

data and legislative activity. Those are reached through law firm analysis, trade press and advocacy research rather than through the orders, testimony and filings themselves. That is the weakest sourcing profile of any chapter in this report, and two of the load-bearing sources, Data Center Watch at note 9 and Good Jobs First at note 20, are organizations with a position rather than newsrooms. The chapter's polling figures are separately solid and come from named pollsters with published fieldwork dates and samples, with one exception: the Reuters and Ipsos survey at note 8 publishes neither calendar fieldwork dates nor a margin of error. Four of the nine `[reporting]` notes are pollsters or a university polling institute rather than journalism, which the tag does not distinguish.

1. [reporting] Gallup, "Nuclear Energy Support Near Record High in U.S.," annual Environment poll, fieldwork March 3 to 16, 2025, n=1,002. news.gallup.com, archived September 18, 2026 Gallup is the primary pollster here rather than a press relay.

2. [analyst] Radiant Energy Group, "The Nuclear Confidence Project: Global Public Opinion Report," July 2026. radiantenergygroup.com Fieldwork December 4 to 31, 2025; 26,545 interviews in 34 markets, weighted by age and gender; global margin of error about 0.6 percentage points. Source of the 44.9 and 64.3 percent figures, which are shares answering "no or low" carbon emissions, the reliability ranking (nuclear 63.5 percent, solar 73.1, wind 69.6), and the Taiwan figures. Radiant Energy Group is a different company from the reactor developer of a similar name covered elsewhere in this report.

3. [regulator] Intergovernmental Panel on Climate Change, *Climate Change 2014: Mitigation of Climate Change*, Working Group III, Annex III, Table A.III.2. ipcc.ch, archive lookup Median lifecycle emissions in grams of CO2-equivalent per kWh: nuclear 12, onshore wind 11, offshore wind 12, utility-scale solar PV 48, rooftop solar PV 41. A later UNECE assessment (2021) puts nuclear lowest of all sources, at 5.1 to 6.4, per Energy Industry Review, "UNECE: Nuclear is the Lowest Carbon Electricity Source," November 23, 2021, [reporting] energyindustryreview.com, archived January 17, 2026.

4. [reporting] Heatmap News, reporting Embold Research polling of registered voters, fieldwork August 22 to 29, 2025 (n=3,741) and August 8 to 13, 2026 (n=2,045, margin 2.3 points). heatmap.news, archived September 18, 2026 Both waves asked the same question: whether the respondent would support or oppose a data center being built near where they live. Heatmap publishes the question verbatim in its release of September 11, 2025 reporting the August 2025 fieldwork, "Would you support or oppose a data center being built near where you live?", and states that the wording did not change across four waves, but it publishes no topline table or crosstabs for either wave, though partisan and rural net figures appear in both articles' text. The 44 percent support figure, the verbatim question and the sample of 3,741 are from that release: Matthew Zeitlin, "Heatmap Poll: Only 44% of Americans Would Welcome a Data Center Nearby," Heatmap News, September 11, 2025, [reporting] heatmap.news , which also gives a margin of error of plus or minus 1.7 points. Heatmap renders the same 2025 wave as 44 percent support in that release and as roughly 43 percent in the 2026 piece above; the earlier release is used here. On the strongly-opposed share for 2026 it publishes only "more than six in 10 Americans say they would strongly oppose such a proposal." The figure of 61 percent widely attributed to this wave appears in secondary reporting, including The American Prospect of September 11, 2026, [reporting] prospect.org , and is not a number either the pollster or Heatmap has published. It is therefore not used in this report. Heatmap's own headline says "75% of Americans" where the sample is registered voters.

5. [reporting] Gallup, local siting questions from the annual Environment poll, fieldwork March 2 to 18, 2026, n=1,000. The nuclear plant proximity split (45 favor / 53 oppose) is reported in "Less Support for Solar, Wind Energy; Nuclear Support Steady," news.gallup.com, archived September 18, 2026 ; the AI data center split (27 favor, being 7 strongly and 20 somewhat / 71 oppose, being 23 somewhat and 48 strongly) is reported in "Americans Oppose AI Data Centers in Their Area," news.gallup.com, archived September 18, 2026. Both Accessed September 14, 2026. The two releases report different questions from the same field period, which is what makes the comparison valid.

6. [reporting] The Economist and YouGov, poll of 1,592 US adult citizens, which is the sample description in the published toplines, fieldwork August 28 to 31, 2026. yougov.com, archived September 18, 2026

7. [reporting] UMBC Poll, Institute of Politics and Department of Political Science, University of Maryland Baltimore County, topline release of October 8, 2026, item DC_COMM. politics.umbc.edu Fieldwork September 22 to 27, 2026. Total sample 776 Maryland likely voters, defined as respondents "absolutely certain" or "very likely" to vote in the November 2026 general election, drawn from registered voters; the DC_COMM item is a split sample of 406. Margin of error plus or minus 3.5 points at 95 percent for the full sample, higher for subgroups, and the release states it is not adjusted for design effects. This is a university pollster publishing verbatim question wording and a full four-point scale, which is why it is used here to test a magnitude rather than to add a national figure. The companion item DC_MD, on data centers anywhere in Maryland, found 52 percent strongly opposed and 26 percent opposed.

8. [advocacy] Brookings Institution, reporting the June 2026 Reuters/Ipsos survey. brookings.edu, archived September 18, 2026 The primary report is Valerie Volcovici and Jason Lange, "Americans wary of AI-driven data center boom, Reuters/Ipsos poll shows," Reuters, June 11, 2026, [reporting] read in the full wire copy carried at wsau.com because reuters.com was not reachable for this report. It gives "just 33% of Americans agreed with a statement that it was mainly a good thing to build data centers at a rapid pace" and "Some 64% disagreed"; "Some 77% of survey respondents … said they were worried that AI would make electricity more expensive"; "Some 57% of people surveyed … also said they would oppose a data center being built in their community"; and "The six-day poll, which surveyed 4,531 people across the country and closed on Monday". Reuters/Ipsos asked about AI, not data centers, on the electricity question; the data center framing that appears in secondary coverage, the Brookings page included, is a paraphrase this report does not adopt. The 57 percent local figure is the bottom of the four-pollster band in the text.

9. [advocacy] Data Center Watch, Q1 2026 report, covering January to March 2026. datacenterwatch.org, archived September 18, 2026 Data Center Watch does not disclose its ownership, sponsorship or funding anywhere on its site, which lists only a contact address. That is a material qualification on the two figures this chapter takes from it, the $130 billion and the 49 states, and no independent

source carrying those two figures was found. The 14-state moratorium count is separately carried by Reuters at note 8, which reports that fourteen states have considered or are considering a moratorium. They should be read as this organization's count rather than as an established total.

10. [reporting] Local reporting on the week of October 5 to 9, 2026: Anne Arundel County, WMAR, wmar2news.com ; Oakland, Oakland North, oaklandnorth.net, archived October 16, 2026 ; Mendocino County, The Mendocino Voice, mendovoice.com, archived October 16, 2026 ; Raleigh, WUNC, wunc.org ; Old Town, Bangor Daily News, bangordailynews.com ; Grand Junction, KJCT, kjct8.com, archived October 16, 2026 ; Allen Township, The Courier, thecourier.com ; Hillsboro, Hillsboro News-Times, hillsboronewstimes.com ; Lexington, WUKY, wuky.org, archived October 11, 2026 ; Cheyenne and Arapaho Tribes, News 9, news9.com, archived October 5, 2026 ; Memphis, Fox News, foxnews.com, archived October 11, 2026 . Accessed October 11, 2026. Several of these are first readings, extensions or zoning amendments rather than outright bans, and the Grand Junction and Hillsboro measures had further votes scheduled later in October. The list is one week of local action assembled from local reporting and is not a systematic census; it is used to show that the 14-state proposal count at note 9 has moved into enactment, not to establish a total.

11. [company] Matt Garman, chief executive of Amazon Web Services, statement of October 2, 2026, quoted in TechCrunch, "Amazon responds to data center backlash, says it no longer uses NDAs," October 3, 2026, [reporting] techcrunch.com, archived October 16, 2026 Source of the quoted sentence on nondisclosure agreements. The figure of more than 100 moratoriums under consideration, and Garman's attribution of the 75 projects and $130 billion to Data Center Watch, are reported by GeekWire, "Amazon pledges $1B to data center communities, warns that local opposition threatens U.S. AI lead," October 2, 2026, [reporting] geekwire.com, archived October 8, 2026 The same announcement carried a community investment figure of more than $1 billion, which the two outlets render incompatibly, GeekWire as a forward commitment over five years and TechCrunch as contributions already made over the past three. That figure is therefore not used here. Neither outlet gives an effective date for the NDA change. On agreements already signed, GeekWire reports that Amazon does not plan to revisit past agreements, most of which it says no longer apply once a project becomes public, and that is the basis for the statement in the text.

12. [advocacy] Data Center Watch, earlier edition, research period May 2024 to March 2025. datacenterwatch.org, archived September 18, 2026 The $46 billion delayed component is attributed in the report's own text to "the last two years," so the period covered by the $64 billion total is not internally consistent.

13. [reporting] Robinson Meyer, Heatmap News, "Exclusive: Data Center Cancellations Top $260 Billion in 2026," October 6, 2026. heatmap.news, archived October 11, 2026 Source of the $260 billion canceled during 2026, the approximately $130 billion canceled in the three months ending September 30, the roughly $1 trillion facing sustained or meaningful opposition, and the statement that about half of all projects meeting local backlash this year were canceled. Heatmap Pro describes its method as a continuous survey of public officials, regulatory filings and local media. The article states that its investment figures are "likely an undercount," that "only about 60% of data center projects disclose the size of their planned investment, especially during a proposal's early stage when it is most likely to run aground," and that the figures "do not include every project currently stalled because of state-level data center moratoriums in Texas and New York." Heatmap Pro is a paid market-intelligence product and the underlying database is not public.

14. [advocacy] Brookings Institution, "Why data centers are a top issue in the 2026 midterms." brookings.edu, archived September 18, 2026 Source of the named races and the Washington Post partisan analysis.

15. [analyst] MultiState, "State data center policy shifts as governors impose new restrictions," June 22, 2026. multistate.us, archived September 18, 2026

16. [analyst] Holland & Knight, "Texas Gov. Abbott directs data center audit," August 2026. hklaw.com, archived September 18, 2026 Corroborated by the Texas Tribune, texastribune.org, archived September 18, 2026

17. [reporting] *Data Center Frontier*, "Cedar Rapids, Iowa gets approval for two major data center investments by Google and QTS." datacenterfrontier.com, archived September 18, 2026 Source of the franchise fee and tax increment rebate terms, which are separate instruments and are frequently conflated in secondary coverage.

18. [advocacy] Brookings Institution, "Why community benefit agreements are necessary for data centers." brookings.edu, archived September 18, 2026 Source of the Cedar Rapids, northern Indiana and El Paso figures. Local reporting gives different Cedar Rapids terms, noted in the text. The article provides no data on whether such agreements change project outcomes.

19. [reporting] Paul Cobler, *Texas Tribune*, "Texas' multibillion-dollar sales tax exemption for data centers is growing, while audits lag," July 27, 2026. texastribune.org, archived September 18, 2026 Source of the 138 certified projects, the 20 reviewed, the six found in breach, the program's job, wage, investment and facility-size conditions, and the recapture provision. This account characterizes the unreviewed remainder as an audit lag. Corroborated on the six-of-20 figure by Holland & Knight, "Texas Data Center Tax Exemption Faces Serious Legislative Risk Ahead of 2027 Session," July 2026, hklaw.com, archived September 18, 2026, which dates the Senate Finance Committee hearing to July 27, 2026 with the Comptroller's office testifying.

20. [advocacy] Anthony Elmo, Good Jobs First, "Texas Data Center Tax Break: 6 Projects Fail Compliance Review," August 19, 2026. goodjobsfirst.org, archived September 18, 2026 Source of the $5.6 million back-tax assessment following a surrendered certification, and of the $3.3 billion 2028 to 2029 biennium projection against $14.6 million in 2014 to 2015. The attribution differs between the two: the $5.6 million assessment, the 138 certifications and the review outcomes are attributed there to the Texas Comptroller's office and Senate Finance Committee testimony, while the $3.3 billion and $14.6 million figures are hyperlinked there to *Texas Tribune* reporting. The Tribune's own published figures differ, at $3.2 billion of lost sales tax revenue over two years and $5.4 million in 2015, and that divergence is unresolved here. This account characterizes the 20 as the projects that have reached the five-year mark rather than as a backlog. Good Jobs First is a subsidy-accountability advocacy organization rather than a newsroom. The two figures that matter most, the six-of-20 result and the 138 certified projects, are independently carried by the *Texas Tribune* at note 19.

Chapter 9: The Army Signed. That Is Not a Market.

On August 26, 2026, the Army announced the Janus Program: up to $2.2 billion for five vendors to own, construct and operate microreactors at five installations. Dr. Jeff Waksman, principal deputy assistant secretary of the Army for Installations, Energy and Environment, gives the requirement in one line: “Everything that we do, from communications to radar, just requires constant energy.”[1]

As Chapter 7 found, the Department of Defense is the only buyer class with binding, funded contracts for new-build advanced reactors at its own sites. Its lane rests on the broadest legal authority, exempt from NRC licensing and not confined to demonstration, but its work does not yet count toward a commercial license. A beachhead is not a market. The exemption turns on a purpose test under the Atomic Energy Act, military economics do not transfer, developers carry indemnification and fixed-price risk, and the program is small beside the civilian ambitions invoked to justify it.

The defense lane still buys three real things. The national security case behind it is three arguments of uneven strength, and none makes the Army the customer this sector needs.

The defense lane buys three things now

A customer that pays before a commercial market exists. Chapter 7 found that no hyperscaler has signed a binding new-build PPA. The Army’s milestone agreements with five vendors are currently the only source of payment for new-build advanced nuclear apart from two utility contracts.

An operating record. A reactor run at a military installation yields data no modeling can produce, and Chapter 4’s proposed NRC rule, still unfinalized, would let some of that work count toward commercial licensing.

A reason for the fuel chain to be built. Enrichment from US-origin technology can be “unobligated,” usable for national security applications, an attribute described under fuel sovereignty below. That gives domestic enrichment a customer whose demand is not contingent on commercial deployment timelines. Chapter 3’s central finding was that the fuel chain is short of time rather than tonnage. Defense demand is one of the few things that can start new fuel capacity before commercial offtake exists.

A beachhead is not a market.

The executive order puts the reasoning in writing

Executive Order 14299, signed May 23, 2025, is the operative document, and it states its reasoning in its own text: advanced computing infrastructure for AI capabilities and other mission capability resources at military and national security installations and national laboratories "demands reliable, high-density power sources that cannot be disrupted by external threats or grid failures."[2] The claim is made about those sites, not about AI compute in general.

The Secretary of Defense, acting through the Secretary of the Army, must "commence the operation of a nuclear reactor, regulated by the United States Army, at a domestic military base or installation no later than September 30, 2028." DOE is directed to prioritize site preparation and authorization with a goal of operating an advanced reactor at the first site within 30 months of the order, only a goal where the Army item is a binding "shall commence."

The order does not itself designate data centers. Section 4(a) directs the Secretary of Energy to "initiate the process for designating AI data centers" in the contiguous States that are "located at or operated in coordination with Department of Energy facilities" as critical defense facilities, "where appropriate." DOE must release not less than 20 metric tons of HALEU for authorized private sector projects at DOE sites. And the administration is to pursue at least 20 new 123 Agreements for international nuclear cooperation by the close of the 120th Congress, with DOE to approve or deny technology transfer export authorization requests within 30 days of a complete application and its own accompanying analysis, a clock that excludes time spent awaiting State Department concurrence and foreign government assurances.[2]

Designating a data center as a critical defense facility would state what the compute is for. The order stops short of that: it directs DOE to begin a process that may end in a designation, and only where appropriate, and no completed designation is cited here. It remains the clearest available statement that the federal government intends to treat some AI infrastructure, namely data centers tied to DOE facilities, as more than a commercial matter.

The August 2026 National Security Science and Technology Strategy lists advanced fission reactors as a critical and emerging technology, within a nuclear energy category alongside fusion, space nuclear power and propulsion, and high-temperature and radiation-resistant materials. On deployment it names the specific application: "Opportunities include improving energy resilience by establishing microgrids powered by advanced nuclear reactors."[3]

The strategy does not specifically address data center power demand or AI power infrastructure requirements. Searches of the document for data center, electricity demand and power demand return nothing, and grid appears only inside the word microgrids, a striking omission after an executive order that tied advanced reactors to AI data centers explicitly.

Its workforce language is more specific. Among efforts that rest on "working with and encouraging non-Federal partners," the strategy lists partnerships between educational institutions, "including community colleges," and industry to create new "certifications, credentialing, and competency models for emerging fields, including AI infrastructure, quantum, biotechnology, and advanced nuclear reactor construction and operation."[3] Advanced nuclear construction and operation is named explicitly, which supports Chapter 5's workforce argument, though as encouragement to others rather than a directive to agencies.

Three strands with different evidence behind them

The national security case is usually presented as one argument. Its three strands do not stand or fall together.

Installation resilience is funded and modest

A military base on a civilian grid has a single point of failure it does not control. That is the least speculative strand, and the one backed by program funding.

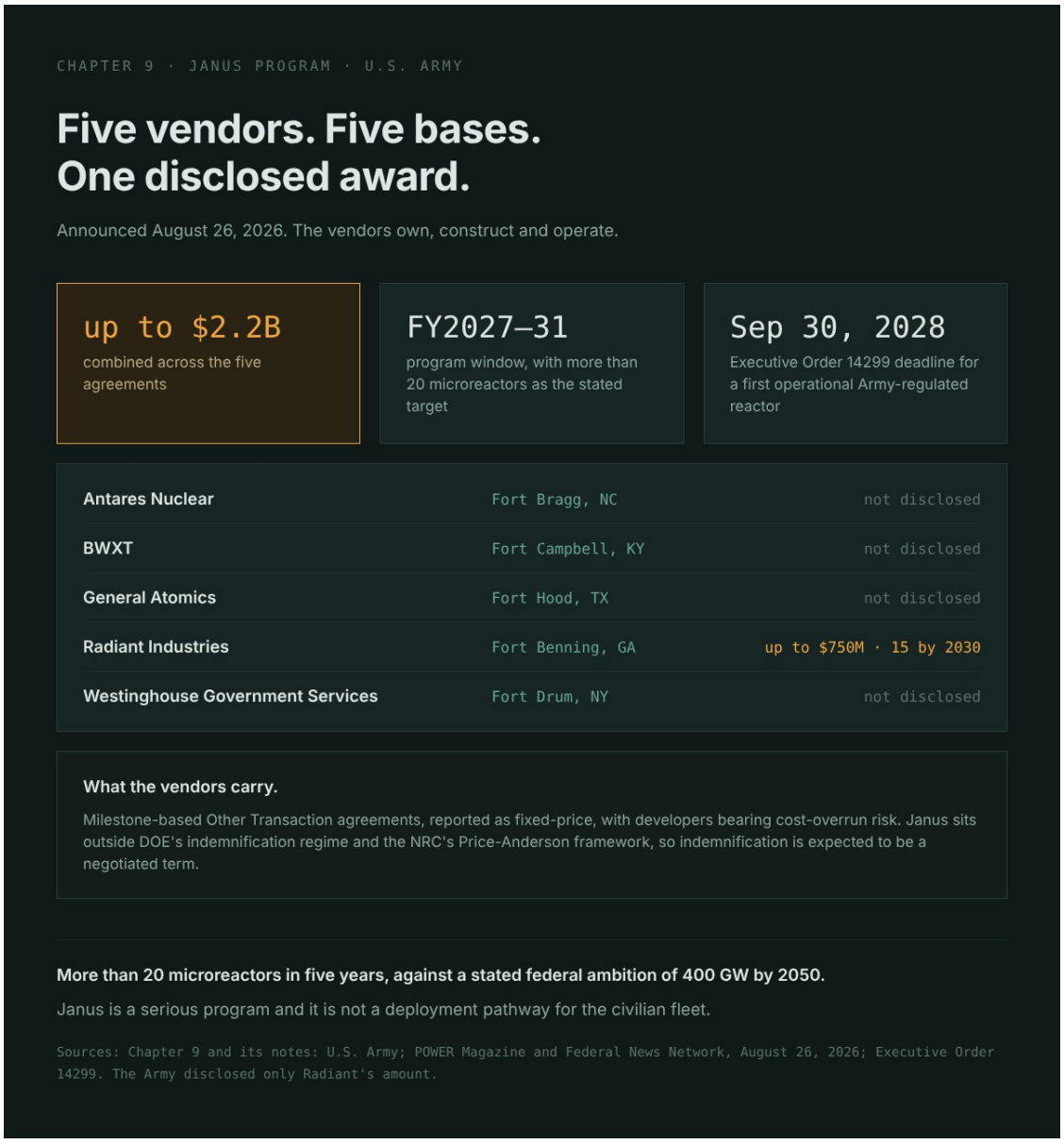


Figure 9.1. The Army's Janus Program: five vendors, five bases, one disclosed award.

The Janus agreements, worth up to a combined $2.2 billion, cover five sites: Antares at Fort Bragg, BWXT at Fort Campbell, General Atomics at Fort Hood, Radiant at Fort Benning,

Westinghouse Government Services at Fort Drum.[4] The program spans FY2027 to 2031 and targets more than 20 microreactors.[5] Radiant's award is up to $750 million for 15 deployments by 2030; the Army declined to disclose the other four amounts.[6]

The design is more modest than often described. Installations stay grid-connected, and the reactors provide backup on grid failure and are not intended to supply 100 percent of installation load. After the first operating year, power purchases transition to Army power purchase agreements.[5]

Fuel sovereignty has the hardest numbers

Russia accounted for 26 percent of US enrichment purchases in 2025, 3.3 million separative work units of 12.7 million total, the largest single reported origin. Foreign sources supplied 77 percent.[7] The waivers permitting those imports terminate no later than January 1, 2028.[8]

For HALEU specifically, "only Russia and China make the commercial-scale HALEU that advanced nuclear reactors need," and trade reporting in April 2025 described commercial supply as available only from TENEX, a Rosatom subsidiary.[9]

This is an import substitution problem framed as a defense issue, and the framing changes which appropriations can pay to fix it and how quickly.

The consequence now shows up in contracts, in the joint release for the Centrus and Radiant HALEU agreement of September 2026 (see Chapter 3). Centrus states that because its technology is US-origin and relies on a US manufacturing supply chain, the enrichment it supplies to Radiant will be "unobligated," meaning it can be used for national security applications. Radiant's chief nuclear officer, Dr. Rita Baranwal, said the agreement gives Kaleidos "a continued source of HALEU for commercial and national security applications and removes one of the biggest constraints facing advanced nuclear deployment."[10] The second clause is the company's assessment, and Chapter 3 reaches a different one. A fuel attribute that exists only because of who enriched it has become a selling point in a commercial supply agreement.

AI as strategic capability is a policy choice

This strand has the weakest evidence and the largest consequences if it holds.

The claim is that AI capability is now a national security capability, that it is power-constrained, and that power for AI is therefore a national security matter. Executive Order 14299 directly asserts the second premise and the conclusion, calling the vulnerability of these sites and resources to energy disruption "a strategic risk that must be addressed."[2] Its instrument for acting on that conclusion, the critical-defense-facility designation, is so far a process the order tells DOE to start, not a designation it makes.

The first premise is stated, not argued. The order counts AI computing infrastructure among "mission capability resources," and the August 2026 strategy repeats the National Security Strategy's naming of AI and autonomy as one of three priority areas for battlefield dominance,[3] but neither document makes the case, and this report does not test it. The framing is a policy choice by an administration, and it may be correct, but it is currently a decision rather than a

demonstration, and the designation meant to act on it has been ordered into process rather than made.

The policy is producing behavior regardless. Chapter 7's Nvidia structures, Chapter 6's $17.5 billion supply chain loan program, and the Janus awards all follow from a framing that treats compute and its power as strategic. Right or wrong, the premise is allocating capital.

Army contracts do not make a commercial market

Army contracts are easy to read as proof of a commercial market for these reactors. Five limits say otherwise.

The legal limit comes first (see Chapter 4). An Army-regulated reactor operates under Section 91 of the Atomic Energy Act with a Section 110(b) exemption from NRC licensing. That exemption is bounded by a purpose test: where civilian power sales are incidental to a military mission such as base islanding, the Department of Defense may regulate the facility, but where "commercial or utility service predominates, NRC licensing applies." Jurisdictional boundaries are "determined less by reactor design than by purpose."[11]

A Janus reactor therefore cannot pivot to commercial customers on its Army authorization. The Army aims to align its process with the NRC's, and Waksman draws the line himself: "It's not saying that the NRC automatically approves whatever the Army approves. That is not how that works." The NRC, he says, "has its own authority to do its own approvals," and what the Army is after is "a clear, straight line so that there are no curveballs and no lack of clarity to the companies about what is expected of them to get to the NRC."[5]

The August 26 roundtable also ruled out reading the Army lane as an environmental or safety carve-out. Installations remain subject to the National Environmental Policy Act, the Clean Air Act and other statutory reviews, with Waksman's own caveat that recent NEPA reforms should shorten timelines against historical nuclear projects.[5] The Section 110(b) exemption covers NRC licensing only, and a reader who takes the defense lane as a way around review is reading it wrong.

The economics do not transfer. A military customer tolerates unusual cost, because resilience at a base is not priced against a wholesale power curve. Its security requirements add cost a commercial customer will not bear. And it buys in units of one installation, far from the order books that Chapter 6 established are the precondition for supply chain investment.

The contracts carry costs the press releases omit. Janus sits outside both DOE's standard nuclear indemnification regime and the NRC's Price-Anderson framework, so developers "will not automatically receive coverage under existing statutory schemes," and lawyers who have reviewed the program expect indemnification to be a negotiated term. The OTAs are milestone-based, with developers bearing cost-overrun risk, and have been reported as fixed-price.[11], [5] For a first-of-a-kind reactor, that is a demanding contract, not a subsidy.

The scale is small relative to the problem it is invoked to solve. Janus plans more than 20 microreactors across five years. The executive order framework's stated ambition is 400

gigawatts of capacity by 2050 and ten large reactors under construction by 2030.[12] Janus is a serious program, but it offers no deployment pathway for the civilian fleet.

The reputational cost is real (see Chapter 8). Chapter 4 carries, as argument rather than finding, the safety critique of the federal fast lanes: Edwin Lyman's characterization of the DOE directive rewrite as "a massive experiment in the deregulation of novel, untested nuclear facilities" conducted "in the shadows".[13] Chapter 8 found public support to be a commercial asset for this sector, with 61 percent approval drawn from a coalition of Republicans and independents. A defense-first path perceived as having bypassed the civilian regulator spends part of that asset, and the cost shows up as opposition at county commission meetings rather than in regulatory dockets.

The finding

The Army is a real, paying customer for new reactors, and its contracts do not add up to a commercial market.

Installation resilience is well evidenced, funded, and modest: backup power at five bases.

Fuel sovereignty is the strongest strand, resting on a number with a statutory deadline. The Russian share of the enrichment US operators bought in 2025, 26 percent or about 3.3 million separative work units, loses its waiver in January 2028, and replacement capacity arrives between 2029 and 2036.

AI as strategic capability is a policy determination whose premise is stated but not demonstrated, and whose designation instrument the order has only set in motion, though the framing is allocating capital regardless.

The legal boundary is a purpose test, the economics do not transfer, and the Army's own officials say NRC approval remains separate.

This repeats Chapter 1's pattern. The milestone that gets photographed is a reactor at Fort Bragg. What decides whether this sector exists commercially is a contract nobody has signed yet, with a customer who is not the Army.

Sources

Notes are numbered per chapter. Each carries a source-interest tag: `[regulator]` for government and agency documents, `[reporting]` for independent journalism and trade press, `[company]` for a subject describing itself, `[analyst]` for banks, consultancies and law firms that earn fees in the sector, and `[advocacy]` for organizations with a declared stake in the outcome. Most notes carry an Internet Archive capture, most of them made September 18, 2026, so a reader can check what a page said on or near the date it was read. Notes for sources added in the days before the freeze date largely do not; the back matter states what is outstanding.

1. [reporting] Federal News Network, "Army awards $2.2B in contracts for nuclear microreactors," August 26, 2026. federalnewsnetwork.com, archived September 18, 2026 Source of the Waksman quotation as printed. The underlying event is also covered by the Army at army.mil, archived September 18, 2026, which could not be retrieved for verification. At least three

wordings of this remark circulate across outlets. Two independent readings agree on the version quoted here; a third drops the word “just” and replaces the commas with dashes. Same document as note 5, cited separately here for the quotation.

2. [regulator] Executive Order 14299, “Deploying Advanced Nuclear Reactor Technologies for National Security,” May 23, 2025. Text via the American Presidency Project, presidency.ucsb.edu, archived September 18, 2026 ; the order of record is published in the Federal Register. Accessed September 13, 2026. [regulator] Federal Register, Vol. 90, No. 102, May 29, 2025, pages 22581 to 22586, FR Doc. 2025-09796, via the Government Publishing Office, govinfo.gov Source for the wording of sections 1, 4(a) and 8(b): section 4(a) directs the Secretary of Energy to “initiate the process for designating” qualifying AI data centers as critical defense facilities.

3. [regulator] The White House, *National Security Science and Technology Strategy*, August 2026. whitehouse.gov, archived September 18, 2026 The strategy does not specifically address data center power demand or AI power infrastructure requirements, contrary to an assumption carried in this project’s earlier working materials.

4. [regulator] U.S. Army, “Army reaches agreement with private industry for nuclear micro-reactors,” August 26, 2026. army.mil, archived September 18, 2026

5. [reporting] POWER Magazine, “U.S. Army mobilizes $2.2B Janus Program to deploy more than 20 commercial microreactors,” August 26, 2026. powermag.com, archived September 18, 2026 The figure of more than 20 reactors is a program aspiration across FY2027 to 2031; the August 2026 announcement names five initial sites.

6. [reporting] Federal News Network, “Army awards $2.2B in contracts for nuclear microreactors,” August 26, 2026. federalnewsnetwork.com, archived September 18, 2026

7. [regulator] U.S. Energy Information Administration, *2025 Uranium Marketing Annual Report*, Table 16. eia.gov, archived September 18, 2026 Corroborated by Energy Connects, [reporting] energyconnects.com, archived September 18, 2026

8. [regulator] U.S. Nuclear Regulatory Commission, “Backgrounder on the Uranium Import Ban.” nrc.gov, archived September 18, 2026 Statute: Prohibiting Russian Uranium Imports Act, Public Law 118-62.

9. [company] General Matter, via PR Newswire, “U.S. Department of Energy awards $900 million contract to General Matter,” January 7, 2026. prnewswire.com, archived September 18, 2026 The statement that only Russia and China produce commercial-scale HALEU comes from an award recipient and is an interested characterization, though it is consistent with the DOE allocation record in Chapter 3. For TENEX: [reporting] POWER Magazine, Sonal C. Patel, “DOE Allocates First Round of HALEU to Five U.S. Advanced Nuclear Reactor Developers,” April 9, 2025. powermag.com The article says commercial HALEU supply “is only available from Russia’s Rosatom subsidiary TENEX” as of its date.

10. [company] Centrus Energy Corp. and Radiant Industries, September 9, 2026. prnewswire.com, archived September 18, 2026

11. [analyst] Orrick, Amy Roma, Cameron Hughes and Stephanie Fishman, “Beyond the NRC: Deploying Nuclear Reactors under DOE and DOW Oversight Authority,” March 26, 2026. orrick.com, archived September 18, 2026

12. [regulator] Executive Order 14300, “Ordering the Reform of the Nuclear Regulatory Commission,” May 23, 2025, section 2(c), for the target of expanding American nuclear capacity “from approximately 100 GW in 2024 to 400 GW by 2050,” and Executive Order 14302, “Reinvigorating the Nuclear Industrial Base,” section 4(a), for the goal of having “10 new large reactors with complete designs under construction by 2030.” govinfo.gov and federalregister.gov Reported alongside the loan program by *Utility Dive*, June 24, 2026, [reporting] which gives the capacity target as 300 GW of net new capacity rather than the 400 GW total in the order. utilitydive.com, archived September 18, 2026

13. [advocacy] Union of Concerned Scientists, January 28, 2026. ucs.org, archived September 18, 2026 Advocacy organization with a long-standing position on nuclear regulation; carried as argument, not finding.

Chapter 10: Zero, Not Low

In March 2026 the NRC issued TerraPower a construction permit, its safety review completed in 18 months against 27 planned. Kairos Power tested a precast shielding structure in February, TRISO-X holds the first NRC Category II license to process HALEU, and Radiant's Oak Ridge factory is under expedited review. Reactors, fuel, factories and licenses have all moved.

The customer has not. Offtake is the least resolved of the seven constraints. Four of the eight companies below hold a contract: one with a federal utility, one with a regulated utility and two with the Army. The number of binding long-term power purchase agreements between a hyperscaler and a new-build advanced reactor is zero. Offtake and fuel choice are what separate the companies.

The chapter ranks no company and predicts no outcome. It asks of each what would have to be true for its bet to work. The eight were selected after Chapters 2 through 9 were drafted, as those appearing substantively in the most constraint chapters, a criterion that picks companies whose strategies actually engage the constraints. Every fact traces to a public source in the notes, and the text flags the report's own arithmetic or classification. The same standard applies to every company, including Aalo Atomics, where the author's disclosed relationship makes it matter most.

Eight companies against seven constraints

Each cell labels the assessment in that company's section below; where they seem to differ, the section is the finding. Bold in the offtake column marks a signed contract, and there are four: two utility power purchase agreements and two Army agreements, none of them with a hyperscaler. In the workforce column, Exposed means no public hiring, training or pipeline commitment was found. Six of the eight companies carry that rating, a finding about the public record and not a measurement of any company's staffing. Absence of a public program is not evidence that a company has no internal staffing plan. Kairos Power is rated Addressing on its NuCAMP membership at note 4. Westinghouse is marked Shared firm because its AP300 licensing work runs through Amentum, which Chapter 1 shows also serves Rolls-Royce SMR as program delivery partner. Workforce and industrial supply chain read Exposed for nearly every company because those two constraints are sector-wide; they do not separate one company from another. The fuel column gives the fuel type first and its supply status where one is known. The permission column shows where each plant connects, which decides which permissions it needs: a grid-connected or base-sited plant needs one, and a plant built behind the meter to serve a data center also depends on the data center's (Chapter 8). Four cells are compressed and the detail sits here: the PacifiCorp agreement is executed and becomes effective only once the commission approvals the contract names are in hand, among them Oregon's approval of a related water use agreement; NuScale's certification covers the 50 MWe design, with the 77 MWe version holding a standard design approval only; Aalo's lanes are the DOE pilot and NRC pre-application; and Westinghouse holds letters of intent with seven partners alongside a Janus other transaction agreement at Fort Drum.

	Fuel	Regulatory	Workforce	Mfg	Supply	Offtake	Siting
Kairos Power	HALEU (TRISO); LEU+ possible	NRC, building	Addressing	Demonstrated	Exposed	**PPA, TVA**	Grid
TerraPower	HALEU, at risk	NRC permit	Exposed	Not factory	Exposed	**PPA, PacifiCorp, not yet effective**	Grid
Radiant	HALEU, contracted	Four lanes	Exposed	Building	Exposed	**Army contract**	Base
X-energy	HALEU, own plant	NRC pending	Exposed	Doosan	Partial	Options	Grid
Oklo	HALEU	Denied 2022; DOE pilot, NRC pre-application	Exposed	Own, operate	Exposed	Non-binding	Mixed
Aalo Atomics	LEU 5% / LEU+ 8%	DOE pilot	Exposed	Factory	Exposed	Partnership	Behind meter
NuScale	LEU	US600 certified; US460 SDA	Exposed	Doosan	Exposed	ENTRA1	Grid
Westinghouse	LEU	AP300 stalled	Shared firm	AP1000 field	Federal loans	LOIs; **Janus OTA**	Grid

Reactors, fuel, factories and licenses have all moved. The customer has not.

Kairos Power

What has to be true: that precast construction methods transfer from a tested mockup to a licensed nuclear structure, and that the TVA PPA grows into the larger deployment the Google framework contemplates.

Kairos is the closest thing in this report to a company that has resolved constraints instead of describing them. It holds one of the two offtake contracts this report counts for a new-build advanced reactor now under construction, and the buyer is TVA, not a hyperscaler.[1] Its NRC review completed in 10 months against 14 planned.[2] It has the most fully documented physical manufacturing test in the sector, a precast shielding structure tested with an iridium-192 source in February 2026.[3] And it launched NuCAMP, the only industry effort found that treats the trades as the constraint, with two community colleges and a school district among its members.[4]

Codification remains unresolved. The governing codes, ASME Section III Division 2 and ACI 349, contain no explicit provisions for modular precast joints, so each new method has to be tested against existing code requirements; for precast work, NuCAMP participants told ENR, structures assembled from multiple components "must be shown to perform like monolithic concrete structures."[5] Until that showing is made and accepted for a licensed nuclear structure, the manufacturing gain cannot be counted on.

Fuel is the second exposure. Kairos fuels its TRISO pebbles with HALEU, and its conditional DOE allocation is of material enriched up to 19.75 percent, which puts it in the twelve-company HALEU cohort from Chapter 2. The company says its design operates most efficiently on HALEU but can use a range of enrichment levels, including LEU+, and that it is exploring interim alternatives until HALEU is more widely available.[3] Until one of those alternatives is in hand, it depends on the allocation process described in Chapter 3.

TerraPower

What has to be true: that HALEU arrives before the plant needs it.

TerraPower holds an NRC construction permit for a commercial-scale advanced power plant, approved March 4 and issued as Construction Permit CPAR-1 on March 9, 2026,[6] reviewed in 18 months against 27 planned, nine months ahead of schedule.[2] Natrium "will provide up to 500 MW of power to Rocky Mountain Power"; PacifiCorp, which trades as Rocky Mountain Power in Utah, Wyoming and Idaho, has executed a 40-year power purchase agreement for the plant's output, which becomes effective only once the commission approvals the contract names are in hand, among them approval of a related water use agreement, a condition precedent, and a waiver of competitive bidding rules. Oregon, Idaho and Utah granted their approvals between April and June 2026; a California application was still active on October 11, 2026, the last date its

docket was checked, and the contract does not publish the full list.[1], [7] On licensing and offtake, the two constraints that stop most companies, no company here is further along.

It is also the company whose Natrium project POWER described as "hindered by a lack of HALEU availability," a line Chapter 2 repeats, even though TerraPower was among the five developers in DOE's first HALEU allocation and holds supply agreements with Centrus Energy, Framatome and ASP Isotopes.[8] An allocation and three agreements have not yet added up to an assured supply, and a construction permit for a reactor whose fuel is not assured is the cleanest illustration of the report's thesis in the dataset.

Natrium is also a 345 MW grid-scale design, with storage able to boost output to 500 MWe, a scale Chapter 2 noted is poorly suited to modular factory output.[9] Its cost reduction path runs through conventional construction learning instead of manufacturing, which exposes it to the construction cost problem Chapter 6 documented at Vogtle.

Radiant

What has to be true: that a factory targeting 50 units a year finds 50 buyers a year, and that the Army contract is a beginning and not the whole business.

Radiant has the most complete constraint response in the sector and is one of only three companies in Chapter 2's twenty-four, with Aalo and Antares, that have both a factory they control and a published production rate. Fuel is contracted through a multi-year definitive agreement with Centrus that includes Radiant prepayments, with unobligated material suitable for national security use.[10] Manufacturing is a 300,000 square foot campus under construction at Oak Ridge, alongside an expedited NRC Part 70 review targeting completion December 18, 2026. Approval would let Radiant construct and operate the campus's fueling building, which trade reporting says would allow fueling as part of the manufacturing process; Radiant calls the site a "manufacturing, fueling and storage campus." Fueling each unit at the factory is therefore within the license's purpose, not outside it.[11] Offtake is up to $750 million from the Army for 15 units by 2030, plus a preorder agreement with deposits from Equinix for 20 Kaleidos microreactors, which is a preorder and not a power purchase agreement.[12], [13] It is engaged with the NRC on a Part 70 license, with DOE under the Reactor Pilot Program and the Launch Pad, and with the Department of Defense, where it holds the Army's Janus agreement for Fort Benning and was selected in April 2026 for Buckley Space Force Base under the Air Force's Advanced Nuclear Power for Installations initiative, which this report counts as four lanes though no source uses that framing. Chapter 4's table lists five for Radiant because it counts NRC pre-application and the Part 70 application separately; counted by institution rather than by filing, it is four.[14]

Two things are unresolved. Radiant has published two production rates at different horizons and has never reconciled them: "over a dozen per year" within a few years of its October 2025 statement, with the first mass-produced unit promised for 2028, and a scale-up target of 50 reactors per year.[12] And Chapter 9's finding applies directly. An Army-regulated reactor cannot pivot to commercial customers on its Army authorization, because the boundary is a purpose test, so Radiant's commercial future runs through the NRC however well Janus goes.

X-energy

What has to be true: that vertical integration into fuel is worth what it costs, and that the pipeline converts.

X-energy is the only developer with a licensed commercial-scale fuel fabrication plant under construction, though Oklo holds DOE approval of the preliminary safety analysis for its Aurora fuel fabrication facility at Idaho National Laboratory and is in NRC pre-application for licensing commercial fuel fabrication, which would address its fuel problem once a plant runs. TRISO-X holds the first NRC license for a commercial Category II fuel fabrication facility, which allows it to fabricate TRISO fuel from HALEU; the plant's first production line is rated at 5 metric tons of uranium a year, and a second phase would take it to 25. The project's environmental impact statement puts the construction phase at $768 million over five years, and on September 24, 2026 the company reported vertical construction of the 214,000 square foot building complete, with interior build-out, equipment installation and supporting facilities still ahead and no operations date stated.[15] Doosan has committed to a fabrication facility sized for approximately 20 Xe-100 reactors a year at full production, and holds a binding reservation agreement to manufacture main power system steel components for 16 units.[16] The reactor itself is not yet licensed: the construction permit application for the first Xe-100 plant, Dow's Long Mott Generating Station in Texas, was docketed in March 2025, and the NRC lists its 18-month review as in progress.[2]

Public markets are not rewarding the strategy. Revenues and grant income grew 132 percent in the first half of 2026 to $98.0 million; total net loss reached $271.6 million, of which $59.1 million was attributable to X-energy itself; the stock closed at $14.93 on September 11, 2026, roughly 35 percent below its $23 April IPO price and 60 percent below its peak.[17] The pipeline of 144 reactors is stated "assuming each customer exercises its contingent rights in full."[18]

A five-year fuel plant and a 144-reactor pipeline both require customers to convert options into orders.

Oklo

What has to be true: that 13.2 gigawatts of non-binding agreements become binding ones, and that the 2022 application failure does not repeat.

Oklo has the widest gap in this report between announced and contracted position, and the company discloses the gap itself. Its 10-K describes "contingent, non-binding agreements related to the purchase of power with potential customers, which may not result in binding agreements for the purchase of electricity or heat from our powerhouses."[19] The announced pipeline sums to roughly 13.2 GW, the 12 GW Switch agreement plus the 1.2 GW Meta campus; that total is this report's arithmetic and not a company disclosure. Revenue for the quarter ended June 30, 2026 was $1.21 million. Cash and marketable securities were about $3.0 billion.[20]

Its 2022 NRC denial was for failure to supply information, not for a design defect, and it was without prejudice.[21] It has since run extensive pre-application engagement, with the NRC now describing the design as a liquid metal-cooled, metal-fueled fast reactor at a maximum power level of 75 MWe, and has broken ground at INL under the DOE pilot.[22], [23]

Oklo's distinctive choice is its business model: it builds, owns and operates its reactors and sells the power.[24] That swaps the manufacturing constraint for a capital constraint, since every unit is a balance sheet item and not a sale. Its roughly $3 billion of cash and marketable securities is a credible answer, provided it converts frameworks into contracts faster than it consumes the cash and the second application goes better than the first.

Aalo Atomics

What has to be true: that the LEU choice compounds, and that a proof of concept becomes a purchase order.

Every fact in this section is from public sourcing, held to the same standard as the seven companies around it.

Aalo's zero-power critical assembly, a full-scale mock-up of the planned 10 MWe Aalo-X, achieved criticality at 12:20 a.m. MT on July 4, 2026 at Idaho National Laboratory under the DOE Reactor Pilot Program. It was the fourth DOE-authorized reactor to reach criticality, after Antares on June 4, Valar Atomics on June 18 and Deployable Energy at the end of June, and all four first went critical at zero power.[25] The company announced a 40,000 square foot Austin factory in 2024, describing an ambition to "do for nuclear reactors what Henry Ford did for cars."[26] It has since published a phased plan, with the 40,000 square foot facility as phase one, a 400,000 square foot facility as phase two and a facility above 4,000,000 square feet as phase three, rated at "1 GW/y per 1,000,000 sqft."[27] That is a throughput figure, but it is a ratio on a company web page, not a dated commitment to a number of units per year. The company says its first reactor, the zero-power critical test unit, was fabricated in Austin and turned on in Idaho, and the factory page counts eight months to manufacture, license and install it; no commercial Aalo Pod has yet been produced at any of the three scales.[27] Aalo, Radiant and Antares are the only three companies in Chapter 2's twenty-four that have published both a facility they control and a rate. Work is under way at Idaho National Laboratory on a second reactor, a commercial-scale 10 MWe unit for Aalo's Project Ascension, expected to produce electricity in 2027.[25] Aalo's arrangement with Crusoe is a strategic partnership: a Crusoe Spark modular data center at INL in 2027 as a proof of concept, with a stated intent to deploy 50 MWe reactors at Crusoe sites by the end of 2029. Neither company has published a dollar figure or a power purchase agreement.[28] It is also in NRC pre-application engagement, under docket 99902128.[29] It has signed a letter of intent with Raven-Flint for conversion services beginning in 2028, and Raven-Flint's chief executive says Aalo is looking to take 100 percent of the planned pilot plant's output.[30]

Aalo's strategic distinction is fuel, and the fuel choice was a deliberate change, not part of the original design. The original design, inspired by Idaho National Laboratory's MARVEL, was to run on uranium zirconium hydride. In a contract signed in July 2025 and announced that September, the company instead turned to Urenco for low-enriched uranium at 5 percent enrichment, with fabrication into uranium dioxide fuel rods by Global Nuclear Fuel, and said why: conventional fuel avoids the multi-year delays of fuel lines that "still operate at pilot scale" and buys access to an existing global supply chain.[31] The contract covers the experimental reactor. The company states that "the Aalo-X demonstration reactor will operate on 5%-enriched UO2 (LEU)" while "our commercial Aalo Pod will run on 8%-enriched UO2 (LEU+) while using the same standardized fuel form," and that it is negotiating follow-on agreements

for the 8 percent material.[32] So the demonstrator is out of the HALEU queue and the commercial product is not in it either, but neither is it in the standard-LEU cohort. Eight percent falls inside the HALEU band by regulatory definition, but the company is seeking it through commercial agreements rather than applying for DOE's allocated material, which is why Chapter 2 counts Aalo among the four developers outside both groups. Chapters 1 and 2 set out the stakes. DOE allocated HALEU to five of fifteen applicants, and TerraPower holds a construction permit for a reactor whose fuel is not assured. What Aalo has done is remove the allocation application from its critical path and substitute a narrower dependency: an 8 percent supply it has not yet contracted, above the five percent level at which US commercial reactor fuel has historically been made, a step up that the NRC says bears on fabrication and transport, so licenses and packages built around that level may need amendment.[32] Chapter 11 records Framatome needing an NRC license amendment, granted in 2026, to work above that same level.

Three things in the company's September 2026 congressional testimony bear on that condition. Loszak described the second Idaho reactor as "designed to produce approximately 10 megawatts of electricity and ultimately power an onsite AI data center," which is the company putting that unit against a data center load in its own words on the record, rather than through a joint announcement with Crusoe.[33] He described a "credible pathway toward a future fast-spectrum product line" able to extract "substantially more energy from uranium resources," cited an existing estimate that "fast reactors can extract roughly 100 times more energy from the same uranium resource," and added that DOE estimates more than 90 percent of the potential energy remains in used nuclear fuel.[33] Neither figure is the witness's own measurement: he attributes the 90 percent to DOE and gives the hundredfold figure as an estimate without naming its source. The testimony does not say what enrichment a fast-spectrum line would need. That matters here, because the LEU choice described above is what currently keeps Aalo out of the HALEU queue, and it is a property of the thermal design rather than of the company. He also described Aalo as "expanding into a one-million-square-foot manufacturing facility in Texas."[33] That figure matches the one-million-square-foot Gigawatt Factory that ANS reported in March 2026 as planned to be on line by 2028, producing at least a hundred reactors a year at maximum capacity.[34] It is not new. ANS's report of the July 4 criticality already quotes the company in its own words ("We are now expanding into a one-million square-foot factory"), so the testimony puts on the congressional record what the company had said two months earlier.[25] The company's factory page carries the same figure: its only calendar-dated timeline entry, against 2026, is that "procurement for Aalo's first million sqft Gigawatt Factory begins," its one dated capacity statement is a goal of enabling the West "to deploy a gigawatt of nuclear capacity per year by 2030," and its three unlabelled scale-up footprints of 40,000, 400,000 and above 4,000,000 square feet carry no years at all. The million-square-foot factory is therefore the company's own unit of account rather than a fourth figure in tension with the others, and at the page's stated ratio of a gigawatt a year per million square feet it is consistent with them. A separate September 2026 filing for a 204,350 square foot, $25 million plant at Georgetown, Texas is a fourth footprint and is not reconciled here.[35]

The testimony also dates the build. Loszak told the subcommittee the company "moved from groundbreaking to a sustained nuclear chain reaction in less than eight months."[33] The chain reaction in question is the zero-power criticality of July 4, 2026 described above, not a reactor producing power, and the distinction is the one Chapter 1 is built on.

The condition is the same one every company in Chapter 7 faces: an intent has to become a contract. The 2027 demonstration is the test, and Chapter 11 carries it as a dated item.

One note on sourcing. The author's relationship with Aalo, including having received non-public information about the company, is set out in the Disclosures section at the end of this report. Every fact in this section comes from public sources and carries its own note; none rests on non-public information. The Raven-Flint letter of intent rests on a single trade-press report, which attributes the details to Raven-Flint's chief executive; Aalo has not commented.[30]

NuScale

What has to be true: that a certified design finds a buyer at a price that works.

NuScale holds the first and, as of this writing, still the only NRC-certified SMR design in the United States, the US600, built from 50 MWe power modules.[36] The design it would actually deploy is a different one. The 77 MWe US460, the configuration behind the ENTRA1 arrangement with TVA, holds only a Standard Design Approval, issued May 2025, which is a staff-level approval: in the NRC's words it "indicates that a proposed reactor design meets applicable agency safety requirements," and anyone using it must still file an application to build and operate a reactor.[37] The certification everyone cites is for a design nobody is selling.

NuScale is also the sector's cautionary precedent, and Chapter 2 showed that the cause was mainly commercial. The Carbon Free Power Project with UAMPS, for which Doosan Enerbility had begun forging the first NuScale module in 2023, was terminated on November 8, 2023 after the target price rose from $58 to $89 per MWh and subscriptions failed to reach the required level.[38] Clean Air Task Force's post-mortem puts commercial structure first: the project "was not positioned for commercial success from its inception," with an unsuitable customer and a first-of-a-kind project forced into a premature commercial model. It also faults the design, whose large reactor pool carried a fixed cost whatever the number of modules, a lack of modularity it says made the plant more expensive and less adaptable than other SMR designs.[39]

Its current position is a 6 GW agreement with TVA through ENTRA1, which the parties describe as ENTRA1 developing and owning assets and selling to TVA "through future power purchase agreements," and call "an important first step."[40] That leaves a certified design for one configuration, a staff approval for the one being sold, and no signed new-build PPA for either.

Westinghouse

What has to be true: that ten AP1000s get ordered, and that the AP300 eventually matters.

Westinghouse is here because Chapter 1's central case study is its AP300 and Chapter 6's largest federal intervention is built around its AP1000. The row is assessed at group level, which means it also carries the Army's August 2026 Janus selection of Westinghouse Government Services' eVinci microreactor for Fort Drum, New York, an eVinci deployment rather than an AP300 or AP1000 one, with government funding contingent on technical milestones.[14] The Army describes the Janus awards as agreements under its Other Transactions Authority (Chapter 4). This chapter counts that as a contract, and as a defense deployment agreement rather than a commercial power purchase, which is the distinction Chapter 7 draws and Chapter 9 tests. The AP300 has been in NRC pre-application since May 2023 with no design certification application

filed, 40 months and twelve white paper topics, one of them now marked “no longer planned.”[41] Chapter 1 established that the explanation is commercial. The chief executive describes a strategy “built on the proven AP1000 reactor and extended through the AP300 SMR,” while DOE has put up to $17.5 billion of conditional supply chain loans behind ten AP1000 units, and the company has confidentially filed for an IPO.[42]

The condition is order conversion. The loans require $1 billion of upfront equity per project from Westinghouse and its utility partner together. Seven letters of intent exist, each with an identified site, none publicly named. Edwin Lyman’s objection is on the record and unanswered: “none of these potential projects is backed up with an actual contract for construction.”[43]

Offtake and fuel separate the eight

Offtake separates them most clearly. Four have a contract: Kairos with TVA, TerraPower with PacifiCorp, and Radiant and Westinghouse with the US Army. None is with a hyperscaler, as Chapter 7 found from the deal side.

Fuel choice is the second divider, and for most of these companies it was made years before anyone could see it mattering. Aalo is the exception, having switched away from its original fuel in September 2025, and it switched to two: 5 percent for the Aalo-X demonstrator, 8 percent for the commercial Pod. TerraPower holds a permit and a fuel problem. NuScale and Westinghouse designed around material that is simply available. Aalo’s demonstrator runs on that material; its commercial reactor does not, and the 8 percent supply is not yet contracted. Aalo is the only one of the eight that markets its enrichment level, on a technology page that sets the price and availability of LEU against HALEU;[32] for the others, fuel is one of the two things that distinguish them without being something they sell on.

Workforce is the constraint nobody has resolved. Six of the eight are marked Exposed and Westinghouse Shared firm. Only Kairos, through NuCAMP, is making a structural response to a constraint that Chapter 5 established now governs throughput, schedule and execution risk.

Regulatory position differentiates least. NuScale has the only certified small modular design and no new-build contract; Oklo had its 2022 application denied and holds about $3 billion in cash and marketable securities. The sector’s most advanced regulatory asset and its largest cash position sit at opposite ends of the commercial spectrum.

The finding

Offtake is the least resolved of the seven constraints, even though workforce is the most universally unresolved.

Workforce is exposed in six rows of eight and resolved in none; offtake is marked resolved for three of the eight, with a fourth signed but not yet effective. On a simple count, workforce is the least resolved. That count is the wrong measure.

Workforce is a shortage, and offtake is an absence. The welders, inspectors and nuclear-qualified machinists Chapter 5 documents are too few today, and training them takes a long

time. But the mechanism that produces them is known and has been run before, and it takes money, programs and years, none of it novel. A company that is short of qualified welders in 2026 and starts paying for them in 2026 has welders by 2030. The constraint is severe and it is ordinary.

Offtake is not merely scarce. For the specific transaction this report is about, a hyperscaler signing a binding long-term power purchase agreement for a new-build advanced reactor, the count is not low. It is zero, and has been throughout the period covered, across a sector that raised billions on the expectation of it. The four contracts among this chapter's eight companies are real, and none is with the buyer class whose demand is the entire commercial premise.

Workforce is a queue that is too long. Offtake is a transaction type that has never been completed, so no working example exists to follow. A constraint with no precedent is less resolved than a constraint with a known remedy and a waiting list, even when the waiting list is longer.

A reader who prefers the count to the argument should choose workforce, and the scorecard supports that reading. The disagreement is about what "resolved" means, not about any fact in the table.

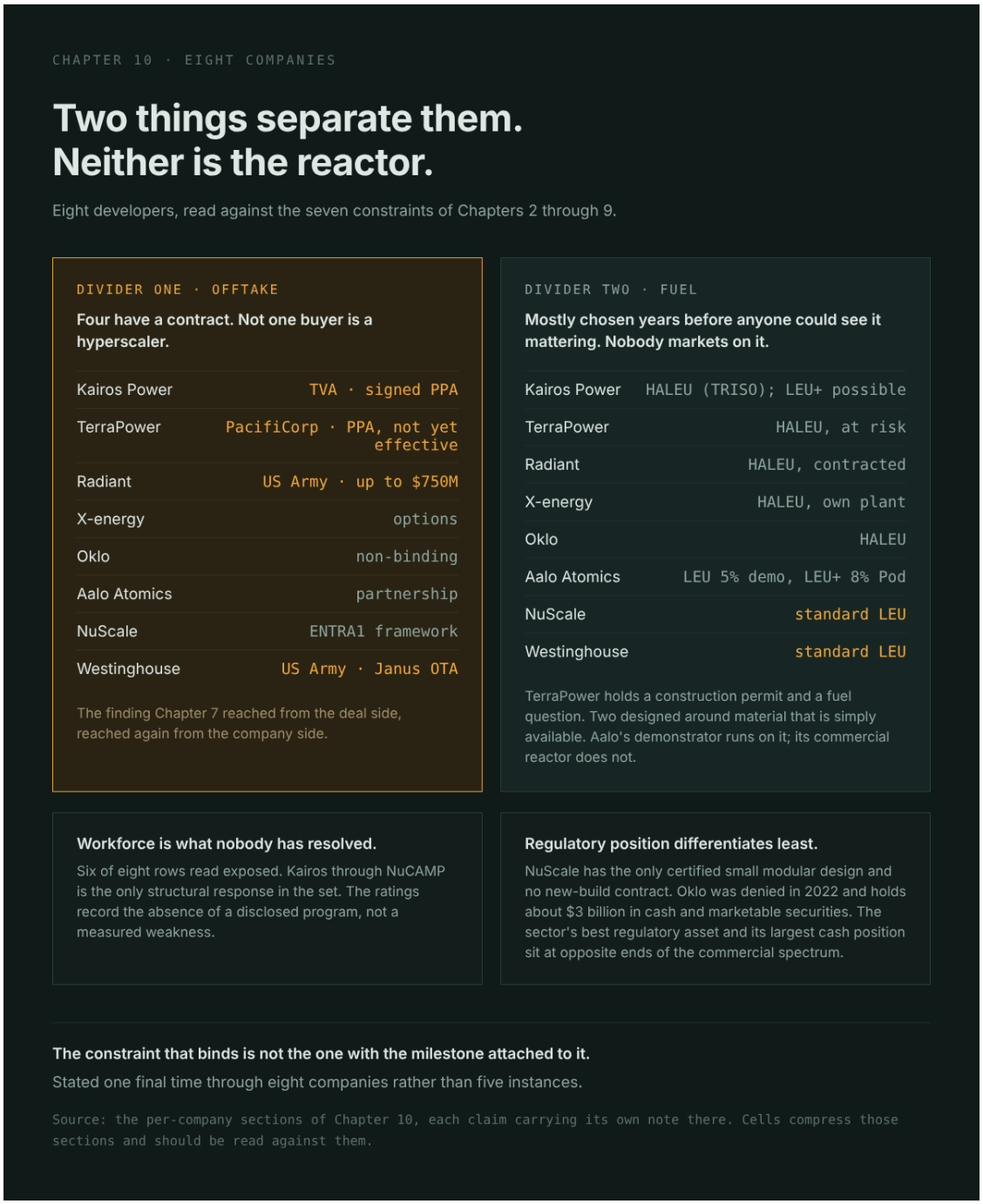


Figure 10.1. Offtake and fuel choice separate the eight companies. The reactor design does not.

Across eight companies, the milestones belong to reactors, fuel, factories and licenses, and the binding constraint belongs to the customer.

Sources

Notes are numbered per chapter. Each carries a source-interest tag: `[regulator]` for government and agency documents, `[reporting]` for independent journalism and trade press, `[company]` for a subject describing itself, `[analyst]` for banks, consultancies and law firms that earn fees in the sector, and `[advocacy]` for organizations with a declared stake in the outcome. Most notes carry an Internet Archive capture, most of them made September 18, 2026, so a reader can check what a page said on or near the date it was read. Sources added later mostly carry a capture of their own. A small number are cited without one, among them Radiant's Buckley release and Aalo's factory page as cited at note 35, and the back matter states what is outstanding.

Company selection was made after Chapters 2 through 9 were drafted, by frequency of substantive appearance across those chapters. It is not a ranking and not a recommendation.

1. [advocacy] Nuclear Innovation Alliance, US Nuclear Energy Project Tracker update, May 7, 2026. nuclearinnovationalliance.org, archived September 18, 2026

2. [regulator] U.S. Nuclear Regulatory Commission, "Licensing Efficiencies." nrc.gov, archived September 18, 2026 As read on October 18, 2026, the same page lists "Long Mott Energy, LLC – Long Mott Generating Station Xe-100" with an 18-month planned review shown as in progress. The docketing date is from the Federal Register, "Long Mott Energy, LLC.; Long Mott Generating Station; Construction Permit Application," June 10, 2025, Docket No. 50-614, [regulator] govinfo.gov , which states that the application was docketed on March 31, 2025. Accessed October 18, 2026.

3. [company] Kairos Power, February 25, 2026. kairospower.com, archived September 18, 2026 The DOE allocation and its 19.75 percent ceiling are from American Nuclear Society, Nuclear Newswire, "Kairos Power finalizes contract on HALEU for Hermes," January 22, 2026, [reporting] ans.org , which describes Kairos as one of five developers "conditionally selected by the DOE last April to receive HALEU enriched up to 19.75 percent fissile uranium-235." The company's statements on enrichment are from Kairos Power, "Kairos Power's Iterative Approach to Fuel Development," December 16, 2024, [company] kairospower.com , which says the design "operates most efficiently with HALEU; however, it can use a range of enrichment levels, including low-enriched uranium plus (LEU+)" and that the company is "exploring alternate solutions for the interim until the material is more widely available." Both Accessed October 18, 2026.

4. [reporting] American Nuclear Society, Nuclear Newswire, "Kairos Power, others launch NuCAMP to develop nuclear workforce," August 20, 2026. ans.org, archived September 18, 2026

5. [reporting] *Engineering News-Record*, "Kairos Power pushes to make nuclear construction repeatable," August 26, 2026. enr.com, archived September 18, 2026

6. [regulator] U.S. Nuclear Regulatory Commission, press release 26-028, March 4, 2026. nrc.gov, archived September 18, 2026 The issuance date is from the Federal Register, "US SFR Owner, LLC; Kemmerer Power Station, Unit 1; Construction Permit and Record of Decision," 91 FR 12628, March 16, 2026, Docket No. 50-613, [regulator] govinfo.gov , which states: "The Construction Permit No. CPAR-1 was issued on March 9, 2026." Accessed October 18, 2026.

7. [company] PacifiCorp, "Application for Approval of Water Use and Conveyance Agreement and Request for Waiver of Competitive Bidding Rules," Public Utility Commission of Oregon docket UM 2408, October 21, 2025. edocs.puc.state.or.us, archived September 21, 2026 PacifiCorp states that it has executed a 40-year power purchase agreement with US SFR Owner, LLC, a TerraPower subsidiary, for the output of Kemmerer Unit 1, and that the agreement, while fully executed, becomes effective only once the commission approvals defined in the contract are received, including approval of the water use agreement, which is a condition precedent, and a waiver of competitive bidding rules. The approvals obtained since are: Oregon, Order No. 26-146 of April 29, 2026 in this docket, approving the water use agreement and granting the competitive bidding waiver, with a request for reconsideration resolved by Order No. 26-304 of August 18, 2026; Idaho, Order No. 37049 of May 22, 2026 in Case No. PAC-E-25-20, waiving the commission's solicitation requirements, [regulator] puc.idaho.gov ; and Utah, Docket No. 25-035-55, order of June 1, 2026, [regulator] pscdocs.utah.gov . A California application under Public Utilities Code section 851, A.25-10-007, was still active on October 11, 2026, the last date its docket was checked; the proceeding's service list, consulted again on October 18, 2026, was last changed July 31, 2026, ia.cpuc.ca.gov [regulator]. No Wyoming approval requirement for this agreement could be established: the agreement does not appear in Rocky Mountain Power's own index of its Wyoming dockets, and no Wyoming condition is asserted here. The Oregon and California orders are cited by order and docket number because no stable public document URL for either could be confirmed. Because the contract does not publish the full list of approvals it names, the report states which have been granted rather than that the set is complete. This is a filing by the utility describing its own contract, which is why it is tagged [company].

8. [reporting] POWER Magazine, "DOE allocates first round of HALEU to five U.S. advanced nuclear reactor developers," April 2025. powermag.com, archived September 18, 2026

9. [regulator] U.S. Nuclear Regulatory Commission, press release 26-028, March 4, 2026. nrc.gov, archived September 18, 2026 Natrium's rating is carried in the permit documentation. The judgment that a grid-scale design is poorly suited to modular factory output is this report's own classification of the companion dataset, described in Chapter 2, not a finding of the NRC.

10. [company] Centrus Energy Corp. and Radiant Industries, September 9, 2026. prnewswire.com, archived September 18, 2026 Duration, volumes and pricing are not disclosed.

11. [reporting] *Nuclear Engineering International*, "US fast-tracks microreactor factory," May 13, 2026. neimagazine.com, archived September 18, 2026 The 300,000 square foot figure is from Radiant's August 26, 2026 release, [company] radiantnuclear.com (the same release as distributed by Business Wire is archived: web.archive.org) , which is also the source of the phrase "manufacturing, fueling and storage campus." The scope of the Part 70 application and the December 18, 2026 target are from American Nuclear Society, Nuclear Newswire, "NRC to review Radiant R-50 Part 70 license application," May 2026, [reporting] ans.org , which reports that approval "would allow the California-based company to construct and operate the fueling building of the R-50 production facility," that this matters because "it would allow fueling as part of the manufacturing process," and that Part 70 "governs the possession and use of special nuclear material." The same article is cited at note 14. Accessed October 18, 2026.

12. [company] Radiant Industries, "Tennessee factory," October 13, 2025, and the August 26, 2026 Army contract release. radiantnuclear.com, archived September 18, 2026 The 50 per year and "over a dozen per year" figures both originate with the company and are not reconciled by it.

13. [company] Radiant Industries, Equinix preorder agreement, August 2025. radiantnuclear.com, archived September 18, 2026 A preorder with deposits for 20 Kaleidos units, not a power purchase agreement.

14. [reporting] American Nuclear Society, Nuclear Newswire, "NRC to review Radiant R-50 Part 70 license application," May 2026. ans.org, archived September 18, 2026 The Buckley Space Force Base selection is a separate matter from the Army's Janus award at Fort Benning and is sourced to [company] Radiant Industries, "Air Force Selects Radiant to Deliver Microreactors to Buckley Space Force Base," April 22, 2026. radiantnuclear.com The release states that the Department of the Air Force made the selection with the Defense Innovation Unit "in fulfillment of the Advanced Nuclear Power for Installations (ANPI) initiative," whose stated goal is at least one advanced reactor operating on at least one Department of the Air Force installation by 2030. The two are distinct programs: Janus is an Army other transaction agreement and ANPI is an Air Force initiative. No capture of the Radiant release later than this report's access date was confirmed, so none is cited. The Westinghouse selection is from World Nuclear News, "US Army selects five microreactor techs for deployment," August 27, 2026, [reporting] world-nuclear-news.org , which lists "Westinghouse Government Services, at Fort Drum, New York," describes its eVinci heat-pipe microreactor, and reports that vendors "will receive government funding contingent on successfully hitting specific technical goals." The Army's own announcement is cited at Chapter 4 note 18. Accessed October 18, 2026.

15. [reporting] POWER Magazine, February 13, 2026. powermag.com, archived September 18, 2026 Construction status from X-energy, "TRISO-X Advances to Next Phase of Construction for TX-1 Fuel Fabrication Facility," August 24, 2026, [company] globenewswire.com, archived September 18, 2026. Vertical construction completion, the 214,000 square foot figure and the remaining scope are from X-energy, "TRISO-X Completes Vertical Construction of TX-1 Fuel Fabrication Facility," September 24, 2026, [company] x-energy.com, archive lookup, which states no date for operations. The POWER article is also the source of the 5 and 25 metric ton figures and of the $768 million five-year construction phase, which it attributes to the project's environmental impact statement. The Oklo comparison rests on World Nuclear News at note 22, which reports that "DOE Idaho approved the A3F Nuclear Safety Design Agreement in November 2025 and the A3F PDSA in December," and on Oklo's Form 10-K at note 19, which describes NRC pre-application activities "for licensing of commercial fuel fabrication."

16. [company] X-energy and Doosan Enerbility, December 18, 2025. businesswire.com, archived September 18, 2026

17. [company] X-energy, Q2 2026 results, August 13, 2026. investors.x-energy.com, archived September 18, 2026 Trading level from StockAnalysis, [reporting] stockanalysis.com, archived September 18, 2026 The IPO price is from X-energy, "X-energy Announces Pricing of Upsized Initial Public Offering," April 23, 2026, [company] x-energy.com , which gives "a public offering price of $23 per share." Accessed October 18, 2026.

18. [company] X-energy, second quarter 2026 results, August 13, 2026. investors.x-energy.com, archived September 18, 2026

19. [company] Oklo Inc., Form 10-K for fiscal year 2025. sec.gov, archived September 18, 2026

20. [company] Oklo Inc., Form 10-Q for the period ended June 30, 2026. sec.gov, archived September 18, 2026

21. [regulator] Federal Register, January 11, 2022, and the NRC denial letter of January 6, 2022. federalregister.gov, archived September 18, 2026

22. [reporting] World Nuclear News, "Licensing of Oklo pilot reactor facilities advances," March 18, 2026. world-nuclear-news.org, archived September 18, 2026

23. [regulator] U.S. Nuclear Regulatory Commission, Oklo Aurora Powerhouse pre-application activities, docket 99902095. nrc.gov, archived September 18, 2026

24. [analyst] Zacks Equity Research, "OKLO business model explained." finance.yahoo.com, archived September 18, 2026 Analyst commentary, used only for the uncontested description of the build-own-operate structure, which the company also states publicly.

25. [reporting] American Nuclear Society, Nuclear Newswire, "Aalo Atomics achieves criticality on July 4." ans.org, archived September 18, 2026 The article, dated July 6, 2026, is the source of the time of criticality, of Aalo as "the fourth DOE-authorized reactor" to reach it, of Project Ascension, and of the company's statement "We are now expanding into a one-million square-foot factory to apply assembly-line manufacturing to reactor production." The dates and zero-power status of the three earlier criticalities are from American Nuclear Society, Nuclear Newswire, "The deadline arrives: Checking in on the Reactor Pilot Program," [reporting] ans.org , which reports Antares reaching "zero-power fueled criticality" on June 4, Valar Atomics on June 18 and Deployable Energy announcing the same on July 1; Chapter 1 note 1 carries DOE's June 30 date for Deployable Energy. Accessed October 18, 2026.

26. [company] Aalo Atomics, "Announcing our new factory HQ in Austin, Texas," August 21, 2024. aalo.com, archived September 18, 2026

27. [company] Aalo Atomics, "Aalo Gigawatt Factory." aalo.com, archived September 18, 2026 The square footage phases and the stated ratio of 1 GW per year per 1,000,000 square feet are the company's own published targets. No third party has verified them, no commercial unit has been produced at any phase, and the page attaches no delivery date to the phase two or phase three footprints. The page counts eight months "to manufacture, license, and install the Aalo-X Critical Test Reactor"; the company's statement that its first reactor was fabricated in Austin is reported by Hoodline, cited at note 35, and World Nuclear News reported in March 2026 that the Aalo-X would be manufactured at the Austin pilot factory (note 31).

28. [reporting] POWER Magazine, "Aalo, Crusoe plan 2027 INL demonstration." powermag.com, archived September 18, 2026 Corroborated by Crusoe, [company] crusoe.ai, archived September 18, 2026

29. [regulator] U.S. Nuclear Regulatory Commission, "Pre-Application Activities for Advanced Reactors." nrc.gov, archived April 30, 2026 Lists Aalo Atomics under docket 99902128.

30. [reporting] American Nuclear Society, Nuclear Newswire, "Raven-Flint U conversion plans land on NRC docket, in Launch Pad," September 4, 2026. ans.org, archived September 18, 2026 ANS is the only source located for the Aalo letter of intent; it does not appear in Raven-Flint's own August 31, 2026 release. ANS states the letter of intent covers conversion services beginning in 2028 and attributes the 100 percent figure to Raven-Flint's chief executive, Nick Smith, as what Aalo "is looking to take."

31. [company] Aalo Atomics, "Aalo Signs Historic Fuel Deal with Urenco," September 10, 2025. aalo.com, archived October 16, 2026 Source of the quoted phrase "still operate at pilot scale" and of the stated reasoning for choosing conventional fuel. Corroborated by Nuclear Engineering International, "Aalo-X secures uranium supply," [reporting] neimagazine.com, archived April 20, 2026 which reports Urenco supplying 5 percent enrichment LEU to be fabricated into uranium dioxide, and by World Nuclear News, "Aalo secures fuel and turbine for experimental reactor," March 4, 2026, [reporting] world-nuclear-news.org, archived May 12, 2026 which reports fabrication into UO2 fuel rods by Global Nuclear Fuel. The earlier UZrH design is described in Aalo Atomics, "Aalo Atomics to Build a Commercial Reactor Inspired by MARVEL," [company] aalo.com, archived June 7, 2026 Archive captures for this note predate the report's September 2026 sweep; each postdates the item it captures and each was confirmed present via the Wayback availability API on September 19, 2026.

32. [company] Aalo Atomics, "Fuel duel with Urenco," September 10, 2025. aalo.com, archived October 16, 2026 Source of both quoted sentences and of the statement that the company is negotiating follow-on agreements for 8 percent enriched uranium hexafluoride. The company's technology page lists the commercial reactor's enrichment as "8 % LEU+" and its own comparison table puts LEU at up to 5 percent and HALEU at up to 20 percent, aalo.com, archived October 16, 2026 [company]. The Urenco contract was signed in July 2025 and announced in September. The fuel cohort Chapter 2 assigns the company follows the commercial product, not the demonstrator. The five percent level is from U.S. Nuclear Regulatory Commission, "Fuel Cycle, Transportation, and Storage," Reviewing Accident Tolerant Fuel, [regulator] nrc.gov , which states that commercial power reactor fuel enrichment "has historically been less than or equal to 5 weight percent uranium-235" and that higher enrichment affects fuel enrichment, fabrication and transportation. Accessed October 18, 2026.

33. [company] Matt Loszak, Chief Executive Officer, Aalo Atomics, written testimony before the Subcommittee on Energy, U.S. House Committee on Science, Space, and Technology, September 2, 2026. docs.house.gov Source of all six quoted phrases. The energy-extraction figure and the used-fuel percentage are as stated by the witness, the latter attributed by him to the Department of Energy; neither is independently verified here. The hearing itself is cited at Chapter 4 note 43.

34. [reporting] American Nuclear Society, Nuclear Newswire, "Aalo Atomics discusses the road ahead," March 12, 2026. ans.org, archive lookup Source of the one-million-square-foot Gigawatt Factory, the 2028 date and the quoted rate of "at least a hundred reactors a year when it reaches its max capacity," which is the company's statement reported by ANS. No unit has been produced at any facility, and the company's own factory page gives a different set of phased footprints; see note 27.

35. [company] Aalo Atomics, factory page, aalo.com Source of the 2026 entry on procurement for the first million square foot Gigawatt Factory, of the three unlabelled scale-up footprints, of the stated ratio of one gigawatt a year per million square feet, and of the 2030 goal; the page's other timeline entry, "8 months," carries no calendar date. The Hoodline report is also the source of the company's statement that its first reactor was fabricated in Austin and turned on in Idaho. The Georgetown filing is reported by Hoodline, September 2026, [reporting] hoodline.com, archived September 18, 2026 , which gives 204,350 square feet, $25 million and a project window of November 2026 to January 2028. No company release for the Georgetown plant was located.

36. [regulator] U.S. Department of Energy, "NRC certifies first US small modular reactor design." energy.gov, archived September 18, 2026 The DOE article describes the first SMR design certified by the NRC, with power modules of 50 megawatts each. That it remains the only one, and the US600 designation, are from POWER Magazine at note 40, which states that "NuScale remains the first and only SMR technology with a certified design (its 50-MWe US600 model approved in 2022)."

37. [regulator] U.S. Nuclear Regulatory Commission, "NRC Approves Standard Design for NuScale US460 Small Modular Reactor," press release 25-033, May 29, 2025. nrc.gov, archived September 18, 2026 See Chapter 2 note 14.

38. [reporting] *Utility Dive*, "NuScale, UAMPS terminate small modular reactor project in Idaho." utilitydive.com, archived September 18, 2026 The article is dated November 9, 2023 and reports that the parties "announced Wednesday" the termination, which was November 8. Doosan's role is from World Nuclear News, "Doosan starts forging components for NuScale SMR," May 5, 2023, [reporting] world-nuclear-news.org , which reports that Doosan Enerbility began forging for the first module of the VOYGR-6 plant for the Carbon Free Power Project, under a 2019 agreement to supply NuScale Power Modules. Accessed October 18, 2026.

39. [advocacy] Clean Air Task Force, "Lessons learned from the recently cancelled NuScale-UAMPS project," November 2023. catf.us, archived September 18, 2026

40. [reporting] POWER Magazine, "TVA, ENTRA1 sign agreement for 6 GW," September 2, 2025. powermag.com, archived September 18, 2026

41. [regulator] U.S. Nuclear Regulatory Commission, "Westinghouse AP300" pre-application activities. nrc.gov, archived September 18, 2026

42. [reporting] American Nuclear Society, Nuclear Newswire, "Westinghouse updates: AP1000 potential, IPO, Amentum partnership," August 5, 2026. ans.org, archived September 18, 2026

43. [reporting] *Utility Dive*, "DOE offers $17.5B loans to help build 10 large nuclear reactors," June 24, 2026. utilitydive.com, archived September 18, 2026

Chapter 11: What Would Change the Answer

On September 8, 2026, a $1.9 billion DOE loan closed for the Duane Arnold restart, with Google as the primary customer.[1] A hyperscaler anchors the offtake and federal debt stands behind it. Because no new reactor design is involved, the deal tests nothing about new build.

The dates below mark the moments when one of the report's constraints either resolves or is shown not to have resolved: a waiver expiring, a rule finalizing, a survey publishing, a demonstration producing a purchase order or failing to. Entries marked *Key test* are the ones whose outcome would confirm or undercut the central argument. Four dated tests fall in 2028, across three of the report's seven constraints. The first signed, binding, long-term power purchase agreement between a hyperscaler and a new-build advanced reactor, the event that would show the offtake constraint resolving, has no date at all.

2026, remaining

September 25, passed. The deadline to request a hearing and petition to intervene on Radiant's special nuclear material license application for its R-50 facility at Oak Ridge, sixty days from the Federal Register notice of July 27. No Atomic Safety and Licensing Board proceeding on that application appears in the Board's 2026 orders, whose most recent entry, when the orders page was last read on October 11, 2026, was of September 24.[2]
Signal: whether factory licensing attracts organized opposition, for which an intervention petition is a stronger signal than a public comment. This is the first test of whether the local permission constraint of Chapter 8 extends from data centers to nuclear manufacturing.

October 14 and 15. NRC staff and General Matter held two closed walkthrough meetings for the acceptance review of the Paducah Part 70 application. A docket number had been assigned, but no acceptance or docketing decision had been published as of October 18, 2026.[3]
Signal: the gap between filing and acceptance for review, which is the part of a licensing schedule companies rarely publish and the part that decides whether the twelve-month target in the late 2027 entry below is reachable.

October 31. *Key test.* Closing date for Fermi America's Data Center Lease and Services Agreement with TensorWave, 222 MW over fifteen years at Project Matador, already extended once from September 30. Its outstanding conditions include securing project-level financing sufficient to fund construction. On October 13, 2026 Fermi announced a credit support agreement with AMD for the phase one lease, which it presented as a step toward project financing; no closing had been announced as of October 18, 2026.[4]
Signal: the nearest dated test of demand in this calendar, and the one that tests financing rather than permission. Chapter 7 found the loop running from lender to buyer and back; this is the loop with a date on it. A previous Fermi tenant arrangement was terminated in December 2025 when its exclusivity expired.

October 31. NRC target for the draft environmental impact statement on Holtec's Pioneer Units 1 and 2 at Palisades, from a Part 1 application docketed February 27, 2026, with Part 2 and its

preliminary safety analysis report submitted September 30, 2026.[5]
Signal: whether the phased construction permit route, which Holtec is the first to use for an SMR with a limited work authorization, moves at the pace its user expects. No offtake has been announced for either unit.

November 3. *Key test.* US midterm elections.
Signal: whether data center opposition converts from polling into electoral outcomes. Chapter 8 documented races in Ohio, Texas and Pennsylvania where it is already an issue, and a Reuters/Ipsos finding that 64 percent oppose rapid data center construction.[6] If the issue moves votes, the 2027 legislative sessions can be expected to be materially more restrictive than the 2026 ones.

December 18. NRC target completion for Radiant's Part 70 license review, an expedited eight-month schedule, compared with a typical eighteen months.[7]
Signal: whether the faster NRC reviews of 2026 extend to fuel facility and manufacturing licenses or stay confined to reactor reviews.

December. NRC final environmental impact statement targeted for Fermi America's four-unit AP1000 combined license at Carson County, Texas, following the draft issued September 30 and noticed in the Federal Register on October 9, 2026, on which the staff's preliminary recommendation is to issue the license. The comment period closes November 23.[8]
Signal: whether the NRC's applicant-prepared environmental statement pilot, under which the applicant drafts the statement with staff supervision, produces a license on the schedule its participants expect. It would be the first combined license for new AP1000 units since Turkey Point's in April 2018, not since Vogtle's: the NRC issued four after Vogtle's, for V.C. Summer, Levy, William States Lee III and Turkey Point. The NRC lists only Vogtle's units as operating, and Levy's and V.C. Summer's licenses were later terminated. A license is permission, not a project.

Undated, in progress. *Key test.* NRC final rule on crediting DOE and Department of Defense authorizations toward commercial licensing. Proposed April 2, 2026; comments closed May 4, 2026; no final rule as of this writing.[9] A companion draft Interim Staff Guidance was published April 17, 2026, with comments due May 18. Because guidance can take effect without a rulemaking, it is the nearer-term signal.
Signal: the single most important undetermined quantity in Chapter 4. Every company in the DOE or Janus lane is betting on licensing credit whose size is currently defined only as applying "to the extent that those reviews cover the same scope as the related content in the NRC license application." The final rule sets how much a DOE or military demonstration counts toward a commercial NRC license.

Undated. X-energy's TRISO-X operational readiness review, which the NRC must complete before uranium may be introduced at TX-1.[10]
Signal: when TX-1, which X-energy describes as one of the first new fuel facilities licensed by the NRC in over fifty years, actually starts.

Undated, reportedly October. Westinghouse IPO, confidentially filed July 31, 2026, with no public registration statement yet. Bloomberg reported on September 18, 2026 that the company is seeking a valuation above $50 billion and targeting an October filing.[11], [12]

Signal: a public market valuation for the company at the center of the $17.5 billion AP1000 program, and a disclosure document that would make its order book visible.

Undated. *Key test.* TVA's decision to build at Clinch River. The NRC issued the construction permit for the BWRX-300 there on September 28, 2026, and TVA announced no construction date and said it was still negotiating cost sharing with industry partners.[13]
Signal: whether a federal construction permit converts into a board decision and a financed project. It is this report's argument inside one project: the permission exists, the commercial package does not, and no power purchase agreement attaches to the unit.

2027

Through the year. *Key test.* State legislative sessions, following more than 300 data center bills filed in the first six weeks of 2026 and moratorium proposals in 14 states.[14] Governor Abbott's stated legislative priorities for the 2027 Texas session include repealing data center sales tax exemptions, requiring water-efficient cooling, and establishing siting requirements.[15]
Signal: whether Chapter 8's prescription is being legislated. Items 1 through 4 of it are each already policy direction in at least one state.

Through the year. New entrants. Atlas Atomics raised about $400 million at a reported $1.9 billion valuation on October 8, 2026, for what reporting on the round describes as heavy water reactor technology that does not rely on enriched uranium, while still in stealth and before any licensing. Chapter 2 counts it among its twenty-four developers and gives heavy water a coolant family of its own, and the companion register carries it as a counted developer.[16]
Signal: whether the field is still widening. Chapter 2's finding is that twenty-four developers occupy seven coolant families; if the reported independence from enrichment holds, the design is a genuine addition to the fuel argument in Chapter 3 rather than a twenty-fourth variation on the same six.

Early 2027. Global Laser Enrichment expects an NRC license for the Paducah Laser Enrichment Facility, from an application completed in July 2025. Cameco, which owns 49 percent of GLE, has agreed to buy all of the plant's future production.[17]
Signal: whether the one enrichment project with committed offtake and feedstock already on site clears licensing when its owners expect. A license produces no SWU. A final investment decision comes after it and construction after that, and GLE says it hopes to complete the plant by 2030, so this is a licensing signal and not a supply one.

Late 2027. General Matter's own target for an NRC decision on its Paducah Part 70 application, filed September 28, 2026, on a requested review of roughly twelve months against the eighteen the NRC typically takes. The company intends to file a HALEU amendment during the same year.[18]
Signal: whether the accelerated review schedule the NRC has granted elsewhere, as with Radiant's December 18 target above, extends to an enrichment plant. Two applications are now pending at the same site, and this one has no published capacity figure attached to it.

April 2027. Orano's target for completion of the NRC review of Project IKE at Oak Ridge, accepted in May 2026 on an accelerated twelve-month schedule, against construction starting

September 2027.[19]
Signal: the licensing step for the one federally funded expansion whose capacity is published, 4 million SWU against a 7 million SWU license. Chapter 3 finds it sufficient in size and three to four years late against the waiver expiry.

During 2027. Urenco USA's ongoing 700,000 SWU expansion completes. Production started in its sixth cascade on October 8, 2026 and the company puts the project at 75 percent complete.[20], [21]

Signal: the only domestic enrichment capacity addition that lands before the Russian waivers expire. It is small relative to the Russian supply it would need to replace.

During 2027. *Key test.* Crusoe Spark data center deployment at Idaho National Laboratory, paired with Aalo's reactor, described by both companies as a proof of concept.
Signal: whether the first behind-the-meter nuclear and data center pairing in the dataset produces a purchase order. Chapter 7 found that no hyperscaler has signed a binding new-build PPA; this demonstration either converts an intent into a contract or does not.[22]

During 2027. Framatome and Standard Nuclear joint venture TRISO manufacturing begins at Richland. The NRC granted the license amendment permitting enrichment up to 10 percent, which covers TRISO particle production, in July 2026, following a site-wide authorization above 5 percent in June; the joint venture plans two tonnes of TRISO a year.[23], [24]

During 2027. Crane Clean Energy Center restart target, accelerated from an original 2028 date, against Microsoft's 20-year PPA.[25]
Signal: whether restart timelines hold. Federal loans to restarts, and hyperscaler contracts at Crane and Duane Arnold, now assume they do. Palisades shows the risk: fuel loading began there in August 2026 and paused after a fuel assembly tilted in the core. On October 13 the NRC approved a one-time license amendment to remove the assembly and, the same day, wrote to Holtec finding a chilled work environment in two departments, while saying those issues would not affect restart efforts.[25]

2028

January 1. *Key test.* Waivers permitting Russian enriched uranium imports terminate.
Signal: the hardest deadline in this report. Twenty-six percent of 2025 US enrichment purchases came from Russia.[26] Replacement capacity at scale arrives in 2029 and later. Either inventory and reallocation cover the gap, or the constraint Chapter 3 described shows up in fuel prices and delivery schedules.

During 2028. Raven-Flint's letter of intent with Aalo covers conversion services beginning this year. Raven-Flint's chief executive says Aalo is looking to take 100 percent of the output of the pilot plant, the company's next step after its July 2026 NRC application to raise the uranium possession limit at its Idaho Falls bench-scale laboratory. No date for the pilot plant itself has been published.[27]
Signal: whether a second American conversion supplier exists in time for its first prospective customer. Chapter 1's fifth case is tested here.

During 2028. *Key test.* Radiant targets first mass-produced Kaleidos delivery from the Oak Ridge factory.[28]
Signal: whether factory production of reactors is real. Chapter 6 established that there is currently no evidence anywhere that it reduces cost, and that MIT modeling, relayed in a national laboratory review, projects higher onsite labor per megawatt for SMRs than for large reactors.

September 30. *Key test.* Executive Order 14299 deadline for an operational nuclear reactor, regulated by the US Army, at a domestic military installation.[29]
Signal: whether the defense lane delivers on schedule. This is the only federal deadline for a deployed, operating reactor with a named date and a named responsible official.

2029

During 2029. *Key test.* Centrus targets first new enrichment capacity at Piketon under the $900 million DOE award, with an initial buildout including 12 metric tons of annual HALEU production and new LEU capacity for the existing fleet.[30], [31]
Signal: whether the HALEU constraint begins to lift, and whether Centrus's new LEU capacity for the existing fleet arrives on time. Chapters 1 and 3 set the more than 1,900 kilograms of HALEU Centrus had produced under its DOE contract by mid-June 2026 against the 50 metric tons a year by 2035 that DOE estimates domestic demand could reach.

During 2029. Duane Arnold restart target, carrying a $1.9 billion DOE loan that closed September 8, 2026, with Google as the primary customer.[1] Under the 25-year agreement announced October 27, 2025, Central Iowa Power Cooperative, currently a minority owner, buys the remaining output, and NextEra is acquiring the minority stakes to take full ownership.[32]
Signal: the cleanest existing-plant case in the report, and for that reason no test of new build.

By 2029. ARC Clean Technology demonstration unit commissioning target at Point Lepreau, subject to approvals and licensing. A site preparation license application was filed June 30, 2023 and remains under review, and the CNSC record shows no construction license application.[33]

June 30, 2029. Arizona's three-year pause on the data center sales tax exemption expires.[15]

By end of 2029. Aalo and Crusoe's stated intent to deploy Aalo Pods and 50 MWe reactor plants at Crusoe data centers.[22]

2029 to 2031. The window in which Georgia Power's claimed $2.847 billion of customer benefit from large-load contracts is supposed to appear, with savings beginning in 2029.[34] The OpenAI contract behind it was filed with its public version entirely redacted. Chapter 7, on the reporting cited there, counts it as the seventh approved under the state's large-load framework; no claim is made here that all seven were redacted.
Signal: whether the claimed savings hold up when examined in a rate proceeding. No specific filing date could be established, and none is asserted.

2030 and beyond

2030. Kairos Hermes 2 is scheduled to begin operations, against the TVA PPA.[35]

2030. Raven-Flint expects a commercial conversion plant on line, at 5,000 to 10,000 tons of conversion capacity a year, a figure its source gives in tons without stating whether of uranium or of UF6.[27]

2030. Radiant targets 15 Army deployments complete.[28]

By 2030. *Key test.* Construction start target for the ten AP1000 units under the $17.5 billion DOE supply chain loan program, each requiring $1 billion of upfront equity first.[36]
Signal: whether the objection of Edwin Lyman of the Union of Concerned Scientists, carried in Chapter 6, holds. As of mid-2026, none of the projects was backed by an actual construction contract.

2031. Orano Project IKE targets first LEU production at Oak Ridge, against a $5 billion total project investment.[37]

2032. Urenco USA targets production from its first new cascades, with additional cascades installed through 2036.[20]

2035. The Kairos and Google order book agreement is to enable 500 MW of new advanced nuclear capacity by 2035.[35] DOE estimates domestic HALEU demand could reach 50 metric tons per year.[38]

Three undated events outweigh most dated ones

The next ORISE nuclear engineering enrollments and degrees survey. *Key test.* The most recent public data is 2022.[39] Chapter 5's degree data shows bachelor's degrees falling 25 percent between 2012 and 2022 while doctorates reached a record in a series going back to 1966, and that nobody can currently verify whether the renaissance reversed it. The next survey is the first evidence either way, and its publication date could not be established.

A signed, binding long-term power purchase agreement between a hyperscaler and a new-build advanced reactor. *Key test.* Chapter 7's central finding is that none exists. Microsoft and Constellation at Crane, Google at Duane Arnold, and Google and Fortum at Loviisa will be raised against that, and none qualifies, because all are contracts against existing plants or restarts. The first such agreement would show that the constraint Chapter 1 sets out is resolving.

A count of qualified nuclear suppliers. Chapter 6 established that no current census of ASME N-stamp or NQA-1 qualified suppliers is publicly available, in a sector whose entire deployment thesis depends on that base existing; the last published count, Sandia's 683 certificates in June 2020, counted certificates rather than companies. Publishing a current one would let the sector's industrial capacity be measured.

The finding

Two clusters of dates carry most of the weight, and the one agreement that would show the offtake constraint resolving has no date.

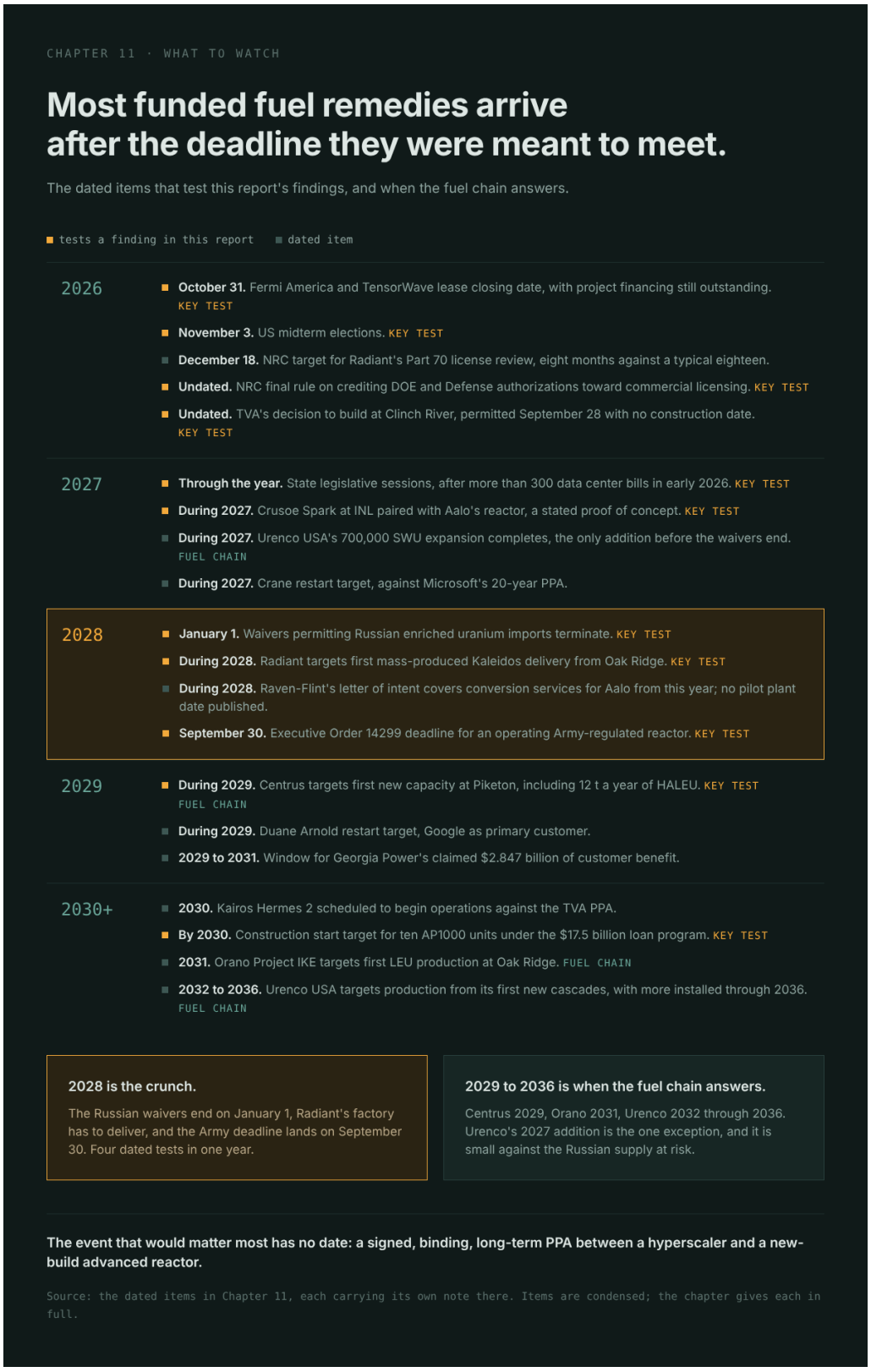


Figure 11.1. Most funded fuel remedies arrive after the January 2028 deadline they were meant to meet.

2028 is the crunch. The Russian waivers expire on January 1, the Army deadline lands on September 30, Radiant's factory has to deliver and Raven-Flint's conversion services for Aalo are due to begin. Four dated tests fall in the same year, across three of the report's seven constraints, since the waivers and the Raven-Flint letter both test fuel, and replacement capacity at scale for the one with the statutory deadline does not arrive until 2029 at the earliest. Georgia's savings window opens in 2029, just outside that cluster, so the ratepayer benefit case cannot be examined until after the other tests are decided.

2029 to 2036 is when the fuel chain answers. Centrus 2029, Orano 2031, Urenco 2032 through 2036. Chapter 3 found the fuel chain short of years rather than tonnage, and the calendar bears that out. Apart from Urenco's 2027 addition, which is small against the exposure, every remedy currently funded arrives after the deadline it was funded to meet.

Most of the remaining entries are demonstrations, and Chapter 1 opened by showing that a demonstration is not a customer. The milestone is not the constraint, and the conclusion turns on a single contract. Until a hyperscaler signs a binding, long-term power purchase agreement for a new-build advanced reactor, every gigawatt figure in this sector's announcements remains an option, a framework or an intent.

That agreement is the entry I will be watching for most closely. If it is signed, the argument of this report will need to be revisited.

Sources

Notes are numbered per chapter. Each carries a source-interest tag: `[regulator]` for government and agency documents, `[reporting]` for independent journalism and trade press, `[company]` for a subject describing itself, `[analyst]` for banks, consultancies and law firms that earn fees in the sector, and `[advocacy]` for organizations with a declared stake in the outcome. Most notes carry an Internet Archive capture, most of them made September 18, 2026, so a reader can check what a page said on or near the date it was read. Notes for sources added in the days before the freeze date largely do not; the back matter states what is outstanding.

Dates given as company targets are targets, not commitments, and are labeled as such in the text.

1. [reporting] *Utility Dive*, "NextEra, DOE loan, Duane Arnold nuclear restart," September 8, 2026. utilitydive.com, archived September 18, 2026 Source of the $1.9 billion loan closing on September 8, 2026, the 615 MW capacity, the 2029 restart target, and Google's role as "the primary customer." It does not state the term of the agreement or how much of the output Google buys; those are in note 32.

2. [regulator] Federal Register, "Radiant Nuclear, LLC; Radiant's Special Nuclear Material License; License Application," document 2026-15130, published July 27, 2026. federalregister.gov, archived September 18, 2026 September 25, 2026 is the sixty-day deadline for a hearing request and petition to intervene.

3. [regulator] U.S. Nuclear Regulatory Commission, public meeting notice 20260766, "Walkthrough of the General Matter Paducah Enrichment Facility license application," October 14, 2026, Docket No. 07007040. nrc.gov The meeting is closed because of security-related information. Its stated purpose is acceptance review, which indicates the NRC had not yet accepted the application for review when the meeting was held. The same notice lists Docket 07007040 for General Matter, so a docket number had been assigned; the notice does not itself state the application's status. The second walkthrough is U.S. Nuclear Regulatory Commission, public meeting notice 20260771, "Walkthrough of the General Matter Paducah Enrichment Facility license application," October 15, 2026, Docket No. 07007040, also closed for security-related information, [regulator] nrc.gov No acceptance letter or docketing notice had been located as of October 18, 2026. See Chapter 3 notes 31 and 32.

4. [company] Fermi Inc., "Fermi and TensorWave Agree to Extend Closing Date to October 31," September 22, 2026, via StockTitan. stocktitan.net See Chapter 7 notes 17 and 18. Fermi describes the lease as binding in its own August 10, 2026 announcement; the

September release states that its effectiveness nonetheless depends on the closing conditions being satisfied or waived. The AMD credit support agreement is from Fermi Inc., "Fermi Signs Credit Support Agreement with AMD and Announces Partnership," October 13, 2026, [company] newswire.com Accessed October 18, 2026; Chapter 7 note 17 explains why it is not read as a guarantee of the tenant's payments.

5. [regulator] U.S. Nuclear Regulatory Commission, Pioneer project page, and Federal Register, "SMR, LLC; Palisades SMR, LLC; Pioneer Units 1 and 2; Phased Construction Permit Application-Limited Work Authorization," October 8, 2026, 91 FR 64409, Docket Nos. 50-616 and 50-617. nrc.gov Source of the October 31, 2026 draft environmental impact statement target and the February 27, 2026 docketing. Neither names the preliminary safety analysis report. Its submission on September 30, 2026 is from Energies Media, "Holtec submits key nuclear safety report to NRC, advancing construction permit process for two Michigan SMR-300 reactors," October 7, 2026, [reporting] energiesmedia.com That it completes the second part of the application is from World Nuclear News, "Second part of construction permit application submitted for SMRs at Palisades," October 2, 2026, [reporting] world-nuclear-news.org The NRC project page and a Holtec statement of September 2026 disagree on the draft safety evaluation report, which the NRC lists as issued August 31, 2026 and the company describes as expected in December 2026; they may refer to different documents and the discrepancy is unresolved here.

6. [advocacy] Brookings Institution, "Why data centers are a top issue in the 2026 midterms," reporting the June 2026 Reuters/Ipsos survey. brookings.edu, archived September 18, 2026

7. [reporting] *Nuclear Engineering International*, "US fast-tracks microreactor factory," May 13, 2026. neimagazine.com, archived September 18, 2026

8. [regulator] Federal Register, "Fermi America LLC (dba Fermi America); Project Matador Advanced Energy and Intelligence Campus; AP1000 Nuclear Units 1-4; Draft Environmental Impact Statement," October 9, 2026, 91 FR 64702, Docket Nos. 052-00051 to 052-00054. federalregister.gov, archived October 16, 2026 Source of the draft statement, the November 23, 2026 close of comments, the applicant-prepared pilot, and the staff's preliminary recommendation to issue the combined license contingent on completion of the safety review. The December target for the final statement is the staff's stated aim and not a commitment. The Federal Register notice gives no date for the final statement. The December 2026 target and the September 30, 2026 issue date of the draft are from [regulator] U.S. Nuclear Regulatory Commission, "Fermi America Project Matador Advanced Energy and Intelligence Campus AP1000 Units 1-4, Combined License Application," Key Milestones table ("Issue DEIS | September 30, 2026 - A"; "Final Environmental Impact Statement | December 2026 - T"), nrc.gov Earlier AP1000 combined licenses are from [regulator] U.S. Nuclear Regulatory Commission, "Combined License Holders for New Reactors," nrc.gov It gives issue dates of February 10, 2012 for Vogtle Units 3 and 4, March 30, 2012 for V.C. Summer Units 2 and 3, October 26, 2016 for Levy Units 1 and 2, December 19, 2016 for William States Lee III Units 1 and 2, and April 12, 2018 for Turkey Point Units 6 and 7, records the Levy licenses as terminated April 26, 2018 and the V.C. Summer licenses as terminated March 6, 2019, and lists only the Vogtle units as operating. That page does not name designs; the AP1000 design of each project is from [regulator] U.S. Nuclear Regulatory Commission, "Combined License Applications for New Reactors," nrc.gov

9. [regulator] Federal Register, "NRC Reviews of Reactor Designs Previously Authorized by U.S. Department of Energy or Department of War," proposed rule, April 2, 2026. federalregister.gov, archived September 18, 2026 The draft Interim Staff Guidance is [regulator] Federal Register, "Draft Interim Staff Guidance: NRC Application Pathway for Reactor Designs Previously Authorized by U.S. Department of Energy or Department of War," document 2026-07566, published April 17, 2026, comments due May 18, 2026. federalregister.gov The proposed rule itself does not mention it.

10. [reporting] POWER Magazine, February 13, 2026. powermag.com, archived September 18, 2026 The fifty-year characterization is the company's, not POWER's: [company] X-energy, as quoted in World Nuclear News, "US regulator issues licence for TRISO-X fuel facility," February 16, 2026, which reports that the approval establishes TX-1 and TX-2 as "the first new fuel facilities licensed by the NRC in over 50 years," X-energy said. world-nuclear-news.org

11. [company] Westinghouse, "Westinghouse confidentially submits draft registration statement for proposed initial public offering," July 31, 2026. info.westinghousenuclear.com, archived September 18, 2026 Share count and price range are not determined.

12. [reporting] Bloomberg News, Bailey Lipschultz, "Westinghouse Targeting Over $50 Billion Valuation in US IPO," September 18, 2026, via Bloomberg Government, news.bgov.com Bloomberg reported that Westinghouse is seeking a valuation above $50 billion in a US initial public offering and targeting an October filing. seekingalpha.com The Seeking Alpha item, dated September 19, is secondary coverage of the same report; no registration statement had been made public when this was written, and the company has not confirmed either figure.

13. [company] Tennessee Valley Authority, "TVA First U.S. Utility to Receive Construction Permit for BWRX-300 Advanced Nuclear Reactor," September 29, 2026, PR Newswire. prnewswire.com, archive lookup Source of the first-utility and second-permit characterizations, of the statement that no construction date has been announced, and of the quoted passages from Mike Skaggs. The issuance is corroborated by Exchange Monitor, "NRC issues construct permit to TVA for Clinch River SMR project," September 29, 2026, [reporting] exchangemonitor.com which reports that the Commission "granted the Tennessee Valley Authority (TVA) a construction permit Tuesday," and by NucNet, September 29, 2026, [reporting] nucnet.org, archive lookup, which calls it "only the second commercial advanced reactor construction permit ever issued in the US" and the first for a BWRX-300. The NRC had published no release and had not updated its project page when this was written. The issue date is from Federal Register, "Tennessee Valley Authority; Clinch River Nuclear Unit 1; Construction Permit and Record of Decision," October 5, 2026, [regulator] federalregister.gov That notice states that "The Construction Permit No. CPAR-2 was issued on September 28, 2026" and records a Record of Decision of the same date. The company and trade-press items above are dated September 29, the day the issuance was made public.

14. [advocacy] Data Center Watch, Q1 2026 report. datacenterwatch.org, archived September 18, 2026

15. [analyst] MultiState, "State data center policy shifts as governors impose new restrictions," June 22, 2026. multistate.us, archived September 18, 2026

16. [reporting] Bloomberg, "Vivek Ramaswamy's nuclear startup raises at $1.9 billion value," October 8, 2026. bloomberg.com Corroborated by Energy Connects, "Ramaswamy nuclear startup raises funds at $1.9 billion value," October 9, 2026, [reporting] energyconnects.com, archived October 13, 2026 . Energy Connects is the source of the description of the technology as improved heavy water reactor technology that does not rely on enriched uranium. The round size and valuation are as reported; the

company is in stealth and has published no design detail, no capacity figure and no licensing engagement, so nothing here is treated as a company disclosure.

17. [reporting] World Nuclear News, "Cameco in offtake agreement for US laser enrichment plant," September 16, 2026. world-nuclear-news.org, archived September 17, 2026 See Chapter 3 notes 27 to 30. The license had not issued as of this writing. The World Nuclear News article gives no completion date. The 2030 target is a GLE vice president's statement at an August 2026 industry conference, repeated in trade reporting of the Cameco agreement with its conditions, both cited at Chapter 3 note 33; it is subject to a final investment decision that has not been taken.

18. [company] General Matter, "Filed," company post, September 28, 2026. generalmatter.substack.com See Chapter 3 notes 31 and 32. The twelve-month target is the company's request reported by Nuclear Engineering International, "General Matter seeks enrichment licence," October 2, 2026, [reporting] neimagazine.com, archived October 12, 2026 , not a schedule the NRC has published or committed to.

19. [company] Orano, "Project IKE enrichment," company page. orano.group See Chapter 3 note 26. The April 2027 review completion target and the twelve-month accelerated schedule are the applicant's statements, not an NRC commitment.

20. [company] Urenco, June 2, 2026. urenco.com, archived September 18, 2026

21. [company] Urenco, "Urenco USA completes 75% of current US uranium enrichment capacity project," October 8, 2026. urenco.com See Chapter 3 note 24. The release publishes no separative work unit figure for the capacity now producing and no revised completion date.

22. [reporting] POWER Magazine, "Aalo, Crusoe plan 2027 INL demonstration." powermag.com, archived September 18, 2026 Both companies describe a strategic partnership and a stated intent; no power purchase agreement is described by either party or by the reporting.

23. [reporting] Tri-Cities Area Journal of Business, October 12, 2025. tricitiesbusinessnews.com, archived September 18, 2026

24. [reporting] Nuclear Engineering International, "Framatome wins NRC TRISO approval," July 30, 2026. neimagazine.com Source of the license amendment permitting enrichment up to 10 percent at the Richland plant, its coverage of TRISO particle and uranium dioxide powder production, the preceding site-wide authorization above 5 percent in June 2026, and the two tonnes a year the joint venture plans.

25. [company] Constellation Energy, September 20, 2024, which gives the original 2028 target. constellationenergy.com, archived September 18, 2026 World Nuclear News, "Crane Clean Energy Centre on track for ahead-of-schedule restart," June 26, 2025. [reporting] world-nuclear-news.org, archived December 9, 2025 Source of the acceleration: the unit "could restart as early as 2027," against the 2028 target first announced. The Palisades events are from U.S. Nuclear Regulatory Commission, news release S-26-009, "NRC Approves Palisades License Amendment Request," October 14, 2026, [regulator] nrc.gov Accessed October 18, 2026, for the October 13 approval "allowing the use of custom equipment and procedures to move a tilted nuclear fuel assembly from the reactor core to the spent fuel pool"; from Michigan Public, "Regulators approve plan to remove damaged fuel assembly at Palisades," October 14, 2026, [reporting] michiganpublic.org Accessed October 18, 2026, for the August start of fuel loading, the pause and Holtec's statement that a delay could affect its restart timeline; and from American Nuclear Society, Nuclear Newswire, "NRC finds 'chilled work environment' at Palisades," October 15, 2026, [reporting] ans.org Accessed October 18, 2026, for the NRC letter of October 13, the supply chain and quality assurance departments, and the NRC's statement that the issues will not affect restart efforts. No restart date has been published, so the report does not state the size of any delay.

26. [regulator] U.S. Energy Information Administration, *2025 Uranium Marketing Annual Report*, Table 16. eia.gov, archived September 18, 2026 Waiver termination date from the NRC, nrc.gov, archived September 18, 2026

27. [reporting] American Nuclear Society, Nuclear Newswire, September 4, 2026. ans.org, archived September 18, 2026 Source of the July 2026 application, which raises the possession limit at the Idaho Falls laboratory for bench-scale work and does not seek authorization for commercial production; of the pilot plant as the company's next step, for which no date is given; of the letter of intent for conversion services beginning in 2028, with the one hundred percent figure attributed to chief executive Nick Smith as what Aalo is looking to take; and of the commercial plant expected on line by 2030 at 5,000 to 10,000 tons a year, a basis the article does not state. See Chapter 1 note 30.

28. [company] Radiant Industries, "Tennessee factory," October 13, 2025, and August 26, 2026 Army contract release. radiantnuclear.com, archived September 18, 2026

29. [regulator] Executive Order 14299, May 23, 2025. presidency.ucsb.edu, archived September 18, 2026

30. [company] Centrus Energy Corp., January 6, 2026. investors.centrusenergy.com, archived September 18, 2026 Buildout scope corroborated by *Engineering News-Record*, [reporting] enr.com, archived September 18, 2026

31. [reporting] POWER Magazine, "Centrus Signs $900M DOE Contract, Pivots Sole U.S. HALEU Cascade to Commercial Operation," July 2, 2026. powermag.com, archived July 15, 2026; Centrus Energy, "Centrus Launches Commercial LEU Enrichment Activities," December 19, 2025. [company] centrusenergy.com, archived August 10, 2026. Accessed September 21, 2026. POWER describes the initial buildout as 12 metric tons of annual HALEU capacity "along with new LEU capacity earmarked to work down a commercial LEU backlog," with first new capacity expected by 2029. Centrus gives the same 2029 date for its first new production capacity. Neither source states the LEU capacity in separative work units, so this report cannot say how much of the Russian share it would replace.

32. [company] NextEra Energy and Google, "NextEra Energy and Google Announce New Collaboration to Accelerate Nuclear Energy Deployment in the U.S.," PR Newswire, October 27, 2025. prnewswire.com, archived September 21, 2026 Source of the 25-year term and of the statement that "one of the plant's current minority owners, Central Iowa Power Cooperative (CIPCO), will purchase the remaining portion of the plant's output." The same release reports NextEra acquiring the combined 30 percent stake of CIPCO and Corn Belt Power Cooperative to reach full ownership.

33. [reporting] World Nuclear News, "ARC-100 completes Canadian regulatory design review," July 9, 2025. world-nuclear-news.org, archived September 18, 2026 Source of the commissioning target, "by 2029, subject to approvals and licensing." It dates the site preparation application to July 2023. The date used here, June 30, 2023, the pending status and the absence of any construction license application are from [regulator] Canadian Nuclear Safety Commission, "New Brunswick Power's ARC-100 Project," cnsc-

ccsn.gc.ca It gives the application as under regulatory review and awaiting additional submissions from NB Power. See Chapter 4 note 25.

34. [company] Georgia Power, "Contract with OpenAI approved as part of portfolio delivering $950 million annual savings," August 2026. georgiapower.com, archived September 18, 2026 The release states no count of contracts and says nothing about redaction. The redaction is from WABE, "Georgia Power agrees to new protections against data center costs," August 27, 2026, [reporting] wabe.org It reports that the publicly filed version of the contract "is entirely redacted" and gives no legal basis. The count of seven rests on Chapter 7 note 39.

35. [company] Kairos Power, August 18, 2025. kairospower.com, archived September 18, 2026

36. [regulator] U.S. Department of Energy, June 23, 2026. energy.gov, archived September 18, 2026 The observation that no project is backed by a construction contract is Edwin Lyman's, reported in *Utility Dive*, utilitydive.com, archived September 18, 2026

37. [company] Orano, January 5, 2026. orano.group, archived September 18, 2026

38. [regulator] U.S. Department of Energy, "HALEU Frequently Asked Questions." energy.gov, archived September 18, 2026

39. [regulator] Oak Ridge Institute for Science and Education, "Nuclear Engineering Enrollments and Degrees Survey." orise.orau.gov, archived September 18, 2026 No publication date for the next survey is announced.

Appendix A: The Offtake Nuclear Register

`The-Offtake-Nuclear-Register_US-Canada_2026-10.xlsx` covers 51 companies, all of them in the United States or Canada, across two company sheets, with a short About sheet in front. It is available at docs.google.com/spreadsheets/d/1WYGG9aLA39dohvVrg9N7vHeg6g2tnRWe7y9PS3Uq0tI. It holds:

- **24 active reactor developers**, the population Chapter 2 counts and sorts
- **24 fuel cycle and ecosystem companies**, covering fuel, enrichment, conversion, recycling, waste, isotopes, software and project development
- **3 defunct or being acquired**, retained because their failures are evidence

It records, per company, the reactor family and coolant, fuel type and enrichment level, manufacturing model, regulatory pathway and current status, disclosed funding, announced offtake and its legal form. The last column of each row lists the documents that row was drawn from, and the column before it lists the chapters of this report that discuss the company. Twelve of the 24 fuel cycle and ecosystem companies are not discussed in the report; they are recorded for completeness.

Three things to know before using it.

It is a derived work, not a source. This report never cites the register, because citing it would make secondary sourcing look like primary sourcing. A reader should not cite it either, and should cite the documents in its Sources column instead.

The edition is part of the citation. The register is maintained on its own cadence, independent of this report, and each edition is dated in its filename. Editions are never overwritten. The October 2026 edition named above is the one every count in this report was derived from, and it remains downloadable at that name after later editions publish. A reader checking Chapter 2's twenty-four developers, or its finding that two of them have a factory, should check the 2026-10 edition named above and not whichever is current.

It is a snapshot even so. In a sector making announcements this often, a figure six months old is a historical record rather than a current one. This edition of the dataset reflects public information as of October 11, 2026, a week before the report's own data date. The report's correction pass changed several classifications the dataset carries, and the dataset's revision 3, October 19, 2026, carries those changes; its Corrections tab lists every changed cell with the previous text and the reason.

The register went through eight review passes, checking every cell against primary and named trade sources and flagging figures found only in aggregators. The published edition shows the result. Every row was reviewed against sector developments through this report's data date, and the rows that moved were updated; that is not a cell-by-cell re-verification of all 51 companies, and the register's About sheet says so.

The counted population and the rest. The 51 companies counted above are everything that meets this report's scope as of its data date: advanced reactor and SMR developers founded to build reactors, at venture or early public stage, in the United States or Canada, plus the fuel cycle and ecosystem companies that serve them. Four further companies this report names fall outside that scope and are listed at the foot of each sheet, each row carrying its reason. Holtec International is an established equipment manufacturer and plant owner that develops reactors alongside a larger existing business. Fermi America builds four large light water AP1000 units and is a campus developer and landlord rather than a reactor developer. Urenco and Orano are fuel cycle incumbents owned by foreign states and utilities rather than North American ventures. They are present because the report names them and a reader should be able to look them up; they are excluded from the counts because they are not the population the report analyses. The register therefore holds 55 rows against the 51 companies counted here, and the four extra are labeled as such on the sheet and explained on its About page. A full edition that records each correction, with the error and the source that settled it, is available on request.

Glossary

Terms are defined as this report uses them. Where an industry term is used loosely in public coverage, the definition here is the narrow one.

Fuel cycle

Conversion. Turning uranium concentrate into uranium hexafluoride so it can be enriched. One US facility performs this step.

Enrichment. Raising the proportion of the fissile isotope U-235. Measured in separative work units.

Fabrication. Turning enriched uranium into finished fuel, whether pellets and rods or the particle fuels advanced reactors use.

HALEU. High-assay low-enriched uranium, enriched above 5 percent and below 20 percent U-235. Required by many advanced designs and currently rationed by federal allocation.

LEU. Low-enriched uranium, formally anything below 20 percent U-235. In this report, as in industry usage, LEU without qualification means conventional fuel enriched to 5 percent or less, the fuel the existing fleet runs on, which is why a design that uses it carries less supply risk.

SWU. Separative work unit, the standard measure of enrichment effort.

TRISO. Tristructural isotropic fuel, uranium kernels in ceramic coatings. Used by several advanced designs.

Yellowcake. Uranium concentrate as it leaves the mill, before conversion.

Regulatory

ADAMS. The NRC's document system. Accession numbers beginning ML are the stable way to cite NRC material.

ADVANCE Act. 2024 legislation directing the NRC on advanced reactor licensing efficiency, and the source of the schedule and cost metrics the agency now publishes.

Construction permit. NRC authorization to build. Distinct from authorization to operate.

Design certification. NRC approval of a reactor design by rulemaking. The strongest form of design approval and distinct from the two below.

Standard design approval. NRC approval of a design short of certification. Not the same thing as a certified design, and the distinction matters commercially.

Pre-application engagement. Discussions and white papers before any application is filed. Time spent here is not time spent in review, because no application exists yet.

Combined license, or COL. A single NRC license to construct and operate.

Part 50, Part 52, Part 53. The NRC's licensing frameworks. Part 53 is the technology-inclusive framework finalized in 2026.

VDR. Vendor design review, the Canadian Nuclear Safety Commission's pre-licensing process. It issues no license and certifies no design.

Generic Design Assessment. The UK's pre-licensing design review, broadly comparable to the Canadian VDR.

Price-Anderson. The US nuclear liability and indemnification framework. Reactors authorized outside NRC licensing do not automatically fall under it.

OTA. Other Transaction Authority, the contracting mechanism used for the Army's Janus Program. Milestone-based and outside standard federal acquisition regulation.

Commercial

Hyperscaler. In this report, the four companies that operate data centers at the largest scale and contract for power directly: Amazon, Google, Meta and Microsoft. Nvidia is a chip supplier that also invests and guarantees, and Crusoe and similar firms are neoclouds; neither is counted as a hyperscaler, and where one of them signs something the text names the company rather than the class. The central finding of this report is a claim about that set of four.

Binding. Used of a contract whose obligations are enforceable on signature, as against a framework, a letter of intent, a master agreement or a right to purchase, none of which obliges either party to buy or sell a unit of power. Where an executed contract waits on a regulatory approval, the report says so.

New build. A reactor not yet operating. It excludes restarts of shut plants, uprates of operating plants and recontracting of existing output, which this report counts separately.

Zero-power criticality. A self-sustaining chain reaction run at negligible power, used to confirm a core's neutronics. It is a normal and necessary step, and it is not operation at power.

Unobligated material. Uranium whose enrichment carries no foreign peaceful-use obligation, which is what allows it to be used for national security purposes.

Part 70. The NRC framework for licensing the possession and use of special nuclear material, which is what a fuel fabrication plant or a reactor factory needs.

Offtake. A commitment to buy the output. The report uses the word narrowly, and distinguishes an offtake agreement from an offtake option throughout.

PPA. Power purchase agreement. A contract to buy power at a price for a term. The report distinguishes a PPA for physical energy from a PPA for clean energy attributes, which are different products.

Behind-the-meter. Generation connected directly to the load, not passing through the public grid.

Front-of-meter, or grid-matched. Generation delivered through the grid, whether or not a specific buyer is matched to it contractually.

First-of-a-kind. The first commercial deployment of a design. Carries cost and schedule uncertainty that later units do not.

Project finance. Debt raised against a project's contracted revenue rather than a sponsor's balance sheet. Distinct from corporate equity, and the distinction is Chapter 7's subject.

Residual value guarantee. A commitment to cover the gap between a guaranteed minimum asset value and what is actually recovered on defined default events. Not the same as an investment.

Backlog. Contracted but undelivered revenue, disclosed in filings as remaining performance obligations. Useful only alongside what has actually been delivered.

Industrial

NSSS. Nuclear steam supply system, the reactor and steam generators together. About 12 percent of a plant's capital cost.

ASME N-stamp, NQA-1. Quality certifications a supplier needs to make nuclear-grade components. No current public census of qualified suppliers exists.

Indirect costs. Engineering, construction management, commissioning and the rest of what is not direct materials and labor. Ran 68 to 76 percent at Vogtle against a 51 percent modeling assumption.

Programs

Reactor Pilot Program. DOE authorization pathway for test reactors, outside NRC licensing. Produces no license to sell power.

Nuclear Energy Launch Pad. DOE program providing prioritized authorization and laboratory access. No federal funding or cost share.

Janus Program. US Army program for vendor-owned microreactors at military installations, up to $2.2 billion across five vendors.

Executive Order 14299. May 2025 order requiring an Army-regulated reactor operating at a domestic installation no later than September 30, 2028.

Disclosures

The value of this report rests entirely on the reader believing it was not written to make anyone look good. That belief is justified only if the interests that could compromise the report are stated plainly, so they are stated here rather than in a footnote.

The author's position. Bijay Alex Mathew is Chief Revenue Officer of Art of Mentoring, a mentoring software, training and facilitation company. He is also CEO and co-founder of SonTeno LLC, a community-led growth practice that helps brands reach buyers inside professional communities and helps associations with sponsorship revenue. He publishes The Offtake. SonTeno's association work involves sponsorship dollars rather than investment dollars. The author has not completed a capital introduction for any company in this sector and has received no compensation for one. This report is produced under his personal byline and SonTeno's, and no client, sponsor or subject paid for it, reviewed it before publication, or was shown a draft.

A commercial interest in these sectors, stated plainly. The author is proposing that Art of Mentoring expand its North American business into nuclear, space, data centers and defense, on the argument that industries hiring at speed against a shortage of experienced people are the industries that need structured mentoring most. Chapter 5 of this report finds exactly that shortage, and finds it binding. A reader should therefore know that the author's employer stands to benefit commercially if the workforce constraint described in Chapter 5 is real and widely recognized, and that the author is the person making that case internally.

Two safeguards follow, and both can be checked rather than taken on trust. The workforce chapter rests on the Department of Energy's own Energy Workforce Advisory Board, on federal degree-completion data, and on a supply chain assessment this report separately flags as commissioned by an organization that advocates for nuclear deployment. None of it originates with the author or his employer. And Chapter 10 concludes that workforce is the most universally unresolved of the seven constraints while offtake is the least resolved, so the report does not rank the constraint tied to the author's interest as the most severe.

Relationships with companies covered in this report. While exploring an introduction between an institutional investor and Aalo Atomics, the author received non-public information about the company. That introduction was never made, and no compensation was received or contemplated. None of that information informed any part of this report: every fact about Aalo here was sourced independently from the public record before it was written, and each carries its own note.

The author's prior employment at the Fernald site was under contractors including Westinghouse, one of the eight companies assessed in Chapter 10. That history is set out immediately below, and is flagged here because this heading is where a reader will look for it.

Prior professional background. The author spent four years studying nuclear engineering and three and a half years at the Fernald site, a US Department of Energy uranium processing facility, working under the federal contractors then operating it, Westinghouse and Fluor. That

background informs the report's understanding of the fuel cycle. It is also decades old, and nothing in this report rests on it as a source.

No financial positions. The author holds no equity, debt or derivative position in any company named in this report. Several of them are publicly traded and this statement covers direct and indirect holdings alike.

No compensation from subjects. No company covered here has paid for placement, coverage, review or removal. There is no advertising in this report and no sponsored content.

Chatham House material. The author attended an executive session held under the Chatham House rule in July 2026. Insights from that session informed which questions this report asks. No fact in this report is sourced to it, and no speaker or affiliation is identified, because a claim that cannot be cited cannot be verified.

Not investment advice. This report contains no investment recommendations, ratings or price targets. The author is not a registered investment adviser or broker-dealer. Nothing here is an offer to buy or sell any security, or a solicitation of one.

Not legal or regulatory advice. The report characterizes licensing pathways and statutory frameworks for analytical purposes. Anyone making a licensing decision should take advice from counsel.

How this report was checked, and what the checking missed

Two scripts checked every chapter. One confirms that each note exists and has a tag, a link and an archive copy. The other flags a note attached to a sentence that shares few words with it, which catches a citation pointing at the wrong source. Neither can tell whether a source actually supports the sentence citing it. That took reading, and the reading found five kinds of error.

Notes pointing at the wrong source. Twice, renumbering the notes left two sources sharing one number. The scripts passed both times. A quotation check caught the second.

A count that looked right and was not. An automated sort of the companion dataset found 22 of the 23 developers then counted were factory-first, because it matched "factory" in sentences such as "not a factory-manufacturing bet." Chapter 2's count was redone by hand against a stated rule, and every other count taken from a sort was re-checked the same way.

Shortened quotations. All 43 quotations from named speakers were compared word for word with the source page. None was misquoted against the source read, but four had been cut short, and in three of them the missing words cut against the point the quotation was used to make.

Claims that something does not exist. A statement such as "no source examined gives X" describes a search on a date. One was wrong: polling on attitudes to a reactor in the respondent's own area did exist. Each such claim now has an archive copy of what was checked.

Sentences that claim more than their source. This was the most common error. The fact is right and correctly cited, but the conclusion goes further. Only reading the source catches it.

A final pass at the level of the single claim. In October 2026 every chapter was checked again, claim by claim, by a reader who had not written it, against the sources its own notes name: 1,277 claims in the eight chapters not already checked that way, and three chapters the same day before them. About 250 findings resulted, 60 of them claims the cited source contradicts, and all were corrected before publication. Two classes recurred. One was a quotation or fact attributed to a document that does not contain it. The other was a figure or qualifier attached to a note that names a different source, invisible to a reader who trusts the notes and fatal to one who checks them. About a dozen corrections changed what a passage could claim, and those passages were rewritten rather than patched. The version history lists them.

One risk no check here reaches: a publication may have quoted a speaker imperfectly in the first place.

Corrections and version history

No corrections have been issued. This section exists so that when one is, it has an established place rather than an improvised one.

Corrections will be listed here with the date, the claim as published, the claim as corrected, and the source that settled it. Substantive corrections will also be noted in the affected chapter. Changes that are developments rather than errors, where a fact was accurate when published and the world moved, will be labeled as such and kept separate, because collapsing the two categories flatters the report at the reader's expense.

Version history

v1.0, October 18, 2026. Eleven chapters, front and back matter, and the companion dataset. October 18, 2026 is this edition's freeze date, and it publishes on October 19. The data date moved three times from the original September 21, to October 3, to October 11 and then to October 18, the last to follow the claim-by-claim correction pass described below. A line-by-line read before release produced twenty-six corrections, set out below. None changed a finding.

Pre-publication read, October 12 and 13, 2026. Six were substantive. Chapter 2's explanation of why heavy water is counted as a family of its own broke off mid-sentence and, as written, contradicted the chapter's own account of Atlas Atomics twice over. Chapter 3 said that mining produces uranium concentrate, where the concentrate comes out of the mill, and it used the abbreviation SWU before expanding it. Chapter 3 also said that an early 2027 license for the Paducah laser plant would come sooner than any other milestone in the table beside it, which that table's own first row contradicts. Chapter 8's account of its own sourcing still carried note counts from before the source-interest tags were revised, and now reports them as they stand. Chapter 10's scorecard did not say what the bold marking a signed contract means, although the front matter and both briefs do. And the coolant table's "Heat pipe, no circulating coolant" became "Heat pipe," because a heat pipe's working fluid does circulate inside its sealed tube; what is absent is a pump and an external loop. Separately, the notes were renumbered to run in order of first appearance, which they had stopped doing as later passes added sources, and each of the 488 markers was checked against the source it resolves to both before and after. The rest were wording, US spelling, and five references to the Department of Defense under a name that the Atomic Energy Act does not use.

Claim-by-claim correction pass, October 18 and 19, 2026. Every chapter was checked claim by claim against the sources its notes name, by a reader who had not written it. About 250 findings resulted, 60 of them claims the cited source contradicts, and every one was corrected before publication; none is outstanding. The corrections that change what a passage claims, rather than a figure in it, are these. Chapter 1 described a docketed Raven-Flint application as one for a pilot conversion plant; it raises the possession limit at a bench-scale laboratory, and the pilot plant is a later step. Chapter 2 counted two developers with both a factory and a production rate; Antares's Torrance facility meets the chapter's own test, so the count is three, and Bluecore is counted in light water on the reporting of its seed round. Chapter 3 gave a fuel qualification clock of three and a half to six years where its source says roughly four to six, and

said no Paducah capacity was published where Silex publishes an 8 million SWU license ceiling. Chapter 4 timed Clinch River from docketing and Darlington from filing; on a common basis the comparison is about 17 months against about 30, and Clinch River was docketed on July 9, 2025, not August 4. Chapter 6 presented a national laboratory's summary of one research group's modeling as the laboratory's own and as independent of an MIT study sharing an author, and said the Sandia count of N-stamp certificates was not public; it is, at 683 certificates in June 2020. Chapter 9 quoted Executive Order 14299 as designating AI data centers critical defense facilities; it directs the Secretary of Energy to initiate a process for designating them. Chapter 10 said Radiant's Part 70 license does not cover fueling, which its sources say it does, and called a September 2026 Aalo statement the first on the record when July reporting had already quoted it. Chapter 11 called a Fermi America license the first AP1000 combined license since Vogtle; four were issued after it, the last in 2018. The front matter's statement that one certified design has no new-build contract now reads one certified small modular design, since the AP1000 is certified too. The rest are narrower: a figure, a date, a qualifier, or a source the note did not name.

Carried from October 12 to October 18. The NRC's direct final rule of October 14 renewing the AP1000 design certification through 2066, in Chapter 1, which is consistent with that chapter's reading that Westinghouse is prioritizing the large reactor. Fermi's credit support agreement with AMD of October 13 for the phase one lease at Project Matador, in Chapters 7 and 11; the lease had still not closed at the freeze date, and it remains a lease for compute rather than a contract for power. The NRC's closed acceptance-review walkthroughs of General Matter's Paducah application on October 14 and 15, in Chapter 11, with no docketing decision at the freeze date. The pause in fuel loading at Palisades and the NRC's letter of October 13 and 14 finding a chilled work environment there, in Chapter 11, against the restart timeline that chapter tracks. And Oracle's subscription of October 2 to part of Point Beach's output, in Chapter 7, which is not counted in the existing-plant total because no capacity is disclosed and it awaits state approval. One earlier development was also carried late: the Texas governor's directive of September 21 halting state permits for data centers until ERCOT's audit is complete, in Chapter 7. No hyperscaler signed a power purchase agreement for a new-build advanced reactor in the week, and the central finding is unchanged.

Carried from September 22 to October 3. Cameco's offtake agreement for all future production of Global Laser Enrichment's Paducah plant, of September 16, in Chapters 3 and 11. The September 2 congressional testimony of Aalo Atomics' chief executive, in Chapters 4 and 10. General Matter's Part 70 license application for a commercial enrichment plant at Paducah, filed September 28, in Chapters 3 and 11, which puts two enrichment applications at that site at once. The NRC's issuance of a construction permit to the Tennessee Valley Authority for Clinch River Unit 1 on September 28, announced the following day, in Chapters 1, 4, 7 and 11. The Constellation and Amazon twenty-year agreement at Calvert Cliffs of September 30, in Chapter 7. NANO Nuclear's agreement of October 1 to buy an unbuilt deconversion facility's license, in Chapter 3. And Amazon's statement of October 2 that it no longer uses nondisclosure agreements with the government agencies it works with, in Chapter 8, against the eighth item of that chapter's prescription.

Carried from October 4 to October 11. The Google and Constellation agreements of October 6, in Chapter 7: a twenty-year power purchase agreement for 890 MW of uprate capacity against existing plants, alongside a fifteen-year energy supply agreement for a further 2,700 MW that is

not counted in any total here, because Constellation does not state that the capacity is nuclear. Together with Calvert Cliffs on September 30, the 890 MW moved this report's total for hyperscaler contracting against existing US plants from about 5.4 GW to about 6.9 GW of disclosed capacity on two days a week apart, while the equivalent figure for new-build advanced reactors stayed at zero. Google's own explanation of that purchase, in Chapter 7, is the clearest statement of this report's central finding by any buyer. The Department of Energy's conditional loan commitment of $4.2 billion to Vistra of October 5, in Chapter 7, which finances the uprate capacity already contracted to Meta. Heatmap Pro's tally of October 6 putting 2026 data center cancellations at $260 billion, in Chapter 8, which gives that chapter's weakest-sourced figure a better-provenanced companion on a different measure. The UMBC Poll released October 8, in Chapter 8, which corroborates a strongly-opposed share above 60 percent for local data center siting from a pollster that publishes its wording. One week of moratorium enactments from October 5 to 9, in Chapter 8. The Federal Register notices of October 5 to 9 for Blue Energy, Pioneer Units 1 and 2 and Fermi America, and Terrestrial Energy's topical report, in Chapters 4, 7 and 11. The start of production in Urenco USA's sixth cascade on October 8, in Chapters 3 and 11. And Atlas Atomics' October 8 financing, in Chapter 11, which is counted rather than noted: it takes the developer population from twenty-three to twenty-four and gives heavy water a coolant family of its own, which changed Chapter 2's title, its tables, its figure and every count that depends on them.

Seven corrections first recorded in the notes have been moved here so the notes read as finished rather than as a worklist: an earlier draft treated Amentum's $730 million contract figure as unverified, which was wrong; an earlier draft of Chapter 3 said no separative work unit figure for the Orano expansion appeared in the public record, and one is published; an earlier draft of Chapter 10 placed Aalo in the standard low-enriched uranium cohort on the strength of its demonstrator rather than its commercial reactor; an earlier draft of Chapter 11's calendar listed the Framatome license amendment as pending when it had been granted in July 2026; an earlier draft of Chapter 3's note on the Darlington docket quoted a sentence truncated at "reactor facility" and closed it with a period, presenting a partial sentence as a complete one; an earlier draft of Chapter 7's note on the Georgia approval quoted only the first half of the Shober sentence; and earlier drafts of Chapter 7's Lazard table printed a restart range of 394 to 783 and a small modular reactor range of 876 to 2,148, both extraction errors, the chart's superscript footnote markers having been read as trailing digits and two unrelated markers on different rows having been read as a range.

Two corrections of sourcing rather than of fact belong in this history. The figure of 61 percent strongly opposed, which earlier drafts carried for the Embold Research wave of August 2026, is not published by either Embold or Heatmap; Heatmap publishes only that more than six in ten would strongly oppose. The precise figure came from secondary reporting and has been removed, with the magnitude corroborated instead from the UMBC release. See Chapter 8 and its note 4. And Chapter 3 stated that no separative work unit figure for the Orano expansion appeared in the public record. Orano publishes one: Project IKE is designed for an initial 4 million SWU against a license written for 7 million. The claim was wrong, the chapter now carries the figure, and the consequence is sharper than the gap it replaced, because that capacity exceeds the Russian share and arrives three to four years after the waivers expire. See Chapter 3 and its note 26.

The companion dataset moved with the report. It publishes as the October 2026 edition, with every row reviewed against sector developments through October 11, 2026. That is not a cell-by-cell re-verification of all 51 companies, which this edition did not perform, and the register's About sheet states the limit in those terms. The correction pass of October 18 and 19 changed several classifications the report draws from the dataset, among them Bluecore Energy's coolant and fuel and Antares's place among the companies with a factory and a production rate; those are carried in the dataset's revision 3 of October 19, 2026, published as a numbered revision with a changelog rather than overwriting the October edition. The October edition counts 51 companies against the September edition's 50: Atlas Atomics is now counted as the twenty-fourth active developer rather than recorded as a later entrant, and four companies the report names sit outside the counted population, listed at the foot of each sheet with the reason on each row. The edition also updated General Matter's regulatory cell for its Part 70 application and brought six counted rows current for developments between October 1 and 11: Deployable Energy's selection for the DOME test bed, Terrestrial Energy's topical report, Blue Energy's construction permit application, Last Energy's DOE safety approval, Valar Atomics' Utah campus reporting and NANO Nuclear's deconversion purchase.

The periods from September 22 to October 3, from October 4 to October 11 and from October 12 to October 18 were each reviewed for developments of the kind listed above and not swept comprehensively. Developments after the freeze date belong in the corrections section above or in Volume II.

Verification state: adversarial source pass complete across all chapters; claim-by-claim check against the cited sources complete across all chapters, with every finding applied; every quotation attributed to a named speaker checked against its source; every cross-chapter reference checked against the chapter it cites; every numeric claim, superlative and cross-reference extracted to an inventory and checked against its note. Most notes carry an Internet Archive capture. Captures for sources added in the final days before the freeze, and a number of earlier captures that could not be confirmed, are outstanding and are not cited as captured.

Reporting an error

Corrections are welcome and will be published with attribution unless the sender asks otherwise. They are logged at sonteno.com/research/criticality-is-not-a-customer. Write to bijay@sonteno.com with the chapter, the claim, and the source that contradicts it.