Catalyzing Commitments to Advanced Nuclear Energy Projects

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Executive Summary

Advanced nuclear energy[1] holds the potential to be a key source of firm clean energy to support the transition to a decarbonized energy supply. While there are several advanced nuclear energy projects under development, including those partially funded by the U.S. Department of Energy's Advanced Reactor Demonstration Program (ARDP), material financial commitments (i.e., signed contracts and spending on project development) to additional projects have been slow in coming.

The Nuclear Innovation Alliance (NIA) conducted a series of workshops under Chatham House rules in 2023 and early 2024 to identify the factors inhibiting commitments to advanced nuclear energy projects and potential steps to accelerate such commitments. Through these workshops, we found that key factors holding back further commitments include the uncertainty in the ultimate cost of projects, resulting from a variety of factors including the lack of experience in developing advanced nuclear energy projects and the immature supply chain supporting them, and the long and expensive development process for such projects driven by the extensive environmental analysis, licensing, and design work currently required to support nuclear energy projects.

We identified potential actions that private-sector actors, the U.S. Department of Energy (DOE), and legislators could take that to accelerate commitments to additional advanced nuclear energy projects. These include:

- Private-sector actions:
  - Serial multi-project developments pursued by one or several sponsors[2], which can enable first-of-a-kind costs to be shared among the projects and cost savings to be captured through increased experience (learning by doing), combined expertise, and larger supply commitments.
  - Energy offtakers sharing costs during design finalization, permitting, and licensing (with compensation later such as an adjustment to offtake costs or participation in project returns).
  - Premium offtake pricing for advanced nuclear energy projects until the process of developing those projects is more mature.
  - Price-adjustment mechanisms to share the impact of unanticipated cost increases.[3]
  - ***The most impactful private-sector action*** would be for offtakers to make capital commitments to provide a backstop for project completion cost (in exchange for a range of possible compensation, and with rights to review estimates and provisions to align incentives) and improve access to financing.
- Public-sector actions:
  - DOE may be able to offer supplemental loans to finance a share of cost overruns[4] and funding to support development costs (this capability appears to be feasible under current authority).
  - ***The most impactful public sector actions*** would be legislation to share completion-cost risk for early-mover advanced nuclear energy projects that commit to a defined set of best project management practices, combined with cost-sharing and incentives to keep costs

[1] See the body of the report for a definition.

[2] See the body of the report for a discussion of the terms "developer" and "sponsor."

[3] Any mechanism to address unanticipated costs must require mature cost estimates, reviewed by an independent advisor, to establish the baseline cost.

[4] See the body of the report for the origin and details regarding this concept.

down, and potentially grant funding for advanced nuclear energy projects in addition to those covered by the ARDP, until there is more experience building such projects and the supply chain is more mature. The Consolidated Appropriations Act, 2024, provides $800 million for up to two projects using Generation 3+ reactor designs.[5]

As with most energy innovation in the United States, the most likely successful path to successful early mover projects will be a combination of public and private partnerships and actions.

Introduction

Several efforts are underway to explore deployment of advanced nuclear energy, many aided by U.S. Department of Energy (DOE) funding through the Advanced Reactor Demonstration Program (ARDP) or other programs. However, in the United States to date there have been no commitments to construct (i.e., final investment decisions) commercial advanced nuclear energy projects,[6] and there has been little funding committed to developing advanced nuclear energy projects beyond those that have been co-funded by DOE.

What is Advanced Nuclear Energy?

There is a range of definitions for what constitutes advanced nuclear energy. The Nuclear Energy Innovation and Modernization Act (NEIMA) defines an advanced nuclear reactor as one with "significant improvements compared to commercial nuclear reactors under construction as of the date of enactment of this Act, including improvements such as

(A) additional inherent safety features;
(B) significantly lower levelized cost of electricity;
(C) lower waste yields;
(D) greater fuel utilization;
(E) enhanced reliability;
(F) increased proliferation resistance;
(G) increased thermal efficiency;
or (H) ability to integrate into electric and nonelectric applications."[7]

The Nuclear Innovation Alliance (NIA) conducted a series of workshops in 2023 and early 2024 to identify the factors inhibiting commitments to advanced nuclear energy projects and potential steps to accelerate such commitments. The workshops were conducted under the Chatham House Rule, under which comments are not for attribution, and the workshops could incorporate only a limited set of potential interested parties. The workshops focused on prospects to deploy reactors of the size typically described as Small Modular Reactors (SMRs), but the conclusions may be relevant for both larger and

[5] Office of Nuclear Energy, "FY2024 Spending Bill Fuels Historic Push for U.S. Advanced Reactors," March 14, 2024. https://www.energy.gov/ne/articles/fy2024-spending-bill-fuels-historic-push-us-advanced-reactors
[6] Ontario Power Generation has signed an agreement with GE-Hitachi Nuclear Energy and other parties to develop and construct a BWRX-300 small modular reactor to be built in Canada, but has not yet received a license to construct or made a final investment decision. A final investment decision, or FID, includes signing a contract to construct and ordering major equipment, and typically does not occur until after major licenses and permits have been obtained.
[7] Nuclear Energy Innovation and Modernization Act. https://www.congress.gov/115/plaws/publ439/PLAW-115publ439.pdf

smaller reactor designs.[8] This report is based on discussions in those workshops, as well as on NIA's participation in individual and group discussions in related forums during that time.

Factors Affecting Commitments

No business case for FOAK. Current and potential project sponsors and offtakers recognize that first-of-a-kind (FOAK) costs will inevitably be higher than costs for eventual, N^{th}-of-a-kind (NOAK) deployments. Furthermore, FOAK costs for advanced nuclear energy will be higher than prevailing sources of firm energy; while those are carbon-emitting, and therefore not compatible with decarbonization objectives, some sponsors do not currently have the flexibility to commit to zero-carbon options if the cost is significantly higher. The most cost-effective sources of firm zero-carbon energy are still being sought, although advanced nuclear energy is among the most promising candidates.[9]

A commonly expressed view is that there is no business case for FOAK projects by themselves; rather, they are a means to reach NOAK projects that have a sound business case. In this view, participants in early-stage projects accept the extra cost as part of an intended multi-project deployment plan (through which the cost of early projects can be shared among the projects) and seek government support where it is available to mitigate the extra cost of FOAK or early-stage projects.

Cost uncertainty. Parties interested in pursuing commercial nuclear energy projects are uniformly concerned about the uncertainty in the ultimate cost of nuclear energy projects, heightened by the cost overruns experienced by some recent projects such as the Vogtle power plant in Georgia. For context, cost overruns on nuclear energy projects are not inevitable; some recent large nuclear projects have been completed in line with estimates, e.g., the Barakah power plant in the United Arab Emirates. At Vogtle, experience made construction at Unit 4 more efficient and less costly than at Unit 3.

Many project stakeholders are exploring steps to manage final costs and reduce the extent of cost overruns, as described below. In addition, potential project participants have expressed strong interest in mechanisms to share the risk of cost overruns (e.g., sharing among an "order book" consisting of many projects of the same design) and in additional government support to address cost-overrun risk.

Development timeframe, cost, and cost recovery. Another factor affecting commitments to nuclear energy projects is the extended timeframe for project development prior to a final investment decision, and the costs associated with that development work. The activities that must be funded include engineering and design, site acquisition or control, environmental permitting, and nuclear licensing. The environmental analysis and design work required for nuclear licensing currently makes the development stage for a nuclear project longer and more costly than for most other clean energy projects. There is considerable uncertainty in the time and cost associated with nuclear reactor licensing, since the Nuclear Regulatory Commission (NRC) has provided approvals to only two advanced nuclear power technologies (in addition, project sponsors must pay for NRC's time spent on licensing their technology).[10] Licensing

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[8] Micro-reactors are expected to have significantly smaller capital requirements than SMRs and to target markets with less sensitivity to cost, which may mitigate some of the cost-related pressures discussed here.

[9] Several studies have confirmed the importance of clean, firm energy – energy that is always available, regardless of environmental conditions, and does not require storage – for achieving deep decarbonization; see, e.g., Nestor A. Sepulveda, Jesse D. Jenkins, Fernando J. de Sisternes, and Richard K. Lester, "The Role of Firm Low-Carbon Electricity Resources in Deep Decarbonization of Power Generation." Joule 2, no. 11 (November 21, 2018): 2403–20. https://doi.org/10.1016/j.joule.2018.08.006.

[10] The NRC has certified the design for the NuScale reactor and has authorized construction of a test reactor by Kairos Power.

should be simpler and less costly for subsequent projects of the same design, which is another reason to pursue a series of multiple projects of the same technology.

Some price-regulated utilities are particularly sensitive to the exposure to project development costs, since they are unable to recover the costs until the projects become operational, and since the electricity rates they can charge to customers are not structured to incorporate that degree of risk into their returns (in some cases regulators provide an allowance for funds used during construction, or AFUDC, to address this issue). To facilitate investment in new nuclear projects, the U.K. has implemented the Regulated Asset Base (RAB) model, which allows projects – if designated by the government as eligible for RAB treatment – to begin to receive payments during construction and to be covered by limited government protection against cost overruns.[11]

What is a project developer?

The terms "project developer" and "project sponsor" do not have precise definitions. We use the term "project developer" to mean the entity responsible for carrying out or coordinating the myriad elements of a project, from site selection and control through licensing, construction (by serving as or hiring engineers and constructors), and operations (through serving as or hiring an operator[12]). Often the project developer will also be the entity that is the key offtaker of the project output, such as an integrated electric utility – historically, most large nuclear energy projects were developed by electric utilities – or an industrial energy user. In industry discussions the term "project developer" is sometimes used to refer specifically to entities that develop projects solely with the intent to sell the output (or sometimes the project) to someone else. If the distinction is needed, we will refer to such entities as "*independent* project developers." Project developers are also distinct from the entities developing nuclear energy technologies, although some of those entities have also become project developers, either temporarily out of a need to demonstrate their technologies, or for the long term as part of their business strategy.

We use the term "project sponsor" somewhat more loosely to mean the entity providing the early initiative for a project and pursuing (and funding) the initial steps to develop one. Often that will be the principal offtaker such as an integrated utility or industrial energy user, but it could also be an independent project developer that sees a business opportunity (since the 1970s when legislation made it more feasible, independent developers have been responsible for initiating many fossil and renewable energy projects). Typically, the project sponsor will incur the greatest exposure to project risk, at least in the early stages of project development.

NIA expects to publish additional research on project development for advanced nuclear energy in the near future.

Lack of independent developers for nuclear energy projects. Potential project sponsors and others in the industry frequently express the desire for independent project development companies that might be willing and able to take on project development, financing, and construction risks for commercial nuclear energy projects, as many companies do for solar, wind, and gas-fired power projects. A few companies are seeking to step into this role. However, there are several obstacles to independent development companies in the current state of the nuclear energy industry (as for other advanced energy technologies that have not

[11] Department for Business, Energy & Industrial Strategy, "Nuclear RAB model: Statement on procedure and criteria for designation," April 2022. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1068133/nuclear-rab-model-statement-procedure-criteria-designation.pdf

[12] Operators of nuclear energy facilities must be licensed by the NRC.

been commercialized). First, until many more projects are completed and there is a visible NOAK cost, independent developers would need a way to manage the early-project cost premia and uncertainty. Second, construction for nuclear energy projects is by its nature more complex than for technologies where independent development has been most successful. In particular, development of projects with gas or renewable technologies is able to rely on key components that are mature enough to receive cost and performance guarantees from well-capitalized equipment manufacturers. Furthermore, the equipment to which the guarantees apply comprises a much greater proportion of project costs than it does for nuclear energy.

Since independent development companies for nuclear energy are just seeking to become established, other project sponsors (electric utility or industrial energy users seeking output from the projects, or nuclear technology companies seeking to demonstrate their technologies) have had to take on the responsibility for project development. In many cases, the entity pursuing nuclear energy project development is missing some development capabilities. Some sponsors do not have project development experience. Others may have had those capabilities in the past, but they may have eroded over time and need to be rebuilt. Some may have strong project development capabilities, but not experience with nuclear energy.

Supply-chain issues. Because the nuclear energy supply chain has eroded during the decades since nuclear projects were constructed at a more rapid pace, cash outlays need to be made early in projects to obtain key components unique to nuclear project requirements (earlier than if components were being regularly produced and could simply be ordered as needed). For many projects contemplating advanced designs that do not use the conventional "light-water" technology common to existing nuclear reactors, the lack of a well-defined path to high-assay low-enriched uranium fuel (HALEU) may be a risk.[13]

Role of offtakers. Potential offtakers of the output of future nuclear energy projects, such as datacenter operators, have typically supported clean-energy projects through power-purchase agreements (PPAs); sometimes these are at premium prices for emerging technologies. Some potential offtakers have sought to accelerate clean-energy projects by offering "advance commitments" or similar mechanisms identifying their willingness to enter offtake agreements before the projects have been identified. For example, Google, Microsoft, and Nucor recently issued a Request for Information for advanced clean electricity.[14] For nuclear energy projects, because of the issues described above, potential offtakers report being asked to help address a combination of development costs, project capital, and/or cost risk, complicating their participation in projects. Potential offtakers may now be recognizing that lack of new clean firm energy supplies is not only affecting their decarbonization objectives, but may hinder their ability to grow and expand, which may provide the impetus for them to provide a greater contribution to project development and take on more of the risks associated with early-stage projects.[15]

Length of offtake agreements. In addition, the economic life of nuclear projects (60 years or more) is well beyond the length of typical PPAs (10-20 years). Offtakers typically aren't prepared to take the risk of longer commitments (which requires a longer-term view of their underlying business and energy

[13] DOE has issued an RFP for HALEU, and $2.7 billion was provided in the Consolidated Appropriations Act, 2024 in part to address HALEU supply.

[14] Google, Microsoft, and Nucor, "Advanced Clean Electricity RFI Overview," March 2024. https://www.advancedcleanelectricity.com/

[15] Grid operators are now recognizing that electric power demand is expected to grow much more rapidly than it has in the recent past, driven in part by power demand from datacenters; see, John D. Wilson and Zach Zimmerman, "The Era of Flat Power Demand is Over," Grid Strategies LLC, December 2023. https://gridstrategiesllc.com/wp-content/uploads/2023/12/National-Load-Growth-Report-2023.pdf

demand, as well as alternative supplies). However, longer PPAs could help enable nuclear energy projects to monetize the value of their anticipated longer economic life and help accelerate projects.

Actions Being Taken or Considered to Control Project Risk

Commitment to best practices. Developers of potential nuclear energy projects are implementing or considering a range of actions to address the risks affecting these projects. Based on discussions with NIA and in industry forums, current and prospective project developers appear to be acutely aware of the lessons learned from the Vogtle project.[16] Project developers have emphasized their commitment to best practices for project development. These include, for example, completion of design before mobilizing manufacturing and site work, and requiring milestones to be achieved (or "gates" to be cleared) and cost uncertainty to be resolved to release additional funds. Developers are reconsidering the form of contracts used, since a fixed price contract may not necessarily result in the lowest-cost or most quickly delivered project. Some project developers are implementing a version of Integrated Project Development (IPD),[17] sharing risks, contingency funding, and rewards among project participants (e.g., sponsor, architect, engineer, procurement manager, constructor), which creates a common incentive to resolve risk (emphasizing a common goal and avoiding finger-pointing) and complete projects within budget.[18]

Serial development of multiple projects with a common design. In recognition of the poor business case for FOAK projects, some project sponsors are recognizing the value of serial development of multiple projects using the same design (which could include constructing multiple reactors on one site). These could capture both early access to clean, firm energy as well as the cost reductions achievable by incorporating experience in later projects. DOE has pointed to a committed orderbook of 5-10 deployments of a single reactor design as necessary to catalyze commercial liftoff for advanced nuclear energy.[19] Implementing a program of serial development of multiple projects could be a challenge for all but the largest sponsors, and no multi-project orders have been implemented to date, although some sponsors appear likely to do so if initial deployments are successful. Serial development of multiple projects could also be achieved through agreements among multiple sponsors, or through independent project developers with commitments from multiple offtakers and sufficient backing from investors.

In serial development of multiple projects, developers have highlighted the potential value of preparation and specific practices to capture value from the lessons learned in the first projects.[20] These practices include scheduling a gap between the first project in the sequence and later projects to provide time to

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[16] See, Department of Energy, "Pathways to Commercial Liftoff: Advanced Nuclear," March 2023, for a discussion of the lessons learned from Vogtle and best practices including design completion before construction, constructability reviews, a detailed project schedule and project controls, and other practices. https://liftoff.energy.gov/advanced-nuclear/

[17] Integrated Project Development (IPD) is a project delivery approach in which participants (such as engineers, procurement managers, constructors, and sponsors) pool incentives, manage through consensus, and use efficient project management techniques. See, e.g., Howard Ashcraft, "Transforming project delivery: integrated project delivery," in Oxford Review of Economic Policy, Volume 38, Number 2, 2022. https://academic.oup.com/oxrep/article/38/2/369/6588219

[18] Ontario Power Generation, "Team forms to build North America's first SMR," January 27, 2023. https://www.opg.com/news-resources/newsroom/media-releases/release/team-forms-to-build-north-americas-first-smr/

[19] DOE, "Pathways to Commercial Liftoff: Advanced Nuclear."

[20] One example is the success of incorporating lessons learned during Ontario Power Generation's refurbishment of its Darlington nuclear power plant. See World Nuclear Association, "Darlington Nuclear Refurbishment Project update," https://www.world-nuclear.org/wnpr2023/world-nuclear-performance-report/case-studies/darlington-nuclear-refurbishment-project-update.aspx

capture lessons learned and identifying specific people, with expertise in key areas, to be responsible for capturing learnings and transferring them to subsequent projects. Serial multiple-project development could also enable managing the supply chain across all of the projects (which adds efficiency, though with some risk if future projects do not materialize as planned) and managing construction labor across the projects.

Serial development of multiple projects is simplest if the projects are all developed by a single sponsor, within a limited geographical area, with common utility regulatory jurisdictions (if the projects are being developed by price-regulated utilities). With multiple sponsors, it may be difficult to align the incentives, timing objectives, and economic tradeoffs of all the parties. If there are multiple project offtakers, it may be challenging to align the project locations for the desired energy uses, and if there are multiple regulatory jurisdictions, it may be complicated to align the regulatory processes (though there are many precedents for utilities that are geographically adjacent sharing project output). For regulatory treatment, it may be particularly difficult to get combined economic treatment of multiple projects where the output is delivered to distinct geographies or power markets.

Pooling efforts. Some project sponsors are also combining their efforts to pursue cooperative development. For example, Ontario Power Generation, the Tennessee Valley Authority, and Synthos Green Energy have agreed to work with GE-Hitachi Nuclear Energy (GEH) on the standard design for GEH's BWRX-300 small modular reactor.[21] A range of expertise from multiple parties can enable achieving a better design more quickly than with teams working alone. Establishing a common design provides the foundation for achieving cost savings in future deployments. It could also provide the opportunity for collaboration in licensing and project development.

Controlling operating costs. The focus on controlling risks needs to extend to operating costs as well – designs that save capital but impose higher operating costs will deliver poor results over time. The design should aim for operations and maintenance (O&M) efficiencies including efficient staffing, design, and equipment selection to minimize operations and future maintenance costs, and use of digital tools.

Potential Actions to Accelerate Commitments

Although project sponsors are taking steps to address cost uncertainty and offset FOAK costs with the benefits of NOAK projects, the potential risk of cost overruns continues to pose a challenge to the next set of commitments to nuclear energy projects. The need to carry project development and licensing costs over a potentially lengthy timeframe also hinders commitments. Steps to mitigate these factors may be feasible through actions by project sponsors and offtakers, by the DOE (through the Office of Nuclear Energy, the Office of Clean Energy Demonstrations, or the Loan Programs Office), or through new legislation.

Potential private-sector actions. As described above, project sponsors can mitigate the risks of cost overruns in early deployments by developing a series of projects with a common design individually or in combination with other sponsors. This can offset the risk of cost overruns in early projects with cost improvements and risk reductions in later projects based on lessons learned, and can also accelerate the development of a supply chain. Agreements between sponsors can enable sharing experience to maximize cost savings over multiple projects and potentially reduce the combined cost of licensing. Such multi-project approaches must include key features to maximize the benefits of joint development and achieve

[21] GE Hitachi Nuclear Energy, "Tennessee Valley Authority, Ontario Power Generation and Synthos Green Energy Invest in Development of GE Hitachi Small Modular Reactor Technology," March 23, 2023 https://www.ge.com/news/press-releases/tennessee-valley-authority-ontario-power-generation-and-synthos-green-energy-invest

cost and risk reductions as each project is implemented. These include strong alignment between the projects, including agreement on plant design (a "standard plant"), agreements on adjustments for site-specific factors, a shared view of FOAK costs and a plan to reduce those costs in subsequent projects, supply chain planning, and best project management practices. Independent project developers could also help implement serial development of multiple projects with a common design if supported by strong offtake agreements and sufficient capital.

Many potential project offtakers, including chemical manufacturers, steel producers, datacenter operators, and municipal utilities are becoming increasingly focused on obtaining access to clean firm energy, such as can be provided by nuclear energy projects, to support a growing need for power and to meet their decarbonization objectives. Offtakers may consider offering premium pricing for offtake from such projects to provide an increased incentive for development. In addition, offtakers could allow offtake prices to increase if project costs increase above mature cost estimates (while incorporating cost control incentives as well as appropriate opportunity to review the estimates and the basis for increase). To the extent offtakers absorb project risks, they could also seek compensation, such as access to output from future projects or rights to project or company equity returns.

Offtakers could share project permitting and licensing costs to reduce the burden on primary project sponsors. Offtakers who contribute to those costs up front should benefit from those contributions later, such as through an adjustment to offtake costs or participation in project returns. In a public utility regulatory environment where those contributions cannot be reflected in targeted offtake discounts, other mechanisms may be feasible, such as joint participation in a special-purpose financing vehicle ("SPV") during the project development phase, which is dissolved at construction or operation (at which time development contributions made through the SPV would be repaid).

Offtakers may need to take on more project risk to achieve their growth objectives

To the extent some potential offtakers recognize that accelerating the buildout of clean, firm energy is a fundamental need to enable their future growth, and that nuclear energy is an essential part of that energy supply, they may need to take on more risk to support future nuclear energy projects. For example, the companies seeking hyperscale datacenters routinely deploy their balance sheets to address obstacles to their growth, and such companies could offer to share completion-cost risk for those projects, in exchange for compensation to be agreed with other project participants. An agreement to share completion-cost risk should come with appropriate rights for outside review of estimates, and deductibles and copayments to align incentives. The compensation for sharing risk could take the form of an equity interest in the energy project or in the nuclear technology company whose value would presumably improve by being incorporated in a completed project. The offtaker may not have a long-term interest in participating in the energy sector, but the equity will have value in the future if the projects are ultimately successful, enabling an exit.

Potential DOE actions. DOE's Loan Programs Office (LPO) may be able to implement a supplemental loan facility to finance the completion of early deployments of nuclear energy projects that incur unanticipated costs.[22] Such a facility would offer additional financing, beyond the financing provided by LPO in the ordinary course, to enable the completion of projects that incur unanticipated costs. DOE could incentivize or require the use of best practices and/or participation in multi-project development as conditions for eligibility for such financing. While project sponsors would ultimately need to repay these loans, such a facility would ensure financing for the additional costs is available, reducing the risk, and

[22] Any mechanism to address unanticipated costs must require mature cost estimates, reviewed by an independent advisor, to establish the baseline cost.

would defer the cashflow required to address them. A supplemental loan facility of this type appears to be feasible under current LPO authority. One example of such an approach is described in the paper "A Cost Stabilization Facility for Kickstarting the Commercialization of Small Modular Reactors" by the EFI Foundation.[23]

While the Loan Programs Office cannot make loans for development costs before a project satisfies the conditions of a project loan (i.e., at the time financing is committed), DOE could provide support for project development and licensing costs and reduce the disincentives for sponsors to pursue nuclear project development. DOE now has a mechanism and funding to enable such support: $8 million has been appropriated to the Advanced Nuclear Energy Cost-Share Grant Program, which was originally established in the Nuclear Energy Innovation Capabilities Act (42 USC 16280).[24] As more projects move closer to licensing, additional funding is likely to be required. The Consolidated Appropriations Act, 2024 provides $100 million to support design, licensing, supplier development, and site preparation specifically for one or more grid-scale projects using Generation 3+ (advanced light-water) reactor design.[25]

Potential legislative actions. Likely the most impactful government action to accelerate commitments to clean firm nuclear energy would be government funding to enable the completion of projects that incur unanticipated costs.[26] As noted earlier, cost uncertainty is one of the principal factors inhibiting commitments to advanced nuclear energy projects. This supplemental funding should maintain incentives for sponsors to minimize overruns, such as requiring continued sponsor responsibility for an initial increment of increased costs (a deductible) and for a share of further increases (a copayment). Access to this funding should require projects to commit to a defined set of best practices, including commitment to multiple projects with the same design. Furthermore, equity grant funding available to more projects, beyond those supported by the ARDP, is needed to expand the number of early-stage projects. These projects will continue to face higher costs and more risks until there is more experience building nuclear energy projects and the supply chain is mature. The Consolidated Appropriations Act, 2024, provides $800 million for up to two projects using Generation 3+ reactor designs.[27]

A Regulated Asset Base approach, such as is being implemented in the U.K., could provide similar protection, and would also help address utility exposure to development costs, including licensing. However, in the U.S. such an approach would need to be implemented through the states (potentially with federal support) and would be most applicable to regions where price-regulated utilities continue to supply generation.

Congress could address project development and licensing costs by increasing the funding to the Advanced Nuclear Energy Cost-Share Grant Program as DOE implements it, and could broaden access to the funds provided in the 2024 consolidated appropriations. Legislative refinements that could help

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[23] EFI Foundation, "A Cost Stabilization Facility for Kickstarting the Commercialization of Small Modular Reactors," October 2023. https://efifoundation.org/foundation-reports/a-cost-stabilization-facility-for-kickstarting-the-commercialization-of-small-modular-reactors/

[24] Nuclear Innovation Alliance, "$5 Million Included in Appropriations to Help Cover Advanced Nuclear Reactor Licensing Fees," January 2023. https://nuclearinnovationalliance.org/5-million-included-appropriations-help-cover-advanced-nuclear-reactor-licensing-fees

[25] Consolidated Appropriations Act, 2024 (see Section 311). https://www.congress.gov/bill/118th-congress/house-bill/4366

[26] As noted earlier, any mechanism to address unanticipated costs must require mature cost estimates, reviewed by an independent advisor, to establish the baseline cost.

[27] Office of Nuclear Energy, "FY2024 Spending Bill Fuels Historic Push for U.S. Advanced Reactors," March 14, 2024. https://www.energy.gov/ne/articles/fy2024-spending-bill-fuels-historic-push-us-advanced-reactors

accelerate commitments to advanced nuclear energy include allowing access to LPO financing for projects that receive government grants such as through ARDP, and addressing the normalization requirements for tax benefits received by regulated utilities, which currently limits their value.

Combined actions. Of course, the above actions are not independent, and combinations of these actions will be more successful than any action on its own.

Conclusion

Advanced nuclear energy has the potential to be a key source of firm clean energy supporting the transition to a decarbonized energy future. However, it continues to face headwinds that are slowing deployment, including the uncertain cost of early-stage projects before experience and mature supply chains enable projects to achieve Nth-of-a-kind cost targets, and the industry-specific permitting and licensing costs and timelines that may be more significant than for other sources of energy production.

Project sponsors are taking steps to address these challenges, including through innovative approaches to project development. A range of actions by potential private sector offtakers, the Department of Energy, and legislators could help to further accelerate commitments to advanced nuclear energy projects and pave the way for advanced nuclear energy to play a key role in the energy transition.