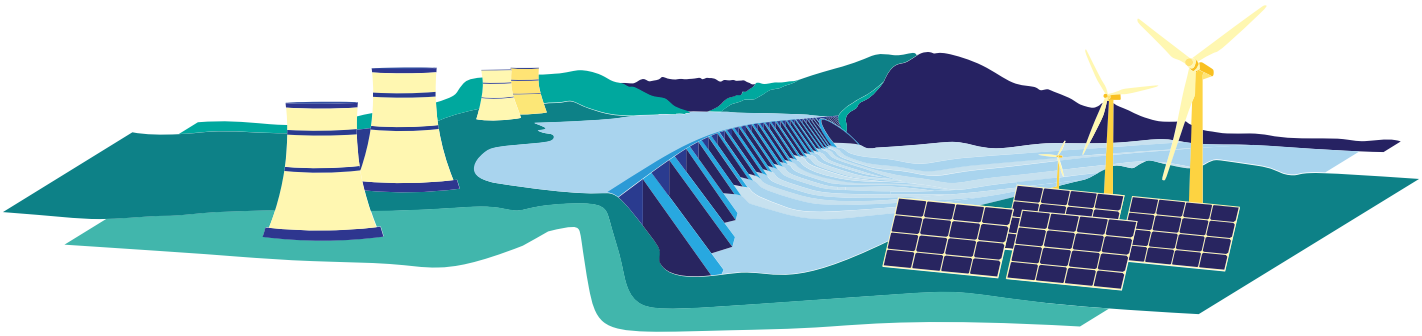
Nuclear Innovation and NEPA

Streamlining NRC NEPA Reviews for Advanced Reactor Demonstration Projects While Safeguarding Environmental Protection

NUCLEAR INNOVATION ALLIANCE

September 2019



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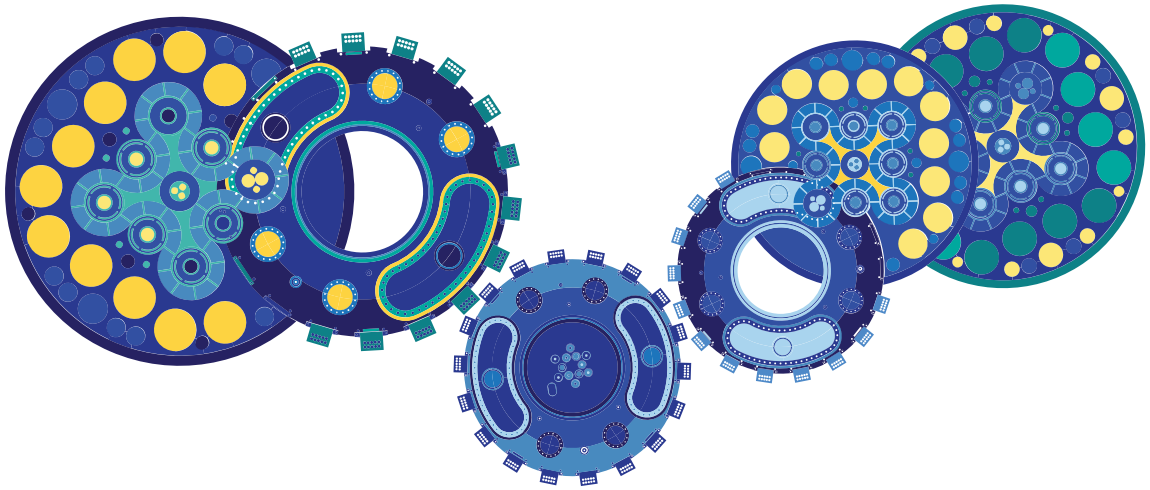
Contributors

Amy Roma
Sachin Desai
Brittainy A. Cavender
Ashley Finan

Disclaimer

The views expressed herein are solely those of the authors, and do not represent the views of any organization other than Nuclear Innovation Alliance.



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I. Executive Summary

The nation stands at the cusp of an energy revolution. Around the country, dozens of companies are developing next-generation nuclear reactors ("advanced reactors"),[1] which have the potential to provide clean, reliable, and affordable energy in abundant quantities. They promise to provide zero-carbon power, return the United States to a position of nuclear energy leadership, and bring thousands of skilled, well-paying jobs to towns and cities across the country. Advanced nuclear has the potential to be a critical contributor in addressing climate change.[2]

Ironically however, one challenge to addressing this environmental crisis resides in an environmental statute—the National Environmental Policy Act ("NEPA")[3]—and its practical application by the agency responsible for licensing advanced reactors—the U.S. Nuclear Regulatory Commission ("NRC"). The NRC should act to streamline NEPA reviews to ensure they are pragmatically proportionate to advanced nuclear development, and do not result in time, money, and resources wasted on regulatory reviews that do not achieve the objectives of the statute.

What is NEPA? The purpose of NEPA is to "prevent or eliminate damage to the environment," by having federal agencies take a "hard look" at the environmental impacts of their actions before they take them.[4] Critically, NEPA does not set substantive standards—the statute instead provides a process to help agencies *consider and disclose* the consequences of their actions.[5] NEPA reviews should be "concise, clear, and to the point."[6] Since its inception, NEPA has generated immense benefits.[7] However, there are times when its execution raises roadblocks contrary to its underlying purpose.

NEPA reviews are implemented at the agency level. It is in execution here that the "concise" and clear nature of NEPA reviews sometimes get lost. Critic after critic—from both sides of the aisle—have discussed the well-known "ratcheting up" of NEPA reviews. As early as 1997, the White House Council of Environmental Quality (CEQ) noted that agencies were trying to generate "litigation-proof" NEPA reviews, increasing costs and

[1] The term "advanced reactor" is used broadly in this article, to refer to passively safe, small modular and non-light water reactors.
[2] Jenkins, Luke & Thernstrom (2018), "Getting to zero: insights from recent literature on the electricity decarbonization challenge," *Joule 2*, 2487-2510, December 19, 2018.
[3] 42 U.S.C. 4321 *et seq*.
[4] 42 U.S.C § 4321.
[5] *See Dep't of Transp. v. Pub. Citizen*, 541 U.S. 752, 756 (2004); *Baltimore Gas & Elec. Co. v. Nat. Res. Def. Council, Inc.*, 462 U.S. 87, 98 (1983).
[6] 40 CFR § 1502.1.
[7] NEPA, *Success Stories and NEPA Benefits*, https://ceq.doe.gov/docs/get-involved/ Success_Stories.html.

time but not necessarily quality.[8] In practice, NEPA reviews have increased in size over the years even though the statute's requirements have remained the same. For example, in the early 1980s, the NEPA review documentation for construction and operation of the Palo Verde Nuclear Power Plant—a greenfield 3-unit power plant, the *largest in the U.S.*—numbered roughly 700 pages including appendices and responses to comments.[9] By comparison, the NRC's NEPA documentation for the recently licensed Vogtle nuclear power plant, a smaller 2-unit expansion on an already existing nuclear plant site, numbered over 1500 pages.[10]

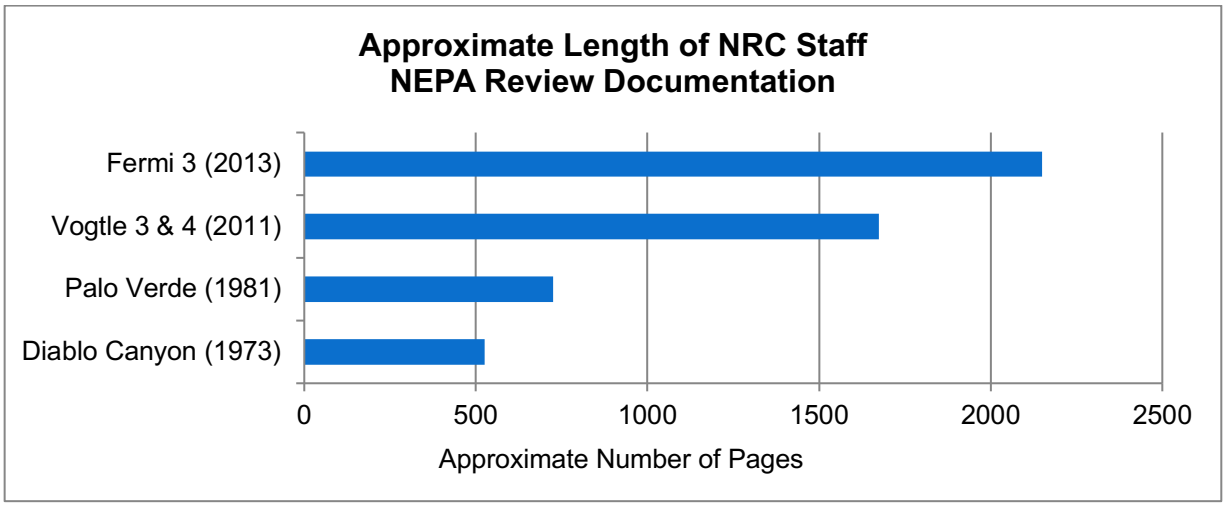

Chart developed by NIA using data derived from U.S. NRC documents

How does NEPA factor into the NRC's advanced reactor licensing review? The NRC licensing review consists of two parts: (1) a robust technical review of safety, (2) and an equally—if not more robust—environmental review to comply with the procedural requirements of NEPA. NEPA reviews can require about a third or more of agency staff effort. It is common that the agency's NEPA documentation, memorialized in an Environmental Impact Statement (EIS), *is the same length or longer than* the NRC's substantive technical evaluation, documented in a Safety Evaluation Report (SER). This wastes significant resources on arguably duplicative efforts that do not have a proven nexus to public safety and delays beneficial projects that would improve environmental quality overall.

[8] CEQ, ENVIRONMENTAL QUALITY -- 25TH ANNIVERSARY REPORT OF THE COUNCIL OF ENVIRONMENTAL QUALITY (1995) https://ceq.doe.gov/docs/ceq-publications/nepa25fn.pdf; Bradley C. Karkkainien, *Toward a Smarter NEPA: Monitoring and Managing Government's Environmental Performance*, 102 Colum. L. Rev. 903, 917-18 (2002).

[9] NRC, *Draft Environmental Statement Related to the Operation of Palo Verde Nuclear Generating Station, Units 1, 2, and 3*, *a* https://books.google.com/books?id=Quc3AQAAMAAJ&lpg=PR14&ots=QqoeXGdVcs&dq=%22final%20environmental%20statement%22%20Palo%20Verde%20operating%20license&pg=PR14#v=onepage&q=%22final%20environmental%20statement%22%20Palo%20Verde%20operating%20license&f=false (providing the final EIS for the for construction permit for Palo Verde, and the draft EIS for Palo Verde's operating permit)

[10] NRC, *NUREG 1872, Final Environmental Impact Statement for an Early Site Permit (ESP) at the Vogtle ESP Electric Generating Plant Site* (Aug. 2008), https://www.nrc.gov/reading-rm/doc-collections/nuregs/staff/sr1872/; NRC, *NUREG-1947, Final Environmental Impact Statement for Combined License (COLS) for the Vogtle Electric Generating Plant Unit 3 and 4* (Mar. 2011), https://www.nrc.gov/reading-rm/doc-collections/nuregs/staff/sr1947/.

The last round of new reactor applicants was better equipped to shoulder the long costs and timelines of NRC reviews: they were large-scale utilities, building large-scale nuclear power plants, and secured by healthy balance sheets of large corporation or ratepayer funding. Moreover, the designs reviewed were comparable to the same traditional light water reactors (LWRs) that comprise the current fleet (although improved to be simpler and safer)—keeping the scope of NEPA reviews in check. Now the NRC is faced with licensing first-of-a-kind advanced reactor designs. Many of these are designed by innovative companies seeking to commercialize technologies coming out of US universities and national laboratories. In today's highly competitive electric power market, neither developers nor ratepayers can afford to waste resources on an inefficient or unpredictable licensing process. Many nuclear entrepreneurs also need a proof-of-concept prototype or demonstration reactor ("demonstration project")[11] to access additional capital from investors and arrange customers. Some innovators are moving abroad to build their demonstration reactors. As a result, the U.S. risks losing out on the immense zero-emissions benefits these technologies can bring to the U.S. energy mix.

In response, the NRC has spent significant energy *right-sizing* the licensing path for its safety-focused *technical* review of advanced reactors, but has paid little attention to applying a right-sized, practical approach to *environmental* reviews. This will be a major roadblock, if left unaddressed. Past experience indicates that NEPA reviews may be a dominant schedule driver for first-of-a-kind NRC licensing actions. In particular, two parts of the NEPA process could prove especially unpredictable for advanced reactors—the requirements to analyze alternatives and connected actions. Without proper attention from the agency and support from Congress, these two requirements could turn what is intended to be a straightforward license application for a small demonstration project into a lengthy and impractical environmental treatise.

The NRC and Congress can take the following steps to help pave the way for advanced nuclear innovation while preserving the important environmental analyses offered by NEPA. There are indications that the NRC is looking to improve the NEPA review process, and this paper provides suggestions in support of that effort.

RECOMMENDATIONS

- **<u>Recommendation 1:</u> Reevaluate the Presumption that Advanced Nuclear Demonstration Projects Require EISs:** Currently, NRC regulations presume that an EIS must be drafted for any power reactor or testing facility license application, which is likely to include most demonstration projects. Yet there are shorter analyses the agency can conduct under NEPA, including Environmental Assessments (EAs) – EISs' smaller cousins – and categorical exclusions.

[11] The scope of what constitutes a "Demonstration Project" can be determined in the future. However, the authors note that the term "Demonstration Project" is defined in the Nuclear Energy Leadership Act (S.3422, 115th Congress), for example, as "an advanced nuclear reactor operated (A) as part of the power generation facilities of an electric utility system; or (B) in any other manner for the purpose of demonstrating the suitability for commercial application of the advanced nuclear reactor."

What the NRC Can Do: The NRC's current policy does not take into account the inherent design benefits of advanced reactors, which can reduce or eliminate offsite environmental impacts and reduce generation of spent nuclear fuel. They can be constructed modularly, sited at brownfield locations, and use less material and space than traditional nuclear plants. Moreover, demonstration projects can be tailored to further reduce impact. It is not necessary to presume that such reactors require an EIS, and the NRC should modify its regulations accordingly. The NRC should further explore CEQ guidance in encouraging agencies to consider how steps to mitigate environmental impacts in the project design can reduce the impact of a proposed action beyond "significant" (called a "Mitigated Finding of No Significant Impact" or "Mitigated FONSI").

What Congress Can Do: Congress can also provide for rebuttal presumptions that certain or all demonstration project reviews fall within NEPA's categorical exclusion from environmental reviews, as has already been done for oil and gas projects under Section 390 of the Energy Policy Act of 2005.

- **Recommendation 2: Tailor the Scope of NEPA Reviews for Demonstration Projects:** NEPA review complexity calibrates to the number of the selected alternatives. Even in licensing traditional LWRs, the agency alternatives analysis proved to be a costly exploration of often unreasonable or unnecessary alternatives, such as siting a natural gas facility at the site of an already operating nuclear plant. Additionally, NEPA's requirement to evaluate "connected actions" or those actions closely related to a project, risks being over-extended here. With an overly broad scope, the environmental review for the licensing of a proof-of-concept or first-of-a-kind demonstration project could become a broad evaluation of the advanced reactor ecosystem, prematurely including industry-wide fuel cycle or spent fuel issues.

  What the NRC Can Do: The NRC can take initiative to streamline its reviews and recognize the benefits of co-location at national laboratories and federal facilities. It can also clarify that broad fuel cycle issues are not to be considered for demonstration project activities.

  What Congress Can Do: To facilitate an initiative by NRC, without risking costly and time-consuming litigation, Congress can provide for tailored exemptions of design alternatives and some connected actions analyses, such as for demonstration projects that are sited at a national laboratory or other federal facilities.

- **Recommendation 3: Increase Use of Generic Environmental Impact Statements (GEIS) to Address Common Advanced Reactor NEPA Questions:** GEISs are broad EISs that handle an issue common to a number of licensees at once—making the plant-specific NRC application shorter and

simpler. The NRC has effectively used GEISs to prevent repetitive NEPA processing. For example, the NRC handles most issues regarding spent nuclear fuel (SNF) storage and disposal through a GEIS, meaning that plant specific NEPA reviews do not have to repeatedly evaluate this topic.

What the NRC Can Do: There are a number of topics common to most, if not all, advanced reactor license applicants—from the use of new fuel types and high-assay low-enriched uranium (HALEU) fuel, to issues with modular construction. The NRC should move to address these in a generic manner to avoid impeding individual projects.

What Congress Can Do: Congress can ensure sufficient funding support is provided for the NRC to take these early steps. It can also encourage the NRC to look at the issue by requesting a report on advanced reactor NEPA issues that can be handled generically.

- **Recommendation 4**: **Allow Applicants to Draft EAs and EISs**: Presently the NRC essentially *duplicates* the cost of a NEPA review. An NRC reactor license applicant submits an Environmental Report (ER) to the agency with their application, which covers all the same areas as an EIS and is prepared with the same level of rigor, at great cost to the applicant. The NRC then duplicates that analysis in preparation of the EIS, and the NRC's costs in preparing the EIS are *charged back to the applicant*. This massive duplication of time and money is ineffective and contrary to the public interest.

  What the NRC Can Do: CEQ already permits applicants to draft EAs, and both the Federal Energy Regulatory Commission (FERC) and the Bureau of Land Management (BLM) also allow applicants to draft EAs. The NRC should adopt this process. Although CEQ regulations only permit applicants to draft EAs, the NRC should explore further how to validate applicant submitted EAs, rather than duplicating work in the drafting of the EIS.

  What Congress Can Do: Congress should instruct the NRC to permit reactor license applicants to draft EAs. In addition, with CEQ support, Congress should implement a process for NRC and other license applicants to draft EISs for demonstration projects.

II. Nuclear Power & the Environment

A. Nuclear Power is an Environmental Champion

Nuclear power is an essential national resource that produces approximately 20 percent of the nation's electricity and more than half of its clean energy.[12] The civil nuclear industry also offers benefits to national security, such as our nuclear navy and military deterrence.[13] Additionally, the industry incorporates tens of thousands of skilled, well-paid jobs at reactor sites—jobs that cannot be outsourced. For many, however, nuclear power's most appealing characteristic is its immense environmental benefit. Its zero-emissions energy, free of mercury or particulates,[14] has saved millions of lives from the harmful effects of air pollution.[15]

Nuclear power is now being recognized as the world's best resource in addressing the challenges posed by climate change. Nuclear power has avoided the emission of *many billions* of tons of CO_2 since its commercialization.[16] As estimated in the U.S. Government's 4th National Climate Assessment, climate change brought on by CO_2 emissions could cost this country hundreds of billions of dollars annually by the end of the century and negatively impact nearly all life on the planet.[17] Leading environmentalists, including esteemed climate scientist, James Hansen,[18] have stated that nuclear power is the linchpin in the challenge of halting climate change.[19]

B. Advanced Reactors Address Nuclear Power's Environmental Concerns

No energy source is without its drawbacks. However, advanced reactors address two of the lingering environmental criticisms often levied against nuclear power. The first criticism is that nuclear power plants carry significant risks to the environment if there is a major accident. Although no one has ever died from a radioactive release at a nuclear power plant in the United States, the possibility of such accidents has shaped the conversation around nuclear power for decades. The second criticism concerns SNF, also

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[12] U.S. Energy Info. Admin., *What is U.S. Electricity Generation by Energy Source* (2017), https://www.eia.gov/tools/faqs/faq.php?id=427&t=3.
[13] Center for Strategic & International Studies, *Back from the Brink: A Threatened Nuclear Energy Industry Comprises National Security* (July 17, 2018), https://www.csis.org/analysis/back-brink-threatened-nuclear-energy-industry-compromises-national-security.
[14] Metin Celebi et al., The Brattle Group, *Nuclear Retirement Effects on CO2 Emissions: Preserving a Critical Clean Resource* 1 (Dec. 2016), http://brattle.com/system/news/pdfs/000/001/158/original/Brattle_Nuclear-Carbon_Whitepaper_-_Dec2016.pdf.
[15] *See* Philip J. Landrigan et al., The Lancet, *The Lancet Commission on Pollution and Health*, at 1, 12 (Oct. 19, 2017), http://www.thelancet.com/commissions/pollution-and-health (estimating millions of deaths are caused by air pollution a year) and Pushker A. Kharecha and James E. Hansen, Environmental Science and Technology, *Prevented Mortality and Greenhouse Gas Emissions from Historical and Projected Nuclear Power*, March 15, 2013. https://pubs.acs.org/doi/10.1021/es3051197.
[16] NEI, *Climate: Nuclear Energy Provides More Than 56 Percent of America's Carbon-Free Electricity* (2018), https://www.nei.org/advantages/climate.
[17] U.S. Global Research Program, *Fourth National Climate Assessment* (Nov. 2018), https://www.globalchange.gov/nca4.
[18] John Abraham, The Guardian, *What's Climate Scientist James Hansen's Legacy?* (Apr. 29, 2013), https://www.theguardian.com/environment/climate-consensus-97-per-cent/2013/apr/29/climate-scientist-james-hansen-legacy.
[19] Letter from Envtl. Progress to N.Y. Pub. Serv. Comm'n, at 2 (July 14, 2016), http://environmentalprogress.org/new-york-public-service-commission-letter.

known as "nuclear waste". The amount of space SNF requires is not large—*all* the SNF produced by *all* U.S. nuclear plants to date roughly totals the same volume of waste produced by coal *every hour*.[20] Nonetheless, there is currently no federally approved long-term disposal site for this waste.

Next-generation advanced reactors address both these concerns. First, advanced reactors employ passive safety features and can shut down automatically, keeping radioactive material safely contained indefinitely without any need for outside support. Some advanced reactor designers propose using molten salt as a fuel, which would harden into a solid in case of a power loss or coolant failure, trapping the nuclear materials safely in the fuel itself. Such systems dramatically reduced the threat of most major accidents. Second, many next-generation nuclear reactors take advantage of 'fast'-spectrum neutrons to actually consume portions of SNF. Bill Gates' TerraPower, for example, advertises that its reactor can run almost entirely on SNF—turning "nuclear waste" into a valuable energy source that is consumed over time.[21]

It is because of nuclear power's immense environmental and climate benefits—combined with the benefits of advanced reactors—that the public conversation concerning this technology is changing. The founder of Greenpeace has now become a supporter of nuclear power.[22] The Union of Concerned Scientists, long opposed to many nuclear projects, has recently advocated for government funding to sustain some existing nuclear power plants.[23] The environmental advocacy groups Natural Resources Defense Council and Environmental Defense Fund both joined with nuclear utilities to defend state initiatives to value the carbon-free benefits of nuclear power.[24] Nuclear power—and its future through advanced reactor innovation—is now firmly cemented as a *necessity* for protecting the environment and the climate.

C. Efficient NRC Licensing of Demonstration Projects is Key to Bridging the Nuclear Innovation "Valley of Death" and Commercializing Advanced Reactors

Yet for all its benefits, advanced reactor innovation is at a critical stage. As of now, the U.S. leads in advanced reactor design. There are dozens of domestic ventures in next-generation nuclear technologies[25]—a number that keeps growing—and many have moved from the whiteboard to the machine shop. However, these innovators face a well-

[20] NEI, *Nuclear Waste: Part of Being a Responsible, Clean Energy Source is Safely Handling Waste*, https://www.nei.org/fundamentals/nuclear-waste.
[21] TerraPower, *A Solution to the Nuclear Waste Problem* (Oct. 29, 2015), https://terrapower.com/updates/a-solution-to-the-nuclear-waste-problem/.
[22] Erika Lovely, Politico, *Why a Greenpeace Co-founder Went Nuclear* (March 4, 2008), https://www.politico.com/story/2008/03/why-a-greenpeace-co-founder-went-nuclear-008835.
[23] Union of Concerned Scientists, *The Nuclear Power Dilemma* (2018), https://www.ucsusa.org/nuclear-power/cost-nuclear-power/retirements#.XAX--ttKj4Y.
[24] *See, e.g.,* Coalition for Competitive Electricity, Dynergy, Inc. v. Zibelman, 906 F. 3d 41 (2d Cir. 2018),
[25] Third Way, *Keeping Up with the Advanced Nuclear Industry* (Jan. 2018), https://www.thirdway.org/graphic/keeping-up-with-the-advanced-nuclear-industry (also showing a marked increase from the previous year); Third Way, *The Advanced Nuclear Industry: 2016 Update* (Dec. 12, 2016), https://www.thirdway.org/infographic/the-advanced-nuclear-industry-2016-update.

known valley of death[26] as they move from the drawing board to fielding a demonstration project. The best, if not only, way for innovators to prove their concepts, maintain investor interest, and deepen customer interest is to deploy a demonstration project.

However, the construction and operation of many demonstration reactors require NRC licensing. Therefore, to cross the threshold to commercial deployment in the United States, developers must move through the NRC licensing process, which includes both independent safety and environmental reviews of the project. The safety review fulfills the core responsibility of the agency under the Atomic Energy Act to provide for reasonable assurance of public health and safety. The environmental reviews are separately required under NEPA.

The NRC licensing process is seen by many as a key part of the valley of death. After the U.S. government recently adopted policies that hindered TerraPower's ability to build a demonstration project in China, fearing theft of U.S. nuclear intellectual property (IP), its founder and chairman Bill Gates—no stranger to innovation and risk—still did not see the United States as a promising location. Gates noted that "[w]e may be able to build [our demonstration project] in the United States if the funding and regulatory changes that I mentioned earlier happen."[27]

More than just an isolated incident, concerns about the costs and delays associated with NRC licensing are contributing to some nuclear innovators' decision to begin their licensing efforts abroad, in places such as Canada. While some developers see a more promising market in Canada, some also perceive the nuclear regulator in Canada, the Canadian Nuclear Safety Commission (CNSC), as being more responsive, as they offer fixed-price reviews and strong commitments to schedule. Many advanced reactor ventures have presented pre-licensing submissions to the CNSC, and one has already submitted a license application to site a demonstration project at the Canadian Nuclear Laboratory site at Chalk River, Ontario.[28]

While Canada is a neighbour and strong ally of the United States, it is still a loss to see U.S. technology with strong export potential moving outside the country. It also proves to be a signal that the U.S. government needs to continue to look at all options to improve the licensing process for advanced reactors. The NRC and Congress have both begun to address the NRC safety licensing process and are actively working to improve it. There are indications that the NRC is also looking to improve the NEPA review process and this paper provides suggestions in support of that effort.

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[26] Josh Freed, Brookings Institute, *Back to the Future: Advanced Nuclear Energy and the Battle Against Climate Change*, (Dec. 12, 2014), http://csweb.brookings.edu/content/research/essays/2014/backtothefuture.html.

[27] Bill Gates, Blog – What I learned at Work This Year, https://www.gatesnotes.com/About-Bill-Gates/Year-in-Review-2018?WT.mc_id=12_29_2018_21_YIR2018_BG-media_&WT.tsrc=BGmedia.

[28] CNSC, Pre-Licensing Vendor Design Review (last modified Mar. 29, 2019), http://nuclearsafety.gc.ca/eng/reactors/power-plants/pre-licensing-vendor-design-review/index.cfm; World Nuclear News, First Canadian SMR License Application Submitted (Apr. 2, 2019), https://www.world-nuclear-news.org/Articles/First-Canadian-SMR-licence-application-submitted.

III. Nuclear Power & NEPA

A. NEPA Offers Immense Environmental Benefits, but Challenges Exist with NEPA Implementation

The purpose of NEPA, as stated directly by Congress in the statute, is to "prevent or eliminate damage to the environment."[29] Over the years, NEPA has brought forth immense environmental health and safety benefits, emerging from a time when the environmental impacts of most federally supported projects were not understood or explored.[30] Nonetheless, there are times when even a successful statute like NEPA needs to be reexamined—after decades of implementation, both sides of the aisle now see NEPA's execution as raising roadblocks that are contrary to its underlying purpose.

At its foundation, NEPA does not set substantive environmental standards—the statute instead provides a process to help agencies *consider and disclose* the consequences of their actions.[31] The CEQ[32] states, in its regulations implementing NEPA, that the purpose of an EIS is to provide "full and fair discussion of significant environmental impacts" of a proposed action and to "inform decision-makers and the public of the reasonable alternatives."[33] Those same regulations also state that EISs are supposed to be "concise, clear, and to the point."[34]

Where NEPA reviews are implemented is at the agency level. It is in execution here that the "concise" and clear nature of NEPA reviews are often lost. Commentators from both political parties have discussed the well-known "ratcheting up" of NEPA reviews. As early as 1997, CEQ noted that agencies were trying to generate "litigation-proof" NEPA reviews, "increasing costs and time but not necessarily quality."[35] In practice, NEPA reviews for similar projects often increase in size and scope over the years.

The steady increase of NEPA reviews is a negative cycle driven in large part by fears of court reversal.[36] Agencies generally do not like to have their licensing actions overturned, and since the 1990s they have sought to make their NEPA reviews "litigation-proof," to minimize intervenor challenges. But as agencies take longer and longer to

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[29] 42 U.S.C § 4321

[30] NEPA, *Success Stories and NEPA Benefits*, https://ceq.doe.gov/docs/get-involved/ Success_Stories.html.

[31] *See Dep't of Transp. v. Pub. Citizen*, 541 U.S. 752, 756 (2004); *Baltimore Gas & Elec. Co. v. Nat. Res. Def. Council, Inc.*, 462 U.S. 87, 98 (1983).

[32] CEQ issues regulations that help implement NEPA, which can be found at 40 C.F.R. §§ 1501-1508. Although it is technically an open question as to whether CEQ's regulations are binding on federal agencies, for the most parts agencies and courts either treat them as such, or grant CEQ's regulations substantial deference. *TOMAC, Taxpayers of Michigan Against Casinos v. Norton*, 433 F.3d 852, 861 (D.C. Cir. 2006); *see also Brodsky v. U.S. Nuclear Regulatory Comm'n*, 704 F.3d 113, 120 n.3 (2d Cir. 2013) (interpreting CEQ regulations as binding on the NRC as the default position). The NRC has agreed in its own regulations to implement the core aspects of NEPA. 10 C.F.R. § 51.10.

[33] 40 CFR § 1502.1.

[34] 40 CFR § 1502.1.

[35] CEQ, ENVIRONMENTAL QUALITY -- 25TH ANNIVERSARY REPORT OF THE COUNCIL OF ENVIRONMENTAL QUALITY (1995) https://ceq.doe.gov/docs/ceq-publications/nepa25fn.pdf, Bradley C. Karkkainien, Toward a Smarter NEPA: Monitoring and Managing Government's Environmental Performance, 102 Colum. L. Rev. 903, 917-18 (2002).

[36] For example, the D.C. Circuit struck down the NRC's approach to addressing long-term disposal of spent nuclear fuel under NEPA (so-called "Waste Confidence Rule"), resulting in an over two year moratorium on many NRC power plant licensing actions until a replacement was issued. *New York v. Nuclear Regulatory Comm'n*, 681 F.3d 471 (D.C. Cir. 2012).

"litigation-proof" their reviews, there is less time and there are fewer resources available for the agency, applicant, and the public, to bear an unforeseen delay. These more sprawling reviews—divorced from the question of whether the additional work actually leads to a public benefit[37]—produce uncertainty and excessive timelines that impact innovation.

This issue has increasingly received wide bipartisan attention. Most notably, in 2015, Congress and President Obama issued the Fixing America's Surface Transportation Act ("FAST Act"),[38] which directed the Secretary of Transportation to "examine ways to modernize, simplify, and improve the implementation of the National Environmental Policy Act of 1969," acknowledging that such environmental reviews "remain[] a significant source of project delay."[39] Just a year earlier, in 2014 the Government Accountability Office (GAO) found that despite agencies' efforts to bulletproof their NEPA reviews, "little information exists on the costs and benefits of completing NEPA analyses."[40] Today, even the alternative energy industry finds itself at odds with NEPA.[41] Presidents from both parties have issued executive orders to rein in the increasingly unwieldy NEPA analyses that delay important projects.[42]

B. NEPA's Challenges Are Pronounced in the Nuclear Context, but the NRC Has Not Yet Addressed the NEPA Review Process for Advanced Reactors

The need to tailor NEPA is particularly compelling in the nuclear context. The NRC, the primary regulator for all nuclear energy projects, conducts a nuclear safety review of the application, published in an SER, which is the core agency review. The Atomic Energy Act, the NRC's originating statute, requires that the agency's licensing process provide for "adequate protection to the health and safety of the public."[43]

The numbers alone illustrate part of this story, but they also add color to insights gained from informal conversations with agency staff and industry experiences with the agency. In the early 1980s, the NEPA review documentation for construction and operation of the Palo Verde Nuclear Power Plant—a large, *greenfield 3-unit* power plant—numbered roughly 700 pages, including appendices and responses to comments.[44] In comparison, the NEPA documentation for the Vogtle nuclear power plant expansion, a

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[37] Bradley C. Karkkainien, Toward a Smarter NEPA: Monitoring and Managing Government's Environmental Performance, 102 Colum. L. Rev. 903, 917-18 (2002).
[38] Pub. L. No. 114-94, 129 Stat. 1312 (2016), https://www.gpo.gov/fdsys/pkg/PLAW-114publ94/pdf/PLAW-114publ94.pdf.
[39] FAST Act §§ 1317, 1318.
[40] GAO, *National Environmental Policy Act – Little Information Exists on NEPA Analyses* (Apr. 2014), https://www.gao.gov/assets/670/662546.pdf.
[41] Irma S. Russell, *Streamlining NEPA to Combat Global Climate Change: Hearsay or Necessity?,* 39 Envir. L 1049, 1058 (2009); Dorothy W. Bisbee, *NEPA Review of Offshore Wind Farms: Ensuring Emission Reduction Benefits Outweigh Visual Impact*, 31 B.C. Envtl. Aff. L. Rev. 349 (2004)
[42] Exec. Order No. 13807, 82 FR 40463 (August 15, 2017), Exec. Order No. 13604, 77 FR 18887 (March 22, 2012).
[43] 42 U.S.C. § 2232
[44] NRC, *Draft Environmental Statement Related to the Operation of Palo Verde Nuclear Generating Station, Units 1, 2, and 3*, *a* https://books.google.com/books?id=Quc3AQAAMAAJ&lpg=PR14&ots=QqoeXGdVcs&dq=%22final%20environmental%20statement%22%20Palo%20Verde%20operating%20license&pg=PR14#v=onepage&q=%22final%20environmental%20statement%22%20Palo%20Verde%20operating%20license&f=false (providing the final EIS for the for construction permit for Palo Verde, and the draft EIS for Palo Verde's operating permit).

smaller 2-unit expansion on an already-existing nuclear plant site, numbered over 1500 pages.[45] That's more than three times the text for a brownfield action with significantly less environmental impact. That only tells part of the story—expanded agency NEPA reviews require the applicant to draft larger environmental submissions with the applications themselves, adding significant costs and duplication of effort as well on the front end of the licensing process.

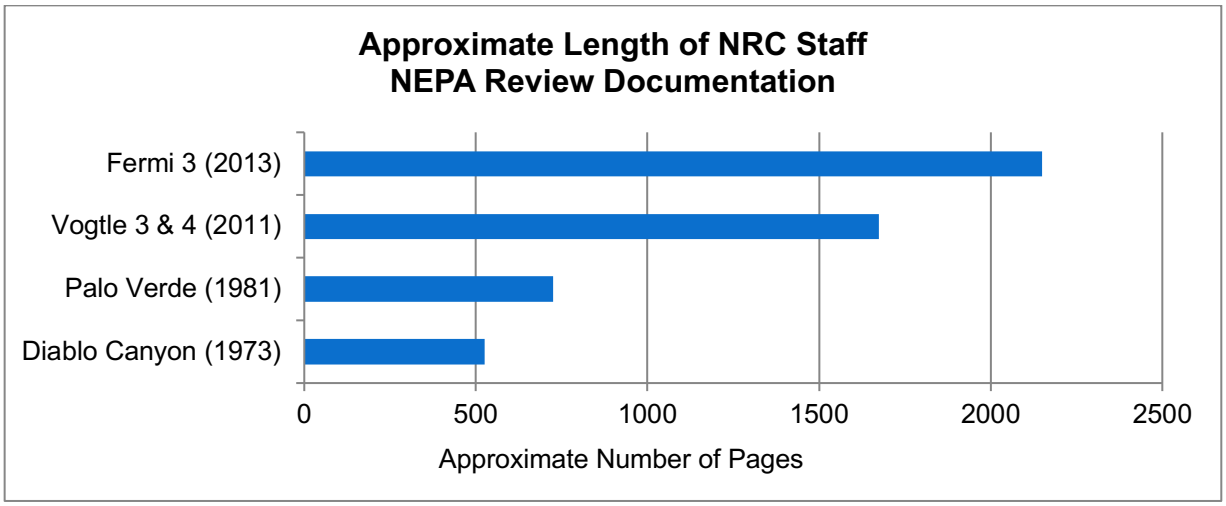

Chart developed by NIA using data derived from U.S. NRC documents

The increasing size and scope of NRC NEPA reviews risks becoming a distraction to the safety evaluations that should be the focus of the agency's efforts. For example, the permitting timelines for two newly proposed nuclear facilities to develop medical isotopes, which may serve as a litmus test for small advanced reactor licensing, required almost the same amount of time to perform the safety and environmental reviews (close to two years).[46] Additionally, the size of the final environmental review documents paralleled that of the safety review.[47] Informal contacts with the agency indicate that the NEPA reviews comprise a third of the overall resources spent on licensing medical isotope facilities and other large nuclear projects.[48]

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[45] NRC, *NUREG 1872, Final Environmental Impact Statement for an Early Site Permit (ESP) at the Vogtle ESP Electric Generating Plant Site* (Aug. 2008), https://www.nrc.gov/reading-rm/doc-collections/nuregs/staff/sr1872/; NRC, *NUREG-1947, Final Environmental Impact Statement for Combined License (COLS) for the Vogtle Electric Generating Plant Unit 3 and 4* (Mar. 2011), https://www.nrc.gov/reading-rm/doc-collections/nuregs/staff/sr1947/.

[46] NRC, *Application Review Schedule for Northwest Medical Isotopes, LLC*, https://www.nrc.gov/info-finder/nonpower/nw-isotopes-schedule.html (demonstrating that the NEPA review took the same time frame as safety review); NRC, *Application Review Schedule for SHINE Medical Technologies Inc.*, https://www.nrc.gov/info-finder/nonpower/shine-schedule.html (same).

[47] NRC, *Final Environmental Impact Statement for the Construction Permit for the Northwest Medical Isotopes Radioisotope Production Facility*, https://www.nrc.gov/docs/ML1713/ML17130A862.pdf; NRC, *Safety Evaluation Report Related to the Northwest Medical Isotopes, LLC Construction Permit Application*, https://adamswebsearch2.nrc.gov/webSearch2/main.jsp?AccessionNumber=ML18025B138; NRC, *Final Environmental Impact Statement for the Construction Permit for the SHINE Medical Technologies, Inc. Radioisotope Production Facility,* https://www.nrc.gov/docs/ML1528/ML15288A046.pdf; NRC, *Safety Evaluation Report: Related to SHINE Medical Technologies, Inc. Construction Permit Application for a Medical Radioisotope Production Facility*, https://www.nrc.gov/docs/ML1622/ML16229A140.pdf. The Northwest EIS outpaced the SER.

[48] While the agency publicizes that its staff spent 16,000 hours and 10,000 hours on each of the two NRC medical isotope construction permit reviews (with 6,000 and 2,000 hours of outside consultant time), the agency does not explain how that time is split between the safety and environmental reviews. *See id*.

Despite this clear risk of diversion of resources, the agency has not yet addressed the NEPA review process as part of its other efforts to improve advanced reactor licensing. The NRC has long recognized that it can do more to prepare for upcoming advanced reactor license applications and thus has issued a Vision and Strategy Statement, guidelines, and policy documents. It also holds periodic meetings with industry and Department of Energy officials to address technical challenges with licensing advanced reactors.[49] However, a review of these policy documents suggests that NEPA is not a major part of these efforts.[50] The NRC has begun evaluating opportunities to make the NEPA process more efficient, and this paper is intended to provide useful input.

C. NEPA Delays Risk Hampering Advanced Reactor Innovation

For the current fleet of LWRs, NEPA-induced licensing costs and delays could perhaps have been absorbed because nuclear power plants are owned by large utilities. For advanced reactors, however, NEPA-induced licensing challenges prove especially problematic. As noted above, most advanced reactor development efforts are smaller programs or companies without major profitable assets, that need to demonstrate the viability of their concept to attract investors and customers to commercialize their design. If there is no timely path forward to demonstrate a first-of-a-kind plant, then these innovators will not be able to access capital from investors and will not move forward, with the possibility of innovative technologies and U.S. leadership in nuclear energy expiring with them. Some of these companies will fail for other reasons, which is a function of the market and the technology development process – however – it should not be a function of regulatory inefficiency.

NRC practice indicates that NEPA can be the most time-consuming and critical process in supporting these novel licensing actions. During the 2000's, the first proceedings to occur under a newly designed NRC licensing process ended up delayed, with NEPA reviews playing a role. During processing of three 10 CFR Part 52 Early Site Permit applications submitted by Exelon, Dominion, and Entergy for new AP1000 and ESBWR nuclear reactors, the EIS was issued roughly 5-6 months *after* the staff completed the safety review, despite the safety and environmental reviews commencing within a month of each other.[51] The chart below shows the time taken to receive a final EIS and final SER for three early site permit applications in which the environmental review took a longer period.

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[49] NRC, *Advanced Reactors (non-LWR designs)*, https://www.nrc.gov/reactors/new-reactors/advanced.html.
[50] NRC, *Policy Issues Associated with Licensing Advanced Reactor Designs*, https://www.nrc.gov/reactors/new-reactors/advanced/policy-issues.html; NRC, NRC Vision and Strategy:
Safely Achieving Effective and Efficient Non-Light Water Reactor Mission Readiness (Dec. 2016), https://www.nrc.gov/docs/ML1635/ML16356A670.pdf; NRC, *Advanced Reactors (non-LWR designs)*, https://www.nrc.gov/reactors/new-reactors/advanced.html.
[51]NRC, Issuance of Early Site Permit for Exelon Generation Company LLC, (ESP-001), ML070670140 (March 15, 2007); NRC, Issuance of Early Site Permit for System Energy Resources, Inc. – Grand Gulf ESP Site (ESP-002), ML070780457 (April 5, 2007); NRC, Issuance of Early Site Permit for Dominion Nuclear North Anna, LLC – North Anna ESP Site, (ESP-003), ML073180440 (November 27, 2007).

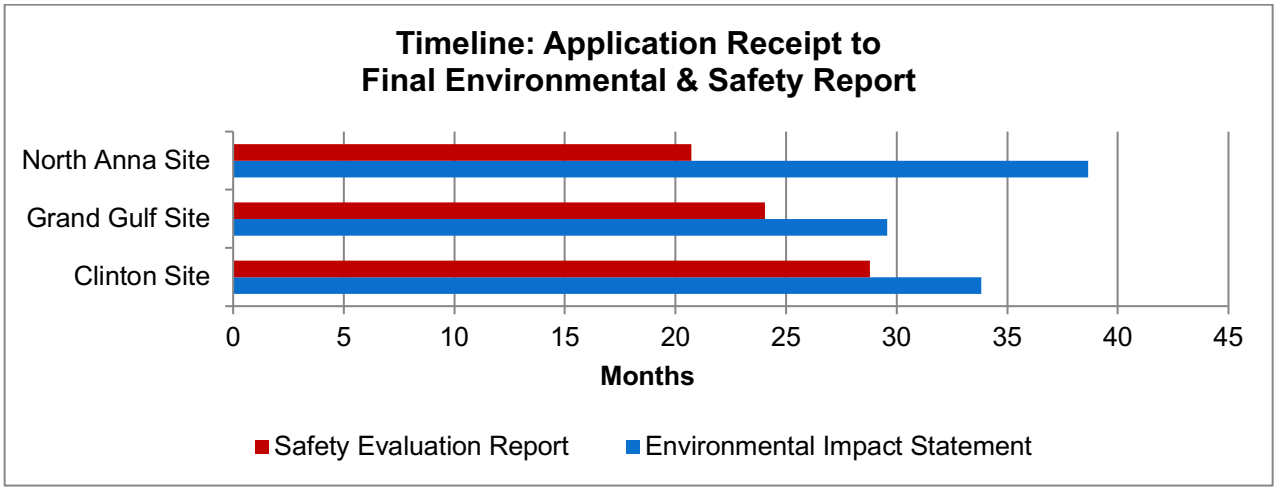

Chart developed by NIA using data derived from U.S. NRC documents

For advanced reactors, potential pitfalls exist that may exacerbate these challenges and make NEPA reviews even longer—including the "selection of alternatives" and the "connected actions" analyses.

Alternatives: NEPA requires that a proposed project be compared to "reasonable" alternatives, to help inform an agency of the different ways to accomplish the same goal.[52] Because it has been labelled the "heart" of the EIS by CEQ,[53] and is often the focus of litigation challenges, the alternatives analysis is where the temptation to be over inclusive is most threatening. Moreover, the environmental impacts of each alternative must be considered in full. Thus, the scope of NEPA reviews increases greatly as more alternatives are considered.

The comparison of alternatives for the new AP1000 reactors at Vogtle 3 & 4 provides an example. As mentioned earlier, Southern Company and the NRC evaluated more than *ten different technologies* instead of nuclear power, despite that fact that Vogtle was an already operating nuclear power plant. Despite the NRC's recognition that a number of other alternatives were unreasonable, the NRC staff still spent time analyzing these alternatives, such as use of wood and municipal solid waste for power (and the possible combination of multiple different such sources). The NRC also performed extensive analyses of *three different sites, including flying staff out to those sites and performing reconnaissance.* The result was a detailed alternatives analysis that cost the agency many millions of dollars (and ultimately cost the applicant, as NEPA costs are billed back to the applicant), with no real impact on the applicant's or agency's decision. In this case the NRC limited the analysis to sites at which Southern Company has operating nuclear plants.

The NRC's NEPA analysis for medical isotope facilities is also concerning. Despite a statutory directive that the NRC make licensing of medical isotope facilities a national

[52] 40 CFR § 1502.14.
[53] 40 CFR § 1502.14.

priority, both applications still faced extensive examination of alternatives. For one such facility, (the SHINE medical isotope facility), the discussion of alternative sites alone reached nearly 100 pages (1/4 of the document).[54] The number of pages for the SHINE EIS for its construction permit alone was nearly the same size of the 1980's Palo Verde EIS for the entire facility (both construction and operation)—and SHINE is not constructing a power reactor, but instead a far smaller medical isotope facility.

These concerns are amplified when applied to advanced reactors. Innovation in the field could prove to be its own handicap. If the NRC is forced under NEPA to give time and space in its EIS to evaluation of nearly all alternatives, how will it compare against the dozens of different advanced reactor technologies innovators are pursuing? For an innovator with no previously fixed site, how can alternative sites be reasonably limited when a reactor is designed for much more versatile siting (or even to be portable)? These questions could result in NEPA reviews dwarfing the targeted nature and purpose of demonstration projects.

Connected Actions: The "connected actions" analysis under NEPA is likewise prone to scope creep in the advanced reactor context, particularly concerning the issue of SNF. An EIS must include not only a full analysis of the proposed action itself (constructing the demonstration project), but of "connected actions" as well—including those actions that "[c]annot or will not proceed unless other actions are taken previously or simultaneously."[55]

For current LWRs, a diversified and large industry means that no single reactor addition would significantly affect the fuel cycle. Moreover, the back end of the fuel cycle is currently covered by the Continued Storage GEIS, a massive generic environmental review that offers treatment of spent fuel environmental impacts in general, rather than including these analyses in individual reactor licensing actions.[56]

However, this rationale may not apply to advanced reactors. Commercial molten salt reactors will need a molten salt fuel cycle, which may be developed along with the demonstration project, or afterwards. In addition, many advanced reactors are designed to use "high assay" low-enriched uranium, which is uranium enriched between 5-20% (current reactors only use up to 5% enriched uranium or less), or even SNF. This fuel could be configured differently, in solid or liquid form. The interconnection between the advanced reactor fuel cycle and reactors themselves could bring the entire fuel cycle (both front and back ends) into a NEPA review for a demonstration project—from enrichment to fuel fabrication to disposal. For a commercial fleet of reactors this would be appropriate, with a GEIS being the most efficient approach. But for an inaugural demonstration project

[54] The time spent on alternatives analyses can be greater than reflected in the number of pages appearing in EISs, because for each alternative, the impacts of the alternative site or technology have to be fully reviewed. However, they are not always listed in detail in the NEPA document.
[55] 40 CFR § 1508.25. "The crux of the test is whether each of two projects would have taken place with or without the other." *Wilderness Workshop v. U.S. Bureau of Land Mgmt.*, 531 F.3d 1220, 1229 (10th Cir. 2008); see also Webster v. U.S. Dep't of Agric., 685 F.3d 411, 426 (4th Cir. 2012); *Pac. Coast Fed'n of Fishermen's Associations v. Blank*, 693 F.3d 1084, 1098 (9th Cir. 2012).
[56] NRC, *NUREG 2157, Generic Environmental Impact Statement for Continued Storage of Spent Nuclear Fuel* (Sept. 2014), https://www.nrc.gov/reading-rm/doc-collections/nuregs/staff/sr2157.

that may be one of a kind, an environmental impact assessment of an industrial fuel cycle is disproportionate and unprecedented, and yet may be foreseeable under recent trends of implementation.

If the NRC finds that the current Continued Storage GEIS does not apply to advanced reactor or HALEU spent fuel, or the radioactive products of burning spent nuclear fuel, then a demonstration project NEPA review may be compelled to take on the issue of SNF disposal at the proof-of-concept stage, before the issue is ready to be analyzed. The threat of being forced to evaluate the impacts of a commercial fuel cycle in the environmental review of a single demonstration project could deter investment. As to the front end of the fuel cycle, while fuel fabrication facilities will have their own separate NEPA reviews through the NRC licensing process, a conservative agency posture, or the threat of litigation, could push the agency to evaluate the impacts of establishing a nuclear fuel cycle along with the environmental review for the demonstration project.

Commercial scale approaches to the nuclear fuel cycle will depend on the commercial viability and scaling potential of the advanced reactor design, which in practice cannot be determined until it is demonstrated. Speculative reviews will not lead to effective and thorough analysis of the potential environmental impacts of the fuel cycle, but nonetheless have the potential to waste thousands of work hours. The issue of SNF in particular should instead be addressed when full-size reactors that will generate substantial amounts of SNF are being proposed for deployment.

* * *

The above considerations suggest that NEPA should be tailored to provide effective, but not excessive or speculative, review of the environmental impacts of next-generation reactors. Too many advanced reactor innovators are already moving abroad to license their designs.[57] The NRC and Congress must act now to preserve U.S. leadership in the nuclear industry and hasten introduction of a critical zero-emissions resource.

[57] *See, e.g.,* Stephen Stapczynski, Bloomberg, *Nuclear Exports Head to China to Test Experimental Reactors* (Sept. 22, 2017), https://www.bloomberg.com/news/articles/2017-09-21/nuclear-scientists-head-to-china-to-testexperimental-reactors.

IV. Recommendations

The NRC's NEPA reviews for advanced reactors should be addressed to ensure they do not pose unnecessary challenges to this growing U.S. industry. This can be achieved while the NRC continues to ensure that the environmental impacts of the project are commensurate with NEPA requirements. The very nature of the facilities—with smaller size and reduced risk—and the delicate status of this emerging industry underscores the importance of conducting proportionate review in a pragmatic manner. There are a number of things both the NRC and Congress can do to help pave the way for efficient reviews of advanced reactors under NEPA. These recommendations focus on tailored, bipartisan approaches for improving environmental reviews for advanced reactor applicants:

A. Recommendation 1: Reevaluate the Presumption that Advanced Reactor Demonstration Projects Require EISs

Current NRC regulations require the issuance of an EIS for licensing nuclear power reactors or "testing facilities," which are likely to include most or the vast majority of demonstration projects.[58] The NRC's guidance further presumes that "prototypes" of advanced reactors will be licensed as commercial power facilities, which would require an EIS.[59] The NRC's presumption of needing an EIS for most types of demonstration reactors stands in stark contrast to the fact that *less than 1% of NEPA actions overall result in an EIS.*[60]

This presumption is not based on a principle that all reactors require EISs—indeed, many non-power reactors (such as many research reactors) do not need an EIS by default under the NRC's current regulations.[61] The presumption in favor of an EIS is instead based on outdated regulatory analyses, which ignore the fact that advanced reactors have incorporated lessons learned from LWRs in terms of limiting environmental impacts, arguably making their impacts akin to those of smaller non-power reactors. Advanced reactors are designed to minimize the risk of offsite radiological impacts due to passive safety features and fuel designs that contain radioactivity even in accident conditions.[62]

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[58] *See* 10 CFR § 51.20(b) (stating that any licensing action for a "nuclear power reactor" or "testing facility," from even a limited work authorization or early site permit, requires an EIS). "Testing facilities" are defined in the NRC's regulations to include research and development reactors intended to operate at a thermal power in excess of 10 MW (i.e., 3 or so MW electric). Testing facilities can also include reactors of just 1 MW thermal power if they have certain features (such as liquid fuel loading). It is expected that except for micro-reactors that use solid fuel, most or all demonstration projects will pass the threshold to be classified as "testing facilities" and thus require an EIS.

[59] *See* NRC, *A Regulatory Review Roadmap For Non-Light Water Reactors* (Dec. 2017), Enclosure at 3, https://www.nrc.gov/docs/ML1731/ML17312B567.pdf (For the purposes of this key NRC position paper on advanced reactor licensing, the NRC staff stated that "a prototype plant will be considered to be licensed . . . as a commercial power facility"—i.e., a nuclear power reactor—which would require an EIS.).

[60] GAO, *National Environmental Policy Act – Little Information Exists on NEPA Analyses*, at 1 (Apr. 2014), https://www.gao.gov/assets/670/662546.pdf.

[61] For example, certain non-power reactors that meet certain size limitations so as to not be classified as "testing facilities" can be licensed using an environmental assessment.

[62] The NRC acknowledges that these safety benefits can result in the elimination of the need of any emergency planning zone ("EPZ") for advanced reactors. NRC, *Regulatory Basis -- Rulemaking for Emergency Preparedness for Small Modular Reactors and Other New Technologies* (Sept. 2017), https://www.nrc.gov/docs/ML1720/ML17206A265.pdf.

Advanced reactors vary greatly in size, from just a few MWe to 100s of MWe,[63] and are intended to be manufactured offsite in a factory, greatly reducing construction impacts. Next-generation reactors also may produce significantly less spent nuclear fuel, or even consume it.[64] Some advanced reactors are designed to be portable and enable quick return of a site to greenfield status, so there is no long-term site impact. And many advanced reactors have lower water consumption than existing technology.

What the NRC Can Do:

There is no requirement to presume that advanced reactors require an EIS. The NRC should consider, for each demonstration project, whether it could be evaluated at a lower level of review, in consideration of its lower impact on the human environment, including through construction on brownfield or national laboratory sites. The NRC should also consider whether there are any steps reactor developers can take to mitigate short or long term impacts that can move the project to a lower level of review. The NRC should consider that other agencies license large infrastructure projects with graded requirements to determine whether an EA or EIS is required.[65]

In improving its NEPA implementation, the NRC can consider modern NEPA guidance on consideration of mitigation strategies in the evaluation of whether an EIS is indicated. In 2011, CEQ issued guidance on the appropriate use of mitigation and "mitigated FONSIs,"[66] to incorporate applicant led mitigation measures to allow the agency to issue an EA. The guidance states that the use of a mitigated FONSI "may allow the agency to comply with NEPA's procedural requirements" while avoiding the need to prepare an EIS.

Mitigation can come in many different forms and can include inherent design features of a project.[67] According to CEQ, "limiting the degree or magnitude of the action," can be a mitigation factor. By allowing the NRC to issue a FONSI (which eliminates the need for an EIS) based on a mitigation plan adopted as part of the project design and set forth as a license condition (such as to address spent fuel or to return a site to greenfield status after decommissioning), mitigated FONSIs provide a mechanism for jumpstarting advanced reactor projects while promoting the goals of NEPA "to prevent or eliminate damage to the environment."[68] Additionally, mitigated FONSIs will encourage entrepreneurs to incorporate environmental considerations into their projects early in development, since earning one would help in avoiding the need for a long and drawn out NEPA process.

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[63] For example, the U-Battery under development by URENCO would consist of just two 4-MWe micro-nuclear reactors. URENCO, *What is U-Battery?*, https://www.u-battery.com/what-is-u-battery.
[64] As discussed above, the impact of the nuclear fuel cycle should also be excluded from evaluation of advanced reactor Demonstration Projects.
[65] For example, FERC only mandates an EIS by default for certain pipeline projects—major projects in which there is no existing pipeline present (i.e., major greenfield projects). *See* 18 CFR § 380.6(a)(3). FERC regulations also provide an option for an EA to be conducted even for a major greenfield pipeline project, where the agency believes there is a reasonable option that the project would not have a significant environmental impact. 18 CFR § 380.6(b).
[66] CEQ, *Memorandum to Agencies--Appropriate Use of Mitigation and Monitoring and Clarifying the Appropriate Use of Mitigated Findings of No Significant Impact* (Jan. 14, 2011), https://www.energy.gov/sites/prod/files/2017/06/f35/NEPA-CEQ_Mitigation_and_Monitoring_Guidance_14Jan2011.pdf.
[67] *Id.* at 6.
[68] 42 U.S.C. § 4321

What Congress Can Do:

Congress can designate categories of activities that benefit from rebuttable presumptions in favor of "categorical exclusions" under NEPA. Categorical exclusions are determinations before an application is submitted that certain activities do not warrant an EIS. Legislative presumptions of categorical exclusions would make clear Congress's intent that the agency explore whether licensing of demonstration facilities truly has a significant impact.

In Section 390 of the Energy Policy Act of 2005, Congress created rebuttable presumptions in favor of categorical exclusions for five categories of activities conducted under the Mineral Leasing Act. These Section 390 categorical exclusions are limited in size and scope and are often dependent on prior NEPA actions or other regulatory actions (such as a resource management plan).[69] For example, Section 390 Categorical Exclusion 3 pertains to drilling an oil or gas well within a developed field for which there is "an approved land use plan or any environmental document prepared pursuant to NEPA" within the last 5 years.[70]

Reviews of Section 390 categorical exclusions have been mixed as to resource savings and consistency in execution. This appears to be due in part to lack of clarity in the law and relevant BLM guidance. Nonetheless, Congress is well positioned to learn from these experiences. Micro-reactors and other small demonstration projects are good candidates for congressionally mandated presumptions in favor of categorical exclusions. The use of clear criteria and existing legislative language will help avoid the pitfalls that faced implementation of Section 390.

B. Recommendation 2: Tailor the Scope of NEPA Reviews for Demonstration Projects

As discussed above, the selection of alternatives and "connected actions" requirements under NEPA could prove highly burdensome to applicants that want to obtain a license for a demonstration project. Both the NRC and Congress can take the following actions to help eliminate this prospect:

- ***Eliminate Design Alternatives from Demonstration Project NEPA Reviews:*** A proof-of-concept demonstration project, even if power generating, is designed to do just that—prove the specific technology at issue. Comparing that project to

[69] 42 USC 15942, PL 109-58 (2005) (https://www.ferc.gov/enforcement/enforce-res/EPAct2005.pdf)

[70] The categorical exclusions provided for in section 390 of the Energy Policy Act of 2005 include: (1) Individual surface disturbances of less than 5 acres so long as the total surface disturbance on the lease is not greater than 150 acres and site-specific analysis in a document prepared pursuant to NEPA has been previously completed. (2) Drilling an oil or gas well at a location or well pad site at which drilling has occurred previously within 5 years prior to the date of spudding the well. (3) Drilling an oil or gas well within a developed field for which an approved land use plan or any environmental document prepared pursuant to NEPA analyzed such drilling as a reasonably foreseeable activity, so long as such plan or document was approved within 5 years prior to the date of spudding the well. (4) Placement of a pipeline in an approved right-of-way corridor, so long as the corridor was approved within 5 years prior to the date of placement of the pipeline. (5) Maintenance of a minor activity, other than any construction or major renovation or a building or facility. 42 USC 15942, PL 109-58 (2005) (https://www.ferc.gov/enforcement/enforce-res/EPAct2005.pdf). The other Section 390 Categorical Exclusions have similar scope and regulatory requirements. *Id.*

energy generation from coal or solid waste does not align with the fundamental intent of the project or of NEPA—nor the government's own substantial interest in promoting advanced reactor development.

- ***Eliminate Site Alternatives if a Project is to be Sited at a National Laboratory or Department of Defense facility***: Some Department of Energy (DOE) laboratories are key centers of nuclear innovation. For example, Idaho National Laboratory has hosted 52 nuclear reactor test projects,[71] and Oak Ridge National Laboratory has unmatched technologies in nuclear testing and simulation,[72] along with one of the most powerful research reactors in the world.[73] These technical resources were key to America becoming the world leader in nuclear power in the mid-1900s. With this in mind, many advanced reactor companies are planning to site their demonstration projects at national laboratories now.[74] The NRC and Congress should make clear that when an advanced reactor company has selected a national laboratory as the site of interest for a demonstration project, and a site use agreement is in place, there is no reasonable need to analyze alternative properties. This could also apply to certain other federal facilities such as Department of Defense sites, or other strategic locations at the discretion of NRC or Congress.

- ***Separate NEPA Analyses of the Fuel Cycle from the Demonstration Project by Limiting Connected Action Analysis***: Fundamentally, many of the key issues associated with the fuel cycle, including generation of SNF, cannot be effectively addressed until designers have demonstrated how a reactor will operate. The front and back end of the nuclear fuel cycle should be addressed generically once full-scale commercial facilities are before the NRC.[75]

This report does not advocate for entirely eliminating the alternatives and connected action analyses. Even in the case of an advanced reactor sited at a national laboratory, the agency and applicant could analyze alternatives within the site of interest, such as design changes to mitigate environmental impacts.[76] The NRC must also evaluate the proposal against the non-action alternative. Moreover, there are many connected actions to evaluate, such as road construction, that would be appropriately applied to a demonstration project. The proposed limited tailoring of NEPA preserves those alternatives that are aligned with the project's purpose and scope and those connected actions that do not primarily pertain to development of a commercial fleet.

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[71] Id. Natl. Lab., *General Information*, https://www.inl.gov/about-inl/general-information/.
[72] Oak Ridge Natl. Lab., *Nuclear Science and Technology*, https://www.ornl.gov/science-area/nuclear-sciences.
[73] Oak Ridge Natl. Lab., *High Flux Isotope Reactor*, https://neutrons.ornl.gov/hfir.
[74] DOE, Office of Nuclear Energy, *Department of Energy Continues Commitment to the Development of Innovative Small Modular Reactors* (Feb. 18, 2016), https://www.energy.gov/ne/articles/department-energy-continues-commitment-development-innovative-small-modular-reactors; Terrestrial Energy, *Terrestrial Energy USA Signs MOU with Energy Northwest for Idaho National Laboratory Project* (Mar. 28, 2018), https://www.terrestrialenergy.com/2018/03/terrestrial-energy-usa-signs-mou-with-energy-northwest-for-idaho-national-laboratory-project/.
[75] In addition, Congress should make clear that these actions, even if connected, do not in themselves comprise a significant impact under NEPA—the significance of the impact of the proposed action should rest on the demonstration project being evaluated itself.
[76] *See Vogtle ESP EIS* § 9.3 (discussing system design alternatives).

What the NRC Can Do:

The NRC can take initiative to streamline its reviews and recognize the benefits of co-location at national laboratories and federal facilities early on. It can also clarify that fuel cycle issues are not to be over evaluated for demonstration project activities because the connection between these issues is too tenuous for a proof-of-concept project, and the appropriate time to evaluate such impacts coincides with the industry's intention to deploy at scale when the potential for cumulative impacts becomes apparent. This can be accomplished through updates to guidance, or even through modification of the NRC's NEPA regulations at 10 CFR Part 51.

As for analysis of SNF, the NRC should consider a tailored expansion to its GEIS for SNF as the appropriate forum to address spent fuel created by demonstration projects (as is discussed more below), and make clear early on that the issue is not to be addressed on a case by case basis. Amendment of the agency's rules to tailor NEPA reviews for demonstration projects will eliminate wasteful administrative litigation, as it will take this NEPA issue out of the scope of individual licensing applications.

What Congress Can Do:

While the NRC can take certain steps, Congress is particularly well-positioned to facilitate NRC process improvements. The NRC may not be able to act alone in streamlining its approach without risking prolonged NEPA litigation, however, Congress has the clear authority to explicitly exempt certain projects from NEPA.[77]

In fact, nuclear power's peer industries largely benefit from blanket NEPA exemptions. The Clean Air Act states that no action taken under it, such as the granting of an air permit, "shall be deemed a major Federal action significantly affecting the quality of the human environment within the meaning of the National Environmental Policy Act of 1969."[78] The Clean Water Act repeats this requirement for many of its permitting actions.[79] This means that many non-nuclear generation stations built on private land and without another significant federal tie *entirely avoid* the requirements of a federal NEPA review. To provide first-of-a-kind advanced reactor demonstration projects with an exemption from NEPA review is minor in comparison.

Congress has been active in introducing and passing nuclear legislation,[80] and pending legislation, such as the Nuclear Energy Leadership Act,[81] is focused on novel solutions to lower barriers for advanced reactor innovation. Congress can introduce tailored exemptions as part of any legislation to pave the way for further agency action.

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[77] *State of Alabama ex. Rel. Seigelmanv. U.S. E.P.A.*, 911 F.2d 499 (11th Cir., 1990) (discussing Congress's right to explicitly exempt NEPA, and providing examples of NEPA exemptions); *see also* K. Robisch, *The NEPA Implied Exemption Doctrine: How a Novel and Creeping Common Law Exemption Threatens to Undermine the National Environmental Policy Act's Application to Public Lands and Civil Works*, 16 V. J. Envlt. L. 173, 180 (2014), http://vjel.vermontlaw.edu/files/2014/12/Robisch.pdf (noting that "[o]ne-off projects like highway construction or pipeline expansion are also commonly insulated from NEPA via [Congressional] express exemption.")

[78] 15 U.S.C. § 793(c)(1).

[79] 33 U.S.C. § 1371(c)(1).

[80] HL New Nuclear, *Significant Legislative Activity Impacting Advanced Nuclear* (Oct. 1, 2018), https://www.hlnewnuclear.com/2018/10/significant-legislative-activity-impacting-advanced-nuclear/.

[81] S.3422, Nuclear Energy Leadership Act, https://www.congress.gov/bill/115th-congress/senate-bill/3422.

C. Recommendation 3: Increase Use of Generic Environmental Impact Statements ("GEISs") to Address Common Advanced Reactor NEPA Questions

Never before has the NRC been faced with licensing so many different types of nuclear reactor designs. At the same time, many of these reactor designs share similar characteristics that could lead to increased use of GEISs (or their analog, Programmatic EISs ("PEISs"), often used for wind and solar projects[82]) to manage common issues. Some common environmental characteristics shared among different advanced reactor designs include:

- Fabrication, use, and storage/disposal[83] of High-Assay Low-Enriched Uranium ("HALEU")
- Fabrication, use, and storage/disposal of spent nuclear fuel of several varieties including TRISO, Uranium-metal, and liquid salt-based fuel
- Modular construction and installation
- Use of new coolants such as molten salt, gas, and liquid metal

The NRC has proven that GEISs, which take a long-term approach to shared environmental issues, can add significant efficiency to the site-specific environmental review process. The most notable example is the NRC GEIS concerning the storage and use of SNF (previously called the "Waste Confidence GEIS" and now called the "Continued Storage GEIS"). Through one GEIS, the NRC has evaluated and considered the complex and highly litigious issue of SNF for every reactor's site-specific NEPA review, saving tens of millions of dollars and countless hours of NEPA review time. The NRC's GEIS for power reactor license renewals[84] also greatly sped up the license renewal process and reduced site-specific litigation on common issues.[85]

What the NRC Can Do:

Overall, the NRC's use of GEISs is limited. Currently, the NRC only employs 5 GEISs relating to life extensions, decommissions, and certain specific elements of the fuel cycle.[86] Given the common characteristics and issues across the advanced reactor space,

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[82] Supra note **Error! Bookmark not defined.**. Many agencies, such as BLM, use PEISs to address many similar actions. F or example, the BLM has prepared a PEIS for solar energy across the Southwestern United States. Solar Energy Development Programmatic EIS, *Five Solar Energy Development Programmatic Environmental Impact Statements (Solar PEIS),* (available at http://solareis.anl.gov/documents/fpeis/index.cfm, http://windeis.anl.gov/documents/fpeis/index.cfm). These PEISs can then be supplemented for specific projects. Practically speaking, this is similar to what the NRC does with its "Generic" EIS process. For example, a single GEIS has been created for license renewals that is briefly supplemented for each specific license renewal action. NRC, Generic Environmental Impact Statement for License Renewal of Nuclear Plants (NUREG-1437), https://www.nrc.gov/reading-rm/doc-collections/nuregs/staff/sr1437/.

[83] Storage and disposal of spent fuel from advanced reactors could be addressed as an update or supplement to the Continued Storage GEIS.

[84] NRC, NUREG 1437, Generic Environmental Impact Statement for License Renewal of Nuclear Plants (May 1996), https://www.nrc.gov/reading-rm/doc-collections/nuregs/staff/sr1437/.

[85] Nuclear Energy Institute, *Second License Renewal Roadmap* (May 2015), https://www.nrc.gov/docs/ML1521/ML15211A401.pdf (NEI agreeing that use of the GEIS contributed to an efficient and effective license renewal review process, and suggesting the same approach for second license renewals).

[86] NRC, *Publications Prepared by NRC Staff*, https://www.nrc.gov/reading-rm/doc-collections/nuregs/staff/.

the NRC has ample opportunities to use GEISs to streamline the NEPA process. The NRC should explore what NEPA issues with advanced reactors may be best addressed on a generic basis, such as those listed above, and seek industry-wide input where helpful.[87] The NRC could draft a GEIS on a single major fuel cycle issue (such as use of molten salt or HALEU in reactors). Then, each individual research or test reactor would need to prepare a site-specific supplement to the GEIS, maintaining environmental quality while increasing efficiency of regulation.

What Congress Can Do:

Congress is well-positioned to provide funds for development of GEISs as part of NRC advanced reactor pre-licensing activities. To encourage the NRC to pursue this, Congress can request that the NRC present to Congress an analysis of environmental issues for advanced reactor licensing that can be handled generically. This would include how any current environmental analysis of SNF would have to be updated to ensure that SNF matters can be addressed in parallel with the licensing of demonstration projects.

D. Recommendation 4: Allow Applicants to Draft EAs and EISs

The NRC requires that nuclear reactor license applicants submit an ER along with the license application, which addresses all the same items the agency must explore in its EA or EIS. The applicant will hire contractors to review the different alternative sites, to evaluate traffic and economic impacts, and look at connected actions. The agency will then repeat the same process, including hiring contractors where needed, and spend the vast majority of its time coming to the same conclusions as the applicant. Indeed, an NRC EA or EIS will often simply repeat the conclusions of the applicant's ER. The result is a needless duplication of time and effort that does not provide for an efficient environmental review.

What the NRC Can Do:

Currently, multiple agencies, including FERC[88] and BLM,[89] permit applicants to draft EAs, which are used to by agencies to help determine whether there is a "significant impact" that warrants the generation of an EIS. These procedures help save license applicants millions of dollars and avoid excessive duplication. The NRC can adopt similar regulations to permit applicant drafting of EAs. Combined with the use of EAs in place of EISs to determine environmental impacts for demonstration projects, this would save significant NRC environmental review time.

What Congress Can Do:

CEQ regulations permit applicants to draft EAs but instruct that only agencies can draft EISs.[90] While this may help enforce agency independence in some cases, the vast cost and time required to duplicate a 1,000 page environmental report into a 1,000 page

[87] Technology-Centered Working Groups have been established for Fast Reactors, High Temperature Gas Reactors, and Molten Salt Reactors. These groups would have useful input on what topics are ripe for GEISs.
[88] FERC, *Guidance for Applicant-Prepared Draft Environmental Assessments For Certain Proposed Natural Gas Projects* (Apr. 28, 2011), https://www.ferc.gov/industries/gas/enviro/draft-ea-guidance.pdf.
[89] BUREAU OF LAND MANAGEMENT, National Environmental Policy Act Handbook, H-1790-1, 124 (2008).
[90] 40 CFR § 1506.5.

environmental impact statement is not justifiable in the case of advanced reactor demonstration projects. Congress should require the NRC, as a lead agency to test this process, to explore the adoption of procedures to permit demonstration project applicants to draft an EIS to include in its license application submission, building on successful precedent of using applicant drafted EAs for other agencies. In addition, after implementation the NRC should issue a report to Congress on its success or challenges. If the program is successful with demonstration projects, the NRC should then consider using this approach for subsequent reactor applications as well.

There is significant precedent for Congress tailoring the NEPA process to meet a pressing need. Most recent in this regard is the FAST Act.[91] The FAST Act did not overwrite the major requirements of NEPA but took a number of steps to guide NEPA reviews as applied to surface transportation and energy infrastructure projects (including nuclear power in part). For example, the FAST Act established a Federal Infrastructure Permitting Improvement Steering Council to provide easy public oversight over complex NEPA reviews (with the NRC as a member of the Council).[92] It created a NEPA permitting dashboard to track large NEPA reviews, which included new reactor reviews.[93] However, the FAST Act's bolder provisions were not created with nuclear power in mind.[94] As a result, Congress should build on efforts such as the FAST Act to provide tailored assistance to the NRC and advanced reactor applicants.

V. Conclusion

Advanced nuclear energy can transform the situation surrounding climate change and greenhouse gas emissions. They offer the country an opportunity to provide clean energy without many of the limitations of traditional reactors. However, they will face NEPA permitting hurdles that add great cost and do not provide a compelling environmental benefit unless the NRC and Congress take action to improve the process. The exorbitant costs and timelines associated with the current implementation of the NEPA process often paralyze new projects and could prove significant roadblocks for advanced reactors—inhibiting the environmental gains they can offer. Using the recommendations presented in this paper, the NRC, with the help of Congress, can create an efficient regulatory path for advanced nuclear reactors, while fulfilling the goals and spirit of NEPA.

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[91] Pub. L. No. 114-94, 129 Stat. 1312 (2016), https://www.gpo.gov/fdsys/pkg/PLAW-114publ94/pdf/PLAW-114publ94.pdf.
[92] Permitting Dashboard, *FAST-41 for Infrastructure Permitting – Fact Sheet*, https://www.permits.performance.gov/sites/permits.performance.gov/files/docs/documentation/37401/fast41fact-sheet-may-2018.pdf.
[93] Permitting Dashboard, *Home Page*, https://www.permits.performance.gov/. Those NEPA reviews captured in the Permitting Dashboard are scrutinized for compliance with estimated project end dates, and reviews that are significantly behind schedule can be reported to Congress. The NRC briefly discusses the FAST Act's timeline-forcing provisions in a fact sheet: NRC, *NRC's Environmental Review Process*, https://www.nrc.gov/reactors/new-reactors/regs-guides-comm/erp.html.
[94] Many of its provisions, such as an innovative approach to letting a state environmental review supplant a federal NEPA review, do not apply in the nuclear power context, where there is federal preemption of radiological health and safety matters.

VI. Table of Acronyms

NEPA	National Environmental Policy Act
NRC	Nuclear Regulatory Commission
CEQ	White Council of Environmental Quality
EIS	Environmental Impact Statement
SER	Safety Evaluation Report
LWR	Light Water Reactor
EA	Environmental Assessment
Mitigated FONSI	Mitigated Finding of No Significant Impact
GEIS	Generic Environmental Impact Statement
SNF	Spent Nuclear Fuel
HALEU	High-Assay Low-Enriched Uranium
ER	Environmental Report
CNSC	Canadian Nuclear Safety Commission
FAST Act	Fixing America's Surface Transportation Act
GAO	Government Accountability Office
PEIS	Programmatic Environmental Impact Statement
GEIS	Generic Environmental Impact Statement
BLM	Bureau of Land Management
FERC	Federal Energy Regulatory Commission
DOE	Department of Energy


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