

Needed: An Effective Nuclear Energy Policy

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KEY TAKEAWAYS

America's system of economic freedom is one of its greatest strengths, and has led to the most diverse and innovative nuclear energy industry in the world.

The economics of nuclear energy are integral to whether it remains a safe and affordable energy choice for Americans in the future.

Congress should protect taxpayers, remove regulatory barriers, work with allies, and use market principles to allow a competitive future for nuclear energy.

Effective nuclear energy policy is important for as many reasons as there are diverse groups engaged in, or affected, by it. Effective nuclear policy matters for the taxpayer, who is on the hook for hundreds of billions of dollars in federal liabilities from legacy nuclear activities and from the Department of Energy's (DOE's) research and development (R&D) budget. It matters to the environmentalist and climate activist seeking realistic energy options to reduce pollutants and greenhouse-gas emissions. Accordingly, the Biden Administration has expressed general support for nuclear energy as an important source of energy now and in the future. Effective nuclear energy policy is an important tool in foreign policy to support nonproliferation goals, and to foster relationships with trading partners and allies. And, it obviously matters for a competitive, innovative civilian nuclear industry in the U.S.

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Principles of free markets, limited government, and strong national defense make for good, effective nuclear energy policy. An effective policy protects taxpayers, focuses government on challenges that are uniquely in its purview, and removes barriers to an innovative, competitive nuclear industry to engage at home and abroad. While by no means exhaustive, this *Backgrounder* identifies recommendations for such a nuclear energy policy in the areas of nuclear waste management, regulation, trade, R&D, and financing and insuring reactors.

Nuclear Waste Management and Cleanup

Nuclear waste presents perhaps the largest liability—and opportunity—for taxpayers and the nuclear industry. Leadership falls uniquely in the federal government’s purview and should be the single greatest priority of Congress and the Administration for nuclear energy policy. Congress and the Administration should:

Practice Oversight of the DOE’s Environmental Liabilities and Push for Efficiency. The DOE is responsible for the overwhelming majority of the federal government’s environmental liabilities, the costs of which are continually rising and currently estimated to total \$512 billion.¹ Most of these liabilities are housed in the DOE’s Environmental Management (EM) office, which oversees the cleanup of facilities remaining from World War II and the Cold War to manufacture and test nuclear weapons. While the DOE has made progress, some of the most complicated, costly, and time-consuming projects remain. The government is not expected to complete cleanup until the end of this *century*. The Government Accountability Office has included the DOE’s environmental liabilities on its “high risk” lists of government programs that need broad reform, suggested a number of programmatic reforms to cut costs and schedules, and found that EM has not met annual progress and cost-reporting requirements to Congress.²

The DOE has made some effort to improve its practices, not least of which was its supplemental notice in 2019 to more clearly distinguish low-level radioactive waste from high-level radioactive waste that requires deep, geologic disposal.³ All EM policies and objectives similarly should be informed and prioritized by accurate characterizations of radiological risk and cost. Human and financial resources, as well as time and physical storage for waste—are finite. Excessively conservative measures that are not informed by radiological risks, and unnecessarily increase costs for little or no public health benefit, do not serve the public, nor do they make progress toward the ultimate goal of cleanup.

Congress should continue to scrutinize cost projections for the remaining EM cleanup sites through hearings and future National Defense Authorization Acts.⁴ EM should also consider adopting recent acquisition and project management changes made by the National Nuclear Security Administration, given similarities in the nature of their work and their improved reputation to finish projects on time and budget in recent years.⁵ The DOE has a legal and moral obligation to clean up these sites and the EM mission should have the commensurate level of attention from the DOE Secretary and from Congress. It is not acceptable nor necessary that cleanup should take the better part of this century to complete. The DOE and Congress must strive for a more risk-informed, scientifically justifiable policy that better serves the taxpayer and affected communities in achieving this goal.

It is not acceptable nor necessary that nuclear waste cleanup should take the better part of this century to complete.

Implement the DOE's Supplemental Notice on High-Level Waste at all EM Cleanup Sites. Astronomical costs for cleanup at the remaining EM sites are due in part to some toxic or low-level radioactive defense waste being labeled for treatment and disposal as high-level waste, for which no disposal facility has yet been built.⁶ In 2019, the DOE clarified its interpretation of the statutory definition of the high-level waste for which it is responsible based on the radiological characteristics of waste rather than its origins.⁷ The clarification allows a more accurate classification of defense waste at EM sites and brings the DOE into greater conformity with the Nuclear Regulatory Commission's (NRC's) and International Atomic Energy Agency's (IAEA's) definitions of high-level waste. It further optimizes limited storage and disposal options, reduces costs, and expedites timelines without endangering health and safety to reach the ultimate goal of cleanup.

The DOE preliminarily evaluated defense waste at three of the costliest EM cleanup sites—the Savannah River Site, Idaho National Laboratory, and the Hanford Site—in light of its 2019 policy, as required by a congressionally requested report published in December 2020.⁸ The report found that significant efficiencies and cost savings in the tens of billions to hundreds of billions of dollars could be achieved by more accurately identifying high-level waste at these sites according to radiological characteristics. The

DOE should implement its clarified interpretation of high-level waste at remaining EM sites to the fullest extent possible under agreements with states and the Environmental Protection Agency (EPA).

Repurpose ARPA-E's Nuclear Program to Tackle Novel EM Cleanup Challenges. The DOE's Advanced Research Project Agency-Energy (ARPA-E) was created in 2007 to fund high-risk, high-reward projects on which the private sector would not embark on its own. Currently, ARPA-E funds research in advanced modeling and materials science for advanced nuclear technology as part of its Modeling-Enhanced Innovations Trailblazing Nuclear Energy Reinvigoration (MEITNER) program, and a new R&D program for waste reduction from advanced reactors called the Optimizing Nuclear Waste and Advanced Reactor Disposal Systems (ONWARDS) program.

Instead of contributing further to the DOE's excessive reactor R&D programs, ARPA-E's nuclear portfolio should be refocused entirely to develop technology for the many complex, novel nuclear cleanup challenges in the EM portfolio. Technological breakthroughs can and have reduced costs and improved the safety and efficiency of cleanup, however, the technology budget within EM has waned significantly over the past two decades.⁹ In 2014, the Obama Administration's Secretary of Energy Advisory Board recommended that ARPA-E house such a program, which, in addition to being focused on solving high-impact energy technology problems, also has the advantage of being outside the bureaucratic culture that has overcome EM.¹⁰

Integrate Market Principles into Spent Nuclear Fuel Policy. The 1982 Nuclear Waste Policy Act (NWPA) established a national policy for disposal of spent nuclear fuel from commercial nuclear power plants.¹¹ The big picture objective of the NWPA is to require operators of civilian nuclear reactors to be responsible for the *costs* of waste disposal through a nuclear waste fee, but to make the DOE responsible for actual *siting, construction, transportation, and operation* of disposal facilities.

This policy framework created a massive market distortion by removing responsibility from reactor operators for the disposal of their spent nuclear fuel.¹² Government management has only directed energy toward political maneuvering, and removed incentives for the nuclear industry to explore ways to reuse spent fuel and create less. That distortion has compounded in the decades since then through legal, contractual, and financial commitments under the NWPA among reactor operators, the DOE, Congress, and the courts.

Perhaps the single best policy change that Congress can make to benefit both existing nuclear power plants and future advanced reactors is to address the NWPA's market distortion with an economic solution that

works with—not against—the incentives of the parties involved. This model is having success in Finland and Sweden, where reactor operators are leading the world in repository siting and construction under the regulatory oversight of the government.

The 1982 Nuclear Waste Policy Act created a massive market distortion by removing responsibility from reactor operators to dispose of their spent nuclear fuel.

Further, properly aligning responsibilities with incentives cannot help but drive innovation and demand through the entire fuel cycle. Spent nuclear fuel has a potentially large value proposition; a market-based waste management policy would direct the nuclear industry and entrepreneurs toward leveraging the economic value of solving the nuclear waste problem. For example, advanced nuclear reactors offer interesting answers to nuclear waste management, as some are designed to produce less waste, or to use waste as fuel.

While challenging, Congress should transition waste management from the DOE to a private entity. This transition should include:

- **Completing the NRC review of a proposed repository at Yucca Mountain**, for which Congress should appropriate the necessary funds *and no more*.
- **Tying interim storage to reform.** Interim storage can help or hurt the necessary transition. While interim storage at reactor sites already is, and can continue to be, a useful part of the spent nuclear fuel management process, Congress should not appropriate funds for a DOE interim storage site without tying significant market-based policy changes to such an appropriation. Interim storage alone is counterproductive to reaching a sustainable and confident waste management policy.¹³
- **Implementing waste-disposal-financing reforms for future commercial nuclear reactors.** Under the NWPA, nuclear operators must enter into contracts with the DOE in order for the DOE to collect, take title to, and dispose of spent nuclear fuel, for which the DOE charges

a fee per megawatt-hour of generated power (the nuclear waste fee).¹⁴ However, the DOE has not collected the nuclear waste fee since May 2014, as required by the courts due to failure to justify the fee in the absence of a defensible disposal program.

Even as Congress deliberates broader waste management policy, it should modify and implement a recommendation by the Obama Administration's 2012 Blue Ribbon Commission on Nuclear Waste directing nuclear operators to set aside funds for waste disposal in private escrow accounts.¹⁵ New nuclear power plants should use these accounts to finance their waste management and disposal, though this could also be expanded to include waste produced by existing reactors since May 2014. The nuclear waste fee should not be reintroduced without accompanying comprehensive policy, updated lifecycle program cost estimates, and market-based reforms to tie the fee to private escrow accounts and the actual value of defined DOE waste management services. Congress should also amend § 302(b) of the NWPA to state that new reactors do not need a contract with the DOE for waste management as a condition of receiving an operating license from the NRC.

- **Regularly reporting liability totals and changes to Congress.** The DOE should annually report to Congress the costs of nuclear waste management (or lack thereof), including cumulative projected costs to store, manage, transport, and dispose of nuclear waste, as well as annual and cumulative payments for failing to manage waste. The DOE should also record the amounts spent to reduce future liabilities to nuclear power plants under contract with the DOE.¹⁶

Regulation

The public looks to the government for reliable, accurate information and regulation of nuclear activities. When government overstates risk or “gold-plates” solutions to give the impression of safety, it is not protecting the public and, in fact, can cause the opposite effect. Regulatory ratcheting and a patchwork of standards over the years have led to standards that are far beyond those for other industries in some areas. Such a regulatory posture has also hampered legitimate activities and innovation. The promise of viable advanced reactors has helped to open a productive bipartisan conversation on regulatory reform, which should be continued to better serve the public with efficient regulations rooted in evidence. Congress should:

Streamline Implementation of the National Environmental Policy Act (NEPA). The federal government’s NEPA review processes impose excessive costs in human, financial, and time resources that have not equated to commensurate or substantially improved environmental outcomes. NEPA assessments have ballooned over the past several decades, as noted by Administrations of both parties.

For example, environmental reviews for nuclear reactor projects can now take as long as, or longer, than the NRC’s technical safety evaluation reviews.¹⁷ In the case of the NRC’s environmental impact statement for the only reactors currently being built in the U.S.—Vogtle 3 and 4 in Georgia—the NEPA review included an evaluation of more than 10 different technologies other than nuclear power as “reasonable alternatives,”¹⁸ even though the reactors were to be sited on an existing, operating nuclear power facility. The uranium mining industry has also faced significant delays because of NEPA. Environmental review takes longer in the U.S. than in any of the other top 25 mining countries.¹⁹ In contrast, environmental permitting takes on average two years in Canada and Australia, which are two of the three largest uranium suppliers to the U.S.²⁰

Even without sweeping NEPA reform or repeal, as many on the political left strongly oppose, there are significant improvements that can be made to NEPA reviews without compromising on environmental quality. A discussion draft of the proposed American Nuclear Infrastructure Act (ANIA) of 2020 included promising NEPA implementation reforms, such as requiring the NRC to use existing information “to the maximum extent practicable” when reviewing permit and license applications for additional nuclear facilities located on current nuclear facilities.²¹

Congress should require agencies to produce more rational, efficient reviews that focus resources on pertinent safety and environmental issues, not on exhaustive compliance for little benefit to the public.

Reforms already made to highway and transit projects should be made to all projects under NEPA review, most notably reforms to decrease the window for judicial review of federal approvals from six years to 150 days. Though objectors can play an important oversight role, 150 days is, itself,

generous compared to the one month afforded in, for example, Germany. Congress should require agency reforms to produce more rational, efficient reviews that focus resources on the pertinent safety and environmental issues rather than exhaustive compliance for little commensurate benefit to the public. Durable reform must come from Congress, as reforms by presidential Administrations of both parties have failed to endure.

Expand on Reforms to the NRC's Cost-Recovery Structure. The **Nuclear Energy Innovation and Modernization Act (NEIMA)** moderately improved both transparency and how the NRC recovers roughly 90 percent of its annual budget through fees on the nuclear industry.²² The burden of NRC fees on individual nuclear power plants had been growing as other nuclear plants closed. Further, the NRC did not have an incentive to develop regulations for new reactor technologies, given that the licensees covering most of the NRC's budget were utilities operating with existing technology under existing regulatory frameworks. NEIMA capped aspects of the fee and removed some additional NRC activities (such as developing advanced reactor regulations) from the industry's required fees.

Congress should build on reforms by exempting all program, administrative, and rulemaking costs that are not specific to an individual, identifiable licensee from the annual NRC fee. Americans have decided that it is an appropriate function of the federal government to regulate nuclear energy and should accordingly bear those costs as taxpayers.

The Administration should:

Re-Evaluate Federal Radiation-Exposure Regulations. Radiation-exposure standards affect a wide variety of nuclear activities, among them the licensing and siting of research, medical, and commercial power reactors; emergency planning and response; food safety; medical procedures; nuclear waste management and disposal; and cleanup of EM sites.

Yet federal standards have lagged woefully behind advances in scientific understanding of the effects of low-level radiation, and are inconsistent across the federal government.²³ For example, the NRC requires licensees to reduce radiation exposure "as low as is reasonably achievable" (ALARA) beyond their own standards.²⁴ And, as the Government Accountability Office concluded in 2000,

EPA- and NRC-preferred protection levels...are both well below the range where radiation effects have been conclusively verified. In this regard, the disagreement [over adequate standards] essentially involves policy judgments—not strictly scientific judgments.²⁵

The public looks to the federal government as a source of reliable, accurate information about radiation. Excessively conservative standards have increased cost and complexity of nuclear energy activities for little or no public health and safety benefit. When government overstates radiological risk, it is not protecting the public and in fact can encourage decisions that are harmful to both people and the environment. This happened, for example, with the over-evacuations around Three Mile Island and Fukushima.²⁶

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There have been several positive changes toward evidence-based regulations in the federal government recently, including the DOE's clarification of the definition of high-level waste and the NRC's effort to develop new emergency planning regulations for advanced reactors.²⁷ Congress and the Administration should encourage these changes and others like it across the federal government. An important part of this work is continuing to support the DOE's Low Dose Radiation Research Program to better inform decision-making and help to educate the public.

Finalize Regulations for Scalable Emergency Planning Zones. Emergency-planning-zone (EPZ) regulations help to define the thresholds for action and establish relationships among reactor operators, the NRC, local and state governments, and residents in an emergency where the public could be exposed to radiation. Existing EPZ regulations have changed little since the joint NRC/EPA Task Force was established in 1978 to develop the first standards, which use a roughly 10-mile plume-exposure pathway and a 50-mile ingestion-exposure pathway according to the spectrum of possible accidents from existing light-water-reactor (LWR) technology at the time.²⁸

In 2020, the NRC proposed new optional EPZ regulations for advanced and small modular reactors, allowing an EPZ to be scaled according to a reactor's radiological risks. Rather than arbitrary mileage standards, the NRC has proposed a bright-line objective that "public dose does not exceed 10mSv (1 rem) TEDE [total effective dose equivalent] over 96

hours,” from which “planning [is] commensurate with the radiological risk” of specific technologies. This standard aligns with the EPA’s most conservative threshold for early action under its Protective Action Guides (for which the EPA recommends actions like sheltering in place on a high-pollution day).²⁹ A radiation dose of 10mSv is equivalent to an abdominal or pelvic CT scan.³⁰

The existing mileage-based EPZ standard is not what should be sacred to emergency preparedness and response, but rather the objective of radiation dose reduction to which the public is exposed. This is important for both adequate safety standards, and for the future of the industry, as it incentivizes nuclear companies to innovate toward qualitative outcomes rather than mere compliance. The NRC’s proposed bright-line objective would be a very good step toward well-reasoned, evidence-based regulation of nuclear power plants. It should be finalized and extended to existing LWR reactors.

Keep Regulatory Reform and Part 53 on Track. The NRC has begun developing an optional “technology-inclusive regulatory framework” for commercial advanced reactor license applications, as required in the NEIMA.³¹ In October 2020, the NRC commissioners approved a plan to develop and finalize this regulatory scheme by 2024 under a new Part 53 of the Code of Federal Regulations.³² While NEIMA requires regulations by 2027, Congress has authorized appropriations through 2024 and already appropriated nearly \$40 million.³³

Part 53 offers an opportunity to rethink regulation of nuclear reactors holistically. Existing regulations to license a reactor (under Parts 50 and 52) were developed over time and consist of a patchwork of prescriptive standards tailored to LWR technology. They are ill-suited to advanced reactor technologies, which differ from LWR technology in a number of ways, including size, coolant, fuel, risk profile, nonproliferation issues, and waste production.³⁴ Even for existing LWR technology, regulations are arguably too focused on compliance with prescriptive technical design features and processes to achieve public health and safety. Regulations are also costly, with costs to license a reactor reaching \$500 million.³⁵

The NRC has proposed to develop performance-based, technology-inclusive, risk-informed, and consequence-oriented regulations for Part 53 and has already made strides in related work, such as its recent proposed rule for advanced reactor emergency planning. The NRC must be careful to think transformationally about Part 53, so as to avoid producing just another set of standards that are inappropriate for new technology, and inconsistent or irrelevant³⁶ to the actual operation of a reactor.

In order to address the intent of NEIMA, the NRC should:

- **Reject a minimalist view of risk.** Part 53 is to “continue to provide reasonable assurance of adequate protection of public health and safety and the common defense and security.”³⁷ This is distinctly different from aiming to “protect health and *minimize* danger to life or property *to at least the same degree of protection* as required for current-generation light water reactors.”³⁸ (Emphases added.) The latter approach is not rooted in scientific evidence, and results in misguided principles, such as ALARA. Some have argued that such regulations are nevertheless necessary to address the public’s perceived threat from radiation and nuclear activities—that the public must not only be safe, but feel safe. If doctors treated their patients according to the patients’ perceived threats, doctors would be sued for malpractice. Similarly, when government exaggerates the risks of nuclear activities through excessive regulatory requirements, it is not protecting the public. NRC standards under Part 53 should be grounded in health and safety outcomes based on evidence and stay true to the objective of being performance-based, risk-informed, and consequence-oriented.
- **Remain focused on top-level objectives and outcomes as much as possible.** Where the NRC must be more prescriptive in equipment requirements, the NRC should refer to nationally and internationally recognized third-party certifications, standards, and generally available commercial equipment to the greatest extent possible. Similarly, the NRC has anticipated using technology-specific regulatory guidance as needed in addition to the Part 53 regulations. While this may turn out to be the best approach, regulatory guidance should not lose focus of the clear purpose of NEIMA to reduce undue regulatory burdens.
- **Consider a re-evaluation of Part 53 after a certain number of years or reviewed applications.** Drafting an entirely new licensing regulatory regime is a big undertaking and it may take time and use to know if Part 53 is successful. A comprehensive re-evaluation planned at the outset could provide a useful opportunity to remove or adjust requirements that prove irrelevant in practice, and help to prevent a patchwork of requirements from developing over time.

- **Consider options and alternatives to regulation regarding Price–Anderson liability coverage.** If the safety case for advanced reactors is as strong as proponents claim, there should be commensurate changes or alternatives to how the NRC regulates them under the Price–Anderson Nuclear Industries Indemnity Act of 1957. (For more information, see the section “Financing and Insuring Reactors” below.)
- **Incorporate learnings while not detracting from existing applications.** The NRC is able to license advanced reactors under existing regulations and exemption processes. NuScale’s SMR achieved design approval from the NRC in August 2020 under Part 52. Privately funded Oklo submitted a combined license application for its micro-reactor under a modified approach to Part 52 in March 2020, marking the first non-LWR commercial reactor application to the NRC. Seven other companies have been in the NRC’s pre-application process for the past several years.³⁹ It will be years before Part 53 is finalized, and Part 53 drafting should not detract the NRC’s attention from these ongoing applications. The NRC should also regularly incorporate lessons learned from these applications into Part 53.

Similarly, Congress should engage in regular oversight to encourage the NRC’s efforts, and make legislative changes where necessary. One important legislative change Congress should make is to:

- **Amend § 302(b) of the Nuclear Waste Policy Act** to clarify that new reactors do not need a contract with the DOE to transport and dispose of spent fuel as a condition of receiving an operating license from the NRC.

Trade

Likely the biggest market for nuclear energy is overseas, given growing electricity demand in the developing world.⁴⁰ According to the BP Statistical Review of World Energy, the growth rate for nuclear power consumption in non–Organization for Economic Co-operation and Development countries has outpaced the rest of the world in the past 10 years.⁴¹ There are currently 443 commercial nuclear power reactors operating globally, with another 55 under construction and 100 planned, particularly in China, India, and Russia.⁴² It is commonly understood that the U.S. has lost dominance in

global commercial nuclear energy trade over the past several decades as companies from other countries—notably France, Russia, South Korea, and, increasingly, China—are exporting reactor technology.⁴³ These countries have offered services with which American companies have found it difficult to compete, among them completing reactor builds on time and budget, and turnkey options to build, operate, and decommission reactors along with spent fuel removal.

It is not the role of the U.S. government and taxpayers to do the job of industry. As Walter Lohman, Director of The Heritage Foundation’s Asian Studies Center, notes, “America’s strength lies not in how much taxpayer (and bond holder) money it can promise, but how well it can harness the advantages of its educational and research institutions, its deep markets, and the ingenuity of its people.”⁴⁴ It is for this reason that the diversity of advanced reactor innovation in the U.S. is unparalleled. While the nuclear industry must supply a compelling product that meets customer needs abroad, the federal government should remove misguided barriers to trade that remove American companies from consideration. Congress and the Administration should:

Explore Ways to Collaborate Further with Europe, Canada, Japan, South Korea, Australia, and India. Congress, the Administration, and U.S. nuclear industry should explore ways to further work with like-minded countries with robust nuclear sectors to meet needs through the entire fuel cycle. There are scores of examples where collaboration has been fruitful, among them: collaboration between the NRC and the Canadian Nuclear Safety Commission to develop advanced reactor regulatory frameworks;⁴⁵ collaboration between the NRC and the Urenco enrichment plant in New Mexico whose parent company is jointly owned by Germany, the Netherlands, and the U.K.; and access to research facilities for ongoing development of new reactor technologies.

Strong and prosperous civilian nuclear industries, manufacturing, supply chains, and R&D amongst allies and friends are complimentary to U.S. strategic interests, nonproliferation objectives, and commercial nuclear industry. Far too often, however, trade is viewed as a threat (as in the 2018 attempt to set national security tariffs and quotas on uranium imports, or the Nuclear Energy Leadership Act), where a vague notion of “economic security” is equated with national security.

The U.S. should explore further opportunities for collaboration on issues like joint bids for new reactor projects, how mutual defense treaties could augment nuclear fuel enrichment capabilities, pushing for and offering transparency in financing reactor projects, and nuclear waste management.

Protectionism aimed at America's allies has proved detrimental to the nuclear industry in America.⁴⁶ Collaboration with friends and allies that are committed to political and economic freedom and to nonproliferation is a critical alternative in international nuclear energy markets.

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Maintain a Flexible, Proactive Approach to Section 123 Agreements, and Continue to Engage with the Middle East and India.

Section 123 of the Atomic Energy Act establishes the long-term nonproliferation conditions for civilian nuclear trade with partner countries. Completing 123 agreements opens new markets for American companies and secures a level of agreement that can help integration of nonproliferation objectives, participation in institutions like the IAEA, and transparency at the outset of a partner country's nuclear energy program. A 123 agreement is just one among a variety of nonproliferation tools available to the U.S. government.⁴⁷

Some in Congress have advocated for "gold standard" 123 agreements requiring partner countries to forswear enrichment and reprocessing. However, such a demand has proved counterproductive even among American allies with strong nonproliferation track records.⁴⁸ Presidents of both political parties have wisely and consistently defended a case-by-case approach in order to negotiate the highest nonproliferation standards possible in light of the nine minimum criteria already required by Congress for 123 agreements.⁴⁹ Maintaining this flexible approach is a defensible position from which to engage in future 123 agreements, particularly in the Middle East where negotiations with Saudi Arabia remain unfinished, and 123 agreements with Egypt and South Africa are soon to expire.⁵⁰

The U.S. should also continue to build upon the ground laid in the 2008 U.S.–India 123 agreement to better foster mutual trade and innovation of nuclear energy technologies, and to normalize India's participation in global nuclear energy supply chains.⁵¹

Collaborate Proactively with Other Nations and Leverage Government-to-Government Training. The U.S. government plays an important role in advocacy and in convening relevant people, the National Laboratories, regulatory bodies, and companies to encourage commercial nuclear trade and collaboration. This is especially so given the highly regulated nature of nuclear energy trade and increased interest by countries without existing nuclear regulatory programs.

The State Department's 2019 "New Approach to Civil Nuclear Cooperation Agreements" was a positive step in fostering such cooperation.⁵² The DOE and State Department should boldly continue to communicate the message to potential trading partners that working with American nuclear companies offers not just mutual economic benefits, but also transparency and freedom from political manipulation. It is a great strength that companies in the U.S. are privately owned and cannot wield the power of government to force action on the part of their customers outside the bounds of agreed contracts. This stands in stark contrast to nuclear power companies in Russia and China, which are outposts of their governments with questionable commitments to transparent business practices and political freedom. America's freedom of enterprise is one of its greatest selling points.

Diplomatic tools, such as memoranda of understanding to foster collaboration, do not replace 123 agreements, which create real opportunity for trade; however, they are useful for convening governments. Another tool proposed by ANIA is to authorize the NRC to proactively help countries develop their regulatory bodies with exchange programs and regulatory training. Doing so would advance the strategic interests of the U.S. to support peaceful uses of nuclear energy, and better mobilize some of America's greatest exports. The U.S. still boasts some of the best nuclear energy university and professional training programs, and among the most important nuclear exports the U.S. can offer are its superior regulatory, safety, and operations standards.

American companies and experts also offer valuable knowledge and experience to address challenges like cybersecurity, physical and material security, and emergency preparedness between the public and private sectors. A strategically and proactively engaged NRC can help partner countries integrate effective safety standards, transparency and accountability, and nonproliferation measures, which is particularly beneficial at the outset of their programs. Doing so can also better position the U.S. and the NRC to again drive international norms for safe and peaceful uses of nuclear energy.

Hold Rogue Nations and Bad-Actor Countries and Individuals Accountable. The U.S. must maintain a firm commitment to hold bad actors accountable for irresponsible nuclear activities and trade conducted under the guise of a civilian nuclear industry. Illegitimate nuclear activities and toleration of them only destabilize efforts to foster peaceful, legitimate, and productive nuclear energy programs in neighboring countries.

Instead of focusing on burdensome export controls and regulations, the U.S. must hold bad actors accountable, as well as those who enable them.

Instead of focusing on adding to already burdensome export controls and regulations—which limit cooperation with friends and allies who share America’s commitments to nonproliferation and peaceful uses of nuclear energy—the U.S. must hold bad actors accountable, as well as those who enable them. This includes continuing to dismantle the misguided Joint Comprehensive Plan of Action, and enforcing maximum pressure sanctions on Iran, including secondary sanctions on its trading partners.⁵³

Present a United Front with Allies on Uranium Imports. The Trump Administration wisely rejected trade barriers on uranium imports, for which the mining industry petitioned in 2019 under Section 232 of the Trade Expansion Act. To the extent that there are legitimate, provable violations of international agreements by trading partners, the Office of the United States Trade Representative should file country-specific disputes through the World Trade Organization, an avenue through which the U.S. has had success.⁵⁴ This approach distinguishes bad actors from companies and countries that have competed in good faith to win American customers. In doing so, the U.S. should present a united front with allies, such as Australia and Canada.

Streamline the NRC’s and DOE’s International Activities. ANIA, as introduced in the past Congress, directed the NRC to more intentionally coordinate international-facing nuclear reactor regulatory activities within the NRC and with other executive branch agencies. Specifically, the bill required the NRC to coordinate all of its work on import and export licensing and on international regulatory cooperation, and to support coordination within the executive branch and with other countries for the consideration of international technical standards.

Intentional regulatory collaboration with other nations can improve the effectiveness of technical standards, particularly so where regulators are building expertise on new reactor technologies to develop new licensing requirements. The NRC is already collaborating with the Canadian Nuclear Safety Commission to develop advanced reactor regulatory frameworks, and should begin collaborating with other close allies, such as Great Britain.⁵⁵

The bill would begin to address a small part of a bigger ongoing regulatory problem that hampers the competitiveness of American companies in international markets. Regulation of exports of nuclear energy technologies and expertise is spread across the NRC, the DOE, Department of Commerce, State Department, and occasionally the Department of Defense. The potential for mixed or contradictory messages and requirements is high, and the approval processes for exporting U.S. technologies is burdensome and time consuming.

Further, review processes and interagency coordination have been notoriously slow. In the past three decades, the DOE and interagency review timelines for Part 810 authorizations to export nuclear services and technology ballooned from 150 days in the 1990s to an average of 400 days in 2017, though timelines appear to be improving.⁵⁶ ANIA includes positive reform both within the NRC and between agencies to reduce some of these conflicts. It should do similarly for all relevant export agencies.

Congress should also assess government-wide improvements across the export regulatory regime to eliminate inconsistencies in time for advanced reactors completing NRC licensing reviews and beginning to engage in international markets. Existing regulatory authority and frameworks have been built up since the 1950s through several re-organizations of the executive branch's nuclear activities and under very different political conditions in which the U.S. enjoyed a near-monopoly on nuclear energy technology and expertise. American nuclear companies should not have to navigate inefficient and unreliable export bureaucracy if it neither advances security and nonproliferation benefits, nor enables nuclear energy companies in the U.S. to be competitive abroad.

Research and Development, Demonstration, and Commercialization

The federal government has been too quick to do the work of private nuclear companies for them—to improve their product, acquire financing, mitigate the cost of nuclear energy through subsidies, and “de-risk” new technology without attending to the many associated negative consequences.

When the government plays market investor, it sends a powerful message to private investors that some technologies and companies are good investments while others are overly risky. Federal subsidies punish first-movers and innovators, while rewarding politically connected incumbents.

Nuclear energy innovation must be pursued in the larger reality of energy markets where actual customers—not the DOE—have needs, preferences, and choices.

Government intervention further obfuscates perhaps the most important question: Who is the customer and what is he looking for? Nuclear energy innovation must be pursued in the larger reality of energy markets where actual customers—not the DOE—have needs, preferences, and choices. Except where government itself is the direct customer, government efforts to create demand fall flat, because—as long as government incentives are not removed—business does not reflect *actual* customer needs, only artificial interest. Nuclear energy will not succeed if it is disconnected from customers. Congress should:

Remove Barriers to, and Reduce Costs of, R&D Through Competitive and Pro-Growth Tax Policy. Congress should make permanent the temporary measures in the Tax Cuts and Jobs Act that remove disincentives for companies to invest in infrastructure and innovation. Immediate expensing of short-lived assets, such as investments in machinery and tools, begins to phase out in 2022, and expensing of R&D investments expires at the end of 2021. Congress should make these provisions permanent, and expand them to include longer-lived investments in structures, such as new manufacturing space.⁵⁷

Support Access, But Eliminate Cronyism, in DOE R&D. Federal programs to support commercial reactor technologies should focus on increasing access to National Labs and on encouraging competition, not on supplanting competition. For example, the DOE's Gateway for Accelerated Innovation in Nuclear (GAIN) voucher program has improved private companies' access to National Lab facilities and personnel, and generally avoided the cronyism of more interventionist DOE programs by being widely available to companies.

In contrast, the DOE and Congress have created new barriers to entry with programs that are designed to narrow the field of advanced reactor technologies through federally funded and directed R&D and demonstration.⁵⁸

There are numerous problems with the DOE's interventionist approach.⁵⁹ Such intervention further distances industry from actual customer needs and interests in their effort to cater to DOE programs; disincentivizes cost discipline; and creates new hurdles for companies and technologies that are not selected (or choose not to participate) as part of the DOE reactor program. This is especially problematic when there is already investment by the private sector, as indeed there is in both existing and advanced nuclear technologies. It is not the constitutional role of the federal government to use taxpayer funds as venture capital, and there is also no surer way to limit growth in the nuclear industry to a privileged few that receive government subsidies.

The DOE and Congress should focus on improving access to National Lab infrastructure and addressing regulatory barriers for private companies to test reactor designs. However, if Congress is determined to spend taxpayer money to further subsidize the commercial nuclear industry, it should do so in the least harmful way. For example, rather than outright selecting companies to participate in government-funded demonstration reactor programs, Congress could implement reverse auctions or offer prizes for performance or successful demonstration of certain technological benchmarks. These approaches would at least better incentivize productivity, allow better technologies and business models to rise to the top, do a better job of protecting taxpayers, and prevent the government from implicitly down-selecting technologies and companies.

Keep Defense Reactor R&D Focused. Advanced nuclear technologies could meet unique defense needs, and there has been sustained interest in exploring those possibilities.⁶⁰ Specifically, the Defense Department's Strategic Capability Office (SCO) microreactor Pele Program has clear *potential* to advance strategic capabilities and battlefield objectives. But its use is not a foregone conclusion, such that SCO must maintain program discipline and Congress must maintain oversight through appropriations.⁶¹

The Departments of Defense and Homeland Security should not be used as stimulus programs, and procurement of energy and technology should clearly meet actual needs for defense capabilities. While Defense Department reactor programs will likely produce spin-off applications and benefits for the civilian commercial industry, the objective should never be inverted to subsidize private-sector desires.

Financing and Insuring Reactors

The economics of nuclear energy are integral to whether it remains a compelling energy choice for Americans in the future. Capital costs have traditionally

been the largest expense in building a nuclear power plant, consuming upwards of 80 percent of the total budget.⁶² Despite billions of dollars in government loan guarantees and tax credits, the price tag for the only two reactors currently being built in the U.S. has doubled since it began construction.⁶³

Customers have a variety of affordable options in a highly competitive energy market, and market pressure has been good for the nuclear industry. For example, in direct response to tough economic competition from low natural gas prices, the Nuclear Energy Institute organized nuclear power plant owners to find operating efficiencies that ultimately reduced costs by 19 percent, resulting in \$1.6 billion in savings.⁶⁴ Nuclear power plants in competitive markets aggressively reduced the amount of time spent offline for refueling and adopted efficiencies to increase production, which resulted in lower operating costs per megawatt-hour than rate-regulated monopoly counterparts.⁶⁵

Customers have a variety of affordable options in a highly competitive energy market, and market pressure has been good for the nuclear industry.

Undoubtedly, some nuclear electricity companies have not been able to endure market pressure, creating room for others to fill the void to the benefit of the customer.⁶⁶ As noted in the Massachusetts Institute for Technology's report, "The Future of Nuclear Energy in a Carbon-Constrained World," "[p]rivate companies must enjoy the potential for profit and also bear the risk of loss."⁶⁷

Subsidizing nuclear plants only calcifies existing industry and technology. Rather, the federal government, states, and the private sector should reform policies that unnecessarily limit competitive financial resources for nuclear energy companies and their customers, while protecting the taxpayer. Congress and the Administration should:

Leverage U.S. Membership in Financial and Investment Institutions to End Policies that Disqualify Nuclear Power from Consideration. Government lending institutions should be far more limited, if used at all. Taxpayer-backed financing injects many distortions into the market, among which are policies that prohibit consideration of nuclear power projects.⁶⁸ This needlessly creates controversy and barriers for nuclear technology companies seeking to attract private capital to finance construction of new reactors at home and abroad.

Encouragingly, the U.S. International Development Finance Corporation (DFC) updated its environmental policies to remove the “production of or trade in radioactive materials, including nuclear reactors and components thereof” from its list of Categorically Prohibited Projects.⁶⁹ Regardless of whether the DFC ultimately finances any nuclear power projects, the categorical change sends an important signal to other financial institutions that have yet to review implicit biases against, or outdated legacy prohibitions of, nuclear power. Similarly, as the World Bank’s largest shareholder, the United States should pressure the World Bank to re-examine its outdated prohibition of nuclear power projects since 1957, which is inconsistent with the bank’s own environmental and strategic missions.⁷⁰ Such a signal could help to further unlock private capital for nuclear power projects.

Similarly, private financial institutions should reconsider outdated or ill-informed environmental definitions and policies that exclude nuclear energy projects from consideration for investment.⁷¹ Nuclear power is consistent with environmental stewardship and, while all energy choices entail trade-offs, the environmental case for nuclear power is uniquely strong⁷² as attested to by entities like the Clean Energy Ministerial.

Revise and Clarify Foreign Ownership Restrictions. While certain investment from certain companies and countries may entail legitimate national security concerns, investment by longtime allies should be welcomed. However, Congress prohibits the NRC from granting licenses to nuclear facilities “owned, controlled, or dominated” by a foreign entity, or to an entity that “would be inimical to the common defense and security or to the health and safety of the public,” according to the Atomic Energy Act.⁷³ In practice, the NRC has taken a conservative interpretation of this otherwise vague foreign-ownership standard, while inconsistently taking a more lenient approach toward uranium mining and fuel fabrication and enrichment facilities.⁷⁴ Foreign-ownership restrictions have halted investment in civilian nuclear energy projects in Texas (by Japanese company, Toshiba)⁷⁵ and Maryland (by French company, Électricité de France),⁷⁶ among others in recent decades.

Congress should amend the Atomic Energy Act to allow the NRC to grant a license to companies under the jurisdiction of a government in NATO, Australia, Japan, or South Korea, provided the NRC determines that doing so is “not inimical to the common defense and security or the health and safety of the public.” At a minimum, the NRC should clarify guidance with a position on what level of ownership meets the Atomic Energy Act’s standard. Ideally, such guidance would follow the clear intent of the act to advance nonproliferation objectives while achieving energy goals. The NRC should separate the concepts of ownership, construction, and operation, and could

maintain a case-by-case approach that permits even complete foreign ownership, provided that national security interests are protected.

Reimagine Price–Anderson Liability Coverage and Regulatory Requirements. The Price–Anderson Nuclear Industries Indemnity Act of 1957 caps the liability of nuclear power operators, beyond which the President must petition Congress for funds to cover remaining claims in case of an accident.⁷⁷ Price–Anderson expires again in 2025, though it was always intended as a temporary program, and it can be reasonably argued that public liability contributes to both a moral hazard and over-regulation to compensate for it.⁷⁸

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After decades of innovation in both the nuclear and financial industries, the time is ripe for reform. According to Mark Tetley, former managing director of the Power, Nuclear & Construction division at Lloyd Bank’s insurance broker Price Forbes & Partners, “transferring the nuclear accident risk at its true scale to the insurance market is entirely feasible and well within the financial capability of the global market; it just needs some new thinking to enable this capacity to be utilized.”⁷⁹

Congress should consider offering an alternative in lieu of public liability coverage that requires nuclear operators to meet a minimum of NRC regulatory standards for an operating license if the licensee acquires complete insurance through a certified third party. Requiring nuclear operators to shoulder the burden of liability could further incentivize safe designs and operations as private insurers have strong financial incentives to assess and adequately hedge their risk. Indeed, if the safety case for advanced reactors is as strong as advertised, there is likewise no case for a public liability scheme. Minimum NRC licensing requirements in addition to full private insurance could include proof of a credible program for financing nuclear waste management and plant decommissioning, emergency planning, and what is necessary to satisfy nonproliferation and transparency commitments with the IAEA.

At a minimum, Congress should begin exploring alternatives to Price–Anderson liability coverage in advance of its expiration in 2025. While it might not be appropriate to alter conditions for existing reactors licensed under Price–Anderson significantly, Congress should develop a new framework for future nuclear reactors that protects taxpayers and further incentivizes safety and innovation in the nuclear and insurance industries.

Eliminate Bias in Federal and State Tax Codes. Congress should permanently eliminate preferential tax treatments for all energy sources and technologies, including preferential treatment for nuclear plants. Federal subsidies in the form of tax credits and direct payments implicitly raise barriers for other energy suppliers to compete, inject political boom-and-bust cycles into energy markets, and in the long run harm the industries they are intended to help.⁸⁰

States also have distorted energy markets with renewable energy mandates and subsidies.⁸¹ Ironically, while many of these financial and regulatory subsidies are intended as climate policy, these same policies discourage or ban⁸² nuclear power as a source of emissions-free electricity, with the counter-productive effect of contributing to early closures. For example, California’s renewable energy mandates have forced the uneconomic operation and ultimate closure of Diablo Canyon, a nuclear power plant responsible for generating 9 percent of power in California.⁸³

Federal, regional, and state policies should create an environment that reduces and eliminates ineffective regulations for existing power sources and new entry, and promotes fuel-neutral competition and consumer choice in the electricity sector.

Put Customers First and Reject Nuclear Bailouts. Bailouts of struggling nuclear power plants have been proposed in a variety of tax, surcharge, legislative, and regulatory measures at the state and federal levels, often under the alleged causes of promoting clean energy or reducing carbon-dioxide emissions. Regardless of the framing, the details of these programs have often revealed a narrowly prescribed subsidy for specific nuclear power plants without commensurate accountability or incentives to reduce costs.⁸⁴

If a particular nuclear power plant cannot compete in the market and threatens to close, policymakers should not be quick to craft a bailout, but should look for root causes. In some cases, that root cause has been state policy (as in the case with Diablo Canyon in California). In others, lobbyists have pursued state subsidies rather than consider how a variety of cost-saving exercises—including selling the power plant to new management—could right the ship. Even if the economic case leads to closure of a reactor, policymakers

must look to the bigger picture. As it relates to customers, the bigger picture is that bailouts force higher prices onto captive customers who must then suffer with an electricity sector that is more deeply riddled with cronyism. As it relates to the nuclear industry, the bigger picture is that it will not thrive if it cannot prove to customers that it offers compelling value. Bailouts reward incumbency rather than innovation in technology and efficiency—the exact opposite of a formula for growth and the long-term health of the nuclear industry.

Taxpayer-backed loan guarantees redistribute capital based on political interests instead of commercial viability, with the goal of helping politically favored companies.

For policymakers tempted by nuclear bailouts in their desire to reduce carbon-dioxide emissions, they should consider how competition in the electricity sector helps the environment.⁸⁵ Competition gives customers more choices, who are increasingly interested in “green” energy options and are always interested in reducing their expenses if given the freedom to make informed decisions. At the same time, competition forces companies to be efficient and innovative—an inherently pro-environment feature—unlike a government-protected monopoly that can ride on political goodwill.

Protect Taxpayers and Remove Remaining DOE Loan Guarantee Authority. The Title 17 Innovative Energy Loan Guarantee Program administered by the DOE has \$10.9 billion remaining in loan guarantee authority for advanced nuclear reactors.⁸⁶ An additional amount of up to \$12 billion is available to the two nuclear reactors being built at Vogtle nuclear power station in Georgia.⁸⁷ Such subsidies have tied nuclear energy investment and innovation to political whims, and at best muddled smart business decisions at great expense to captive electricity customers in Georgia.

Shifting the financial risk of energy projects through taxpayer-backed loan guarantees steers private investments away from other projects that may not have the DOE’s blessing but have more commercial promise. The federal government is quite literally redistributing capital based on political interests instead of commercial viability, in hopes of helping politically favored companies to succeed. Since this does nothing to change the fundamentals of a company or technology, it will have no impact on a company’s ultimate

success. It also puts taxpayers at undue risk to cover costs when political goals get ahead of the more important duty to use taxpayer dollars responsibly. Congress should rescind the remaining loan guarantee authority.

Conclusion

One of the diverse U.S. nuclear industry's strengths is that it is largely privately owned, and it is for this reason that the nuclear innovation in the U.S. is unparalleled. American nuclear companies could have much to offer in a world where hundreds of millions of people are still without access to electricity, and where some competitors in the field have questionable commitment to transparent business practices and political freedom. America's freedom of enterprise is one of its greatest selling points. Rather than doing the work of industry, Congress and the Administration would provide leadership toward a strong future for the nuclear industry by addressing underlying policy problems.

The recommendations in this *Background*, while far from exhaustive, take a wide view of civilian nuclear energy policy reform. The nuclear energy sector and its current or potential customers are highly diverse, encompassing far more than the large utilities operating nuclear power plants that often come to mind. Rather than focusing narrowly on how to extend government largesse to one sector or another, these recommendations are about protecting taxpayers, creating a better environment for innovation, reducing regulatory barriers that harm competitiveness, and focusing the federal government on issues that are uniquely its responsibility.

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