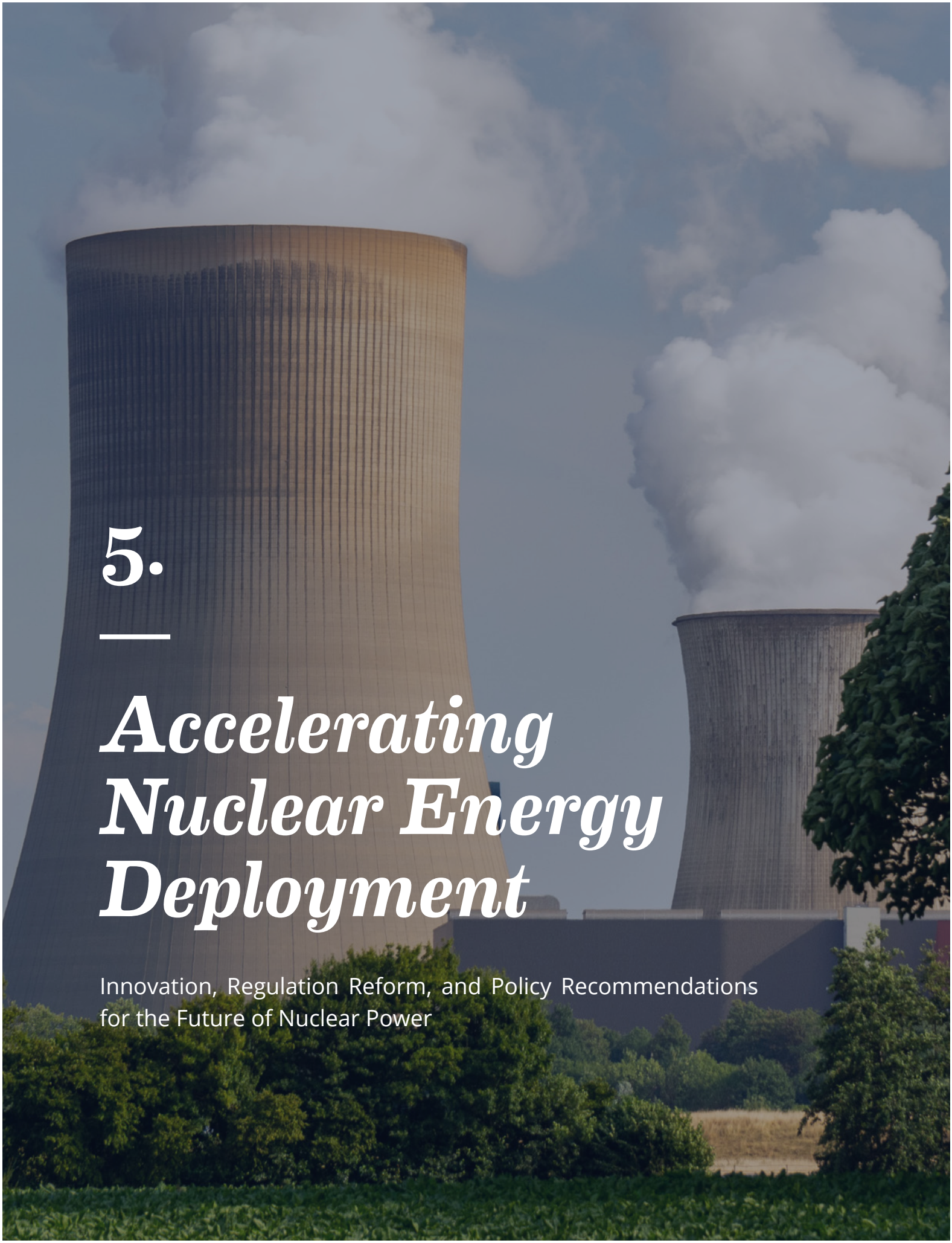

5.

Accelerating Nuclear Energy Deployment

Innovation, Regulation Reform, and Policy Recommendations for the Future of Nuclear Power

NUCLEAR ENERGY OVERVIEW

Key Takeaways:

- Nuclear power is safe, reliable, and the world's second-largest source of carbon-free electricity.
- Innovative companies are paving the way for the next generation of nuclear power plants.
- Modernizing regulations will accelerate the deployment of nuclear energy in the United States, and opening markets will encourage the safe deployment of emissions-free nuclear power around the world.

This comprehensive analysis explores the current state and future potential of nuclear power, emphasizing its safety, reliability, and capacity for considerable expansion. It also examines various innovative technologies in advanced reactor designs, the potential of small modular reactors (SMRs), and unique applications like recycling spent nuclear fuel. The report highlights a significant barrier to nuclear power expansion, namely outdated and cumbersome regulations, which, if modernized, could accelerate the deployment of nuclear energy. The document concludes with a robust set of policy recommendations aimed at streamlining permitting, modernizing radiation standards, adopting consent-based nuclear waste siting strategies, and encouraging more efficient and equitable licensing processes. This multifaceted approach is presented as a way to facilitate the growth of the nuclear power industry, fulfilling its promise to provide clean, affordable, and safe energy on a global scale.

THE POTENTIAL FOR NUCLEAR TO SUPPLY CLEAN, AFFORDABLE POWER

Nuclear power is the second largest emissions-free source of electricity in the world, after hydropower. With 435 reactors (and 58 more reactors under construction across 50 countries), nuclear provides about 10 percent of the world's power.[1] In the United States, 94 reactors in 28 states generate approximately 20 percent of the country's electricity and about half of the country's emissions-free electricity.[2] In addition to commercial nuclear plants that provide electricity, "there are about 220 research reactors operating in over 50 countries, with more under construction. As well as being used for research and training, many of these reactors produce medical and industrial isotopes."[3]

In the U.S., support for nuclear power is the highest it has been in a decade, with 55 percent of adults strongly or somewhat favoring the energy source.

Nuclear power has significant potential to meet the world's energy needs and climate goals. Innovative companies are paving the way for the next generation of nuclear power plants that are designed to pose even fewer public safety or proliferation risks than the ones that are currently operating. In fact, nuclear is already among the safest forms of energy that exists today. Nuclear power is responsible for only 0.03 deaths per terawatt-hour of electricity produced, making it the second-safest form of energy behind solar power.[4]

The vast majority (90%) of waste from nuclear power plants consists of lightly-contaminated items such as tools or workers clothing and only contains 1% of total radioactivity. Spent nuclear fuel is responsible for 3% of the total volume of waste, but holds 95% of the total radioactivity.[5] Spent nuclear fuel is safely stored onsite in dry or wet storage. In total, all of the spent nuclear fuel since the 1950s would cover a full football field at a height of less than three stories.[6] There have been no recorded deaths from nuclear energy waste and the radiation of a nuclear waste depository is 50 times smaller than the average radiation of our natural background.[7] In fact, the Netherlands' COVRA nuclear waste facility doubles as an art museum and provides field trips to schoolchildren to teach them about the safety of the nuclear energy industry.[8]

Different technologies, including advanced water-cooled reactors, molten-salt reactors, and fusion reactors, could improve upon an already-safe nuclear industry. Another technology is sodium cooled reactors— which are being deployed by TerraPower at the site of a retired coal plant in Kemmerer, Wyoming and could power 400,000 homes.[9] Advanced nuclear reactors, whether they are small modular reactors (SMRs) or microreactors, offer several potential advantages to complement the large (1,000 megawatt) light-water fleet of reactors that exist in the United States today. Smaller reactors have lower upfront capital costs, can be built in remote areas or underground, and have smaller (and in some cases nonexistent) waste streams.[10]

Some small reactor designs, such as Oklo's 1.5-megawatt reactor, are micro-reactors.[11] It would use spent nuclear fuel as an energy source[12], Oklo is partnering with two Department of Energy national laboratories (Argonne and Idaho) and Deep Isolation for an advanced fuel recycling demonstration project. The facility "will enable Oklo to convert nuclear waste from existing used nuclear fuel into clean energy, as well as to recycle fuel from Oklo's plants, allowing for a dramatic cost reduction and solving for a key supply chain need."[13]

In January 2023, the Nuclear Regulatory Commission (NRC) certified NuScale's small modular reactor (SMR) design, making it the first design to receive approval in the United States.[14] This ruling is significant, as it will allow companies to reference NuScale's SMR design when applying for a license from the NRC which will speed up the licensure process. NuScale has also signed memorandums of understanding with Poland[15] and Romania[16] to deploy its SMR to these European nations. While domestic certification approvals and DOE partnerships represent a significant milestone, they also represent an opportunity to learn and improve the process. NuScale's initial design certification application, for instance, consisted of 12,000 pages and 2 million pages of additional documents for regulatory audits.[17] While safety is a priority, NuScale's experience also speaks to the need for more efficiency and expediency in the regulatory process. NuScale spent half a billion dollars and over two million labor hours to get through the approval process.[18]

The aforementioned developments are a mere snippet of the innovation, investment, and deployment of nuclear power in the U.S. and around the world (For a more detailed picture, please see Third Way's advanced nuclear map).[19] With promising technologies and a global desire for emissions-free power sources, the future of nuclear energy is bright.

POLICY RECOMMENDATIONS

In the U.S., support for nuclear power is the highest it has been in a decade, with 55 percent of adults strongly or somewhat favoring the energy source.[20] Nuclear power will be critical to meeting domestic and international climate targets, but antiquated policies and regulations inhibit its progress. Congress and the administration should establish a flexible, technology-neutral framework to enable different nuclear energy technologies to compete in the marketplace. Whether it is research and development, licensing and permitting, or spent fuel management, policymakers should remove impediments to nuclear energy innovation, investment, and spent fuel management.

Nuclear power will be critical to meeting domestic and international climate targets, but antiquated policies and regulations inhibit its progress.

To promote nuclear innovation, cost reduction and deployment, policymakers and regulators should:

- **Streamline permitting for new reactor construction, whether for large light-water reactors, small modular reactors, or microreactors.** Specifically, Congress and the administration should:

    - Require the NRC to use prior environmental impact assessment and information "to the maximum extent possible" for permitting new plants at existing locations.

    - Use Environmental Assessments and Finding of No Significant Impact before conducting an EIS when applicable (more efficient designs and/or sited at brownfield locations).[21]

    - Adopt the process of allowing applicants to draft Environmental Impact Statements and Environmental Assessments (a process that is already accepted at the Federal Energy Regulatory Commission and Bureau of Land Management).[22]

    - Include nuclear power generation in categorical exclusions as part of Section 390 of the Energy Policy Act of 2005 for activities that are part of prior NEPA reviews or other regulatory actions that would qualify.

    - Narrowly tailor design and site alternatives under NEPA for demonstration projects connected to DOD facilities or national laboratories.

- **Modernize radiation standards.** Radiation standards vary across federal agencies and vary from international standards. The NRC requires that nuclear companies reduce radiation to a level "as low as is reasonably achievable," or ALARA.[23] The result is higher costs for no meaningful benefit and can disincentivize the development of innovative nuclear technologies. Transitioning to evidence-based regulations that comport with international standards would continue to protect public health and safety while creating a more competitive environment for reactor technologies.

- **Develop a modernized licensing process to better accommodate innovation.** In 2019, Congress directed the NRC to develop a new licensing framework for next generation nuclear technologies. In 2022, the NRC staff released its initial rulemaking, which is twice as long as prior frameworks. It mandates that advanced reactors "demonstrate that they have the same design elements required for large light water reactors," and retains ALARA radiation standards. While the ruling still has to be finalized, NRC Commissioners should direct staff to implement a framework that is technology-neutral and adopts a truly risk-informed radiation standard.

- **Appropriate funds for Low Dose Radiation Research.** Continued support for the Department of Energy's research on low dose radiation will support our understanding of radiation risk and should better inform evidence-based regulations surrounding radiation.

- **Adopt a strategy for consent based siting for nuclear waste.** As seen in the Yucca Mountain debate, successfully establishing a centralized and national location for the long-term disposal of nuclear waste will be hard to achieve if left to the political whims of elected officials. Instituting consent based siting can meet community needs and address their concerns while it incentivizes communities for spent fuel management and provides a long-term storage solution that breaks national political gridlock.

- **Continue to support and appropriate funds for federal research and development.** Research and development programs such as the Department of Energy's Advanced Reactor Demonstration Program and the Department of Defense's Project Pele, which funds the development of transportable microreactors to enhance the military's capabilities while ushering in a new generation of commercial reactors, have yielded several positive technological breakthroughs for nuclear power.

- **Produce an annual report about spent nuclear fuel and high-level radioactive waste in the U.S. including updating the amount of waste generated, the potential lifecycle costs of various spent fuel management options, and options for cost-effective solutions.** The study should also examine successful international models of spent fuel management and what it would take to implement a similar program in the U.S.

- **Amend the Nuclear Waste Policy Act to state that new reactors do not need to contract with the Department of Energy for waste management for an NRC license.** As Katie Tubb, formerly of The Heritage Foundation, writes, "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. New nuclear power plants should use these accounts to finance their waste management and disposal."

- **Shift application and safety costs to the federal government.** The provisions of nuclear safety are a public good and thus the costs should be borne by the taxpayer. Congress should appropriate money to extend cost-sharing on license applications or eliminate NRC licensing fees (which the NRC charged at $290 per hour per person in FY 2022) for all nuclear applicants. Further, Congress should appropriate money to the extent necessary to NRC for nuclear security and environmental safeguards at power plants.

- **Expand international cooperation on commercial nuclear power.** U.S. cooperation on commercial nuclear power will help expand the deployment of nuclear power, which will be critical in meeting future global energy demand and reducing global greenhouse gas emissions. Specifically, Congress should:

    - Require the NRC to coordinate and engage in nuclear import and export licensing, international cooperation, exchange programs and training with other countries, technical assistance, and other nuclear regulatory and legal frameworks (as stipulated by Section 101 of the American Nuclear Infrastructure Act).

    - Allow foreign ownership and investment by amending the Atomic Energy Act to allow the NRC to grant a license to companies under the jurisdiction of an allied government, such as a NATO member, Australia, Japan, or South Korea, as well as other countries in which the NRC determines there is no national security threat. As Tubb points out, "Foreign-ownership restrictions have halted investment in civilian nuclear energy projects in Texas (by Japanese company, Toshiba) and Maryland (by French company, Électricité de France), among others in recent decades."[24]

    - Ensure nuclear exports meet nonproliferation standards.

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