U.S. ENERGY AND CLIMATE ROADMAP · CHAPTER BRIEF

Restoring the Future of Nuclear Energy

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To successfully decarbonize its economy, the United States should incorporate the technology that is here, proven, and ready to deploy: nuclear energy. Modern nuclear plant designs are capable of ramping production up and down, making them an important complement to wind and solar energy. But policymakers should improve design, manufacturing and construction processes to lower the cost of building new facilities, confront market failures to improve overall cost competitiveness, and take steps to improve public trust in the technology's safety.

The Challenge

To decarbonize the electricity sector, the United States is increasing electricity generation from renewable resources. Grid operators and utilities, however, are more exposed to the risk of reductions or interruptions in supply as variable sources like wind and solar power grow. Today, operators largely manage that risk through contracts with fossil fuel plants that can ramp production up or down based on demand. If the United States is to pursue a decarbonized future, that option will not be available long-term. Carbon capture and storage (CCS) for fossil fuel plants or grid-scale battery storage for renewable generation could in principle help address the grid reliability challenge. However, CCS isn't technically ready or economically competitive enough for widespread deployment, while grid-scale battery storage cannot yet supply adequate backup for extreme shocks, such as those associated with severe weather including polar vortexes and extended heat waves. Nuclear power is the only technology available in all geographic locations that both does not generate greenhouse gases and—depending on design—can ramp up or down in response to changes in demand for short and long periods of time. It faces, however, substantial challenges: 1) the high initial cost of building new nuclear power plants, making the energy source uncompetitive compared to other sources; 2) the political stalemate over nuclear waste disposal; and, 3) public concerns about safety. If policymakers do not act, nuclear power in the United States will continue to decline—potentially to zero by midcentury—as plants reach the end of their operating licenses.

Policy Context

Longstanding federal support for nuclear energy began to wane in the 1980s in concert with public opposition following the Three Mile Island and Chernobyl nuclear plant accidents in 1979 and 1986. Meanwhile, public concerns about nuclear waste disposal have thwarted plans to open a used fuel repository in Yucca Mountain, Nevada for decades. While both Democratic and Republican administrations continued relatively modest research and development, mostly in the direction of new reactor designs, construction of new nuclear power plants

20%

NUCLEAR POWER'S CURRENT CONTRIBUTION TO THE ENERGY MIX

12%

NUCLEAR POWER'S EXPECTED CONTRIBUTION TO THE ENERGY MIX BY 2050

79%

SOLAR AND WIND'S EXPECTED CONTRIBUTION TO THE ENERGY MIX RESOURCES BY 2050

ceased almost entirely after 1996, leaving a twenty-year gap during which no new nuclear plants were put on-line. Not only has that resulted in an aging nuclear fleet, but also to a serious decay of U.S. industrial capacity to construct new nuclear power plants. Without concerted action now, the United States risks taking nuclear power off the table as a significant electric power source into the latter part of this century.

Recommendations

The United States can achieve a technologically plausible path towards complete decarbonization of its electricity sector by at least the end of this century, if not sooner, if the critical challenges facing nuclear power are addressed:

- **Improve design, manufacturing and construction processes to reduce the cost of building new nuclear plants.** The nuclear industry faces designs that do not account for modern manufacturing technology, broken or non-existent supply chains for important system components, and the lack of a sufficiently trained workforce. To address these issues, the Department of Energy (DOE) can strengthen its R&D programs in advanced reactor designs. At the same time, the Nuclear Regulatory Commission (NRC) and Federal Emergency Management Agency can revisit regulations governing the operations of these new reactor designs. The NRC should receive sufficient funding to develop and apply the technical capabilities to grant design and operating licenses for advanced nuclear plants, including small modular reactors. Finally, to help staff manufacturing facilities and build new reactors, DOE can strengthen its partnership with industry and the nation's technical colleges to train a new generation of nuclear workers focused on plant construction.
- **Make nuclear cost competitive by pricing all externalities in the power sector.** Without placing an appropriate price on carbon emissions and the costs of managing the intermittency of renewable sources (while continuing to subsidize sources like wind and solar), fossil fuels and renewables gain a cost advantage over nuclear. To confront this, 1) Congress could pass legislation pricing carbon emissions, 2) states issuing renewable energy credits could transition to clean energy standards and zero emissions credits (which incentivize all carbon-free electricity, including nuclear), and 3) state utility commissions could explicitly account for the costs of dealing with renewable power supply fluctuations.
- **Revive the sensible roadmap for resolving the nuclear waste problem outlined by the Blue Ribbon Commission on America's Nuclear Future in 2012**. The roadmap includes consolidating all interim nuclear waste storage and building a new nuclear waste repository, all predicated on a fully transparent, consent-based siting process. It also recommends establishing a new, federally chartered corporation to set standards, field public concerns, and take the handling of nuclear waste out of DOE's hands. Countries such as Canada, Finland and Sweden are already putting in place similar nuclear waste solutions that are focused on transparency and have eased public safety concerns.

MULTI-NATIONAL RESEARCH PROJECT

Global Nuclear Future Initiative

American Academy of Arts & Sciences

As more and more countries seek the benefits of nuclear energy to respond to fast-paced industrialization and urbanization, the nuclear proliferation, security, and safety risks increase exponentially. Robert Rosner is a co-chair of The Academy's Global Nuclear Future Initiative, which seeks to guide domestic and international policymakers trying to balance the pursuit of a national nuclear