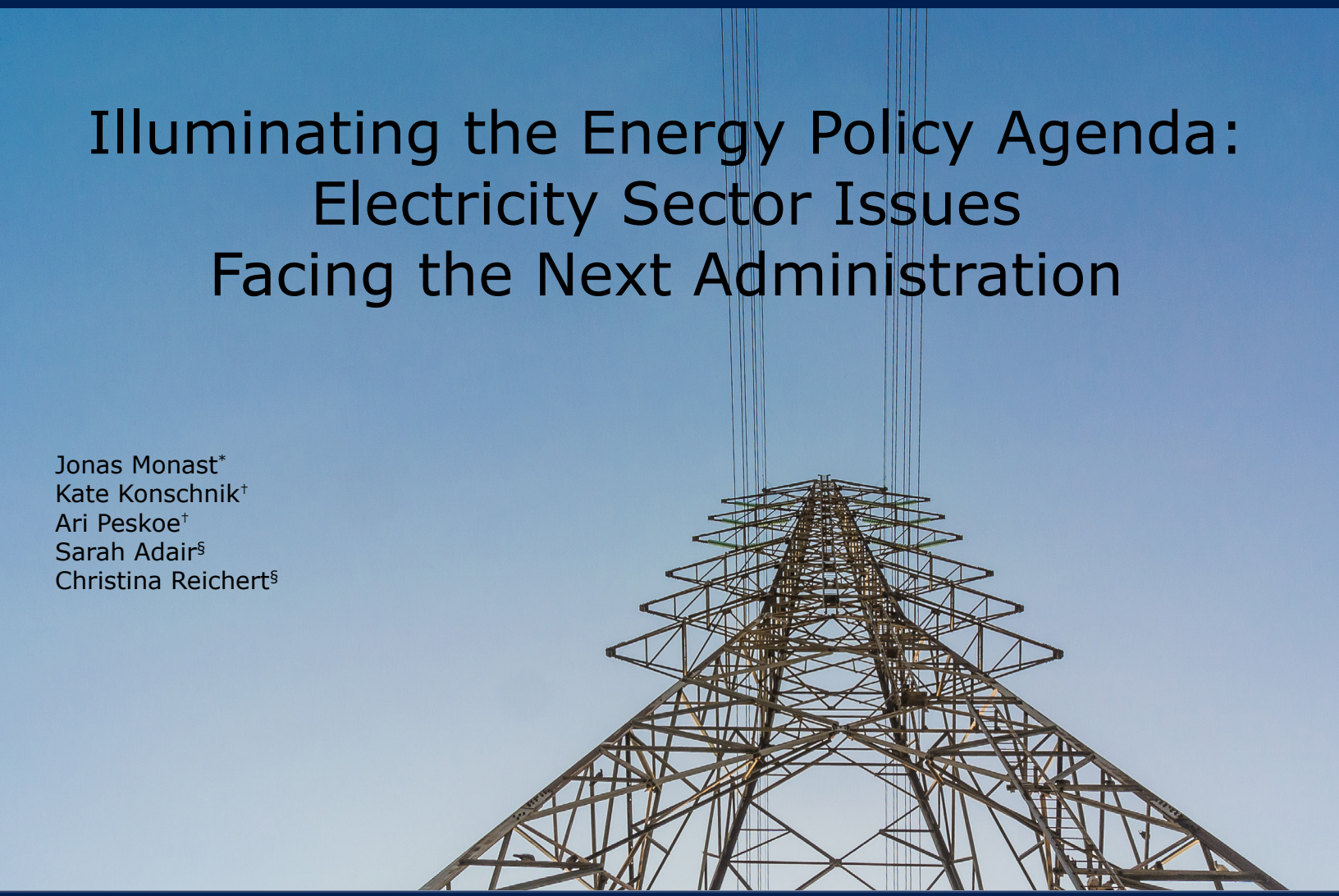
Illuminating the Energy Policy Agenda: Electricity Sector Issues Facing the Next Administration

Jonas Monast*
Kate Konschnik†
Ari Peskoe†
Sarah Adair§
Christina Reichert§



Part 3: Nuclear Energy

Duke NICHOLAS INSTITUTE FOR ENVIRONMENTAL POLICY SOLUTIONS
UNC CENTER FOR CLIMATE, ENERGY, ENVIRONMENT AND ECONOMICS
HARVARD LAW SCHOOL Environmental Law Program POLICY INITIATIVE

Report NI R 16-01

October 2016

CONTENTS

Affiliations
*University of North Carolina, Chapel Hill
†Harvard University
§Nicholas Institute for Environmental Policy Solutions, Duke University

Citation
Monast, Jonas, Kate Konschnik, Ari Peskoe, Sarah Adair, and Christina Reichert. 2016. *Illuminating the Energy Policy Agenda: Electricity Sector Issues Facing the Next Administration--Part 3: Nuclear Energy.* NI R 16-01. Durham, NC: Duke University. http://nicholasinstitute.duke.edu/publications.

Acknowledgments
The authors thank Ken Colburn, David Spence, and the participants of the July 25, 2016, Power Shift workshop for invaluable feedback on this paper. They also thank David Hoppock for comments on an early draft and Laura Appelt and Jamie Konopacky for research and editing assistance.

Review
The work reported in this publication benefited from review from experts in the field. The preliminary analysis was shared with external parties, and this publication reflects their feedback. However, this publication has not undergone a formal review process due to the timely nature of its contents.

SUMMARY

The next president will take office during a period of rapid market and regulatory change for the U.S. electricity sector. Due to statutory deadlines, pending lawsuits, and agency rulemakings—if not by choice—the next president will tackle energy policy. To prepare policy makers for what promises to be a dynamic period in electricity law and policy, this report provides an overview of six key areas of federal policy and, for each area, identifies the decision points—in time or circumstances—that will force the next administration to make choices that shape the future of the grid. For each decision point, the report explores the next president's options and the federal agencies and authorities that he or she could deploy.

Part 3 of this report explains that nuclear plants operating in Federal Energy Regulatory Commission-regulated regional transmission organizations are facing economic challenges due to low wholesale prices, which are contributing to a recent wave of nuclear unit retirements. The nation's nuclear fleet is aging and the Nuclear Regulatory Commission (NRC) will soon oversee the relicensing process for existing units that wish to operate beyond the terms of their current operating license. Nascent technologies promise lower costs, increased safety, and added flexibility but face their own set of regulatory and market challenges. Meanwhile, the U.S. Department of Energy has yet to site a permanent repository for nuclear waste nearly two decades after the Nuclear Waste Policy Act's goal of commencing operation in 1998.

NUCLEAR ENERGY

At a Glance

Federal Actors: Nuclear Regulatory Commission (NRC), U.S. Department of Energy (DOE), Federal Energy Regulatory Commission (FERC).

Appointments: The next president will have the opportunity to nominate at least three NRC commissioners.

Legal Authorities: The Atomic Energy Act, the Nuclear Waste Policy Act (NWPA), the Federal Power Act.

Decision Points:

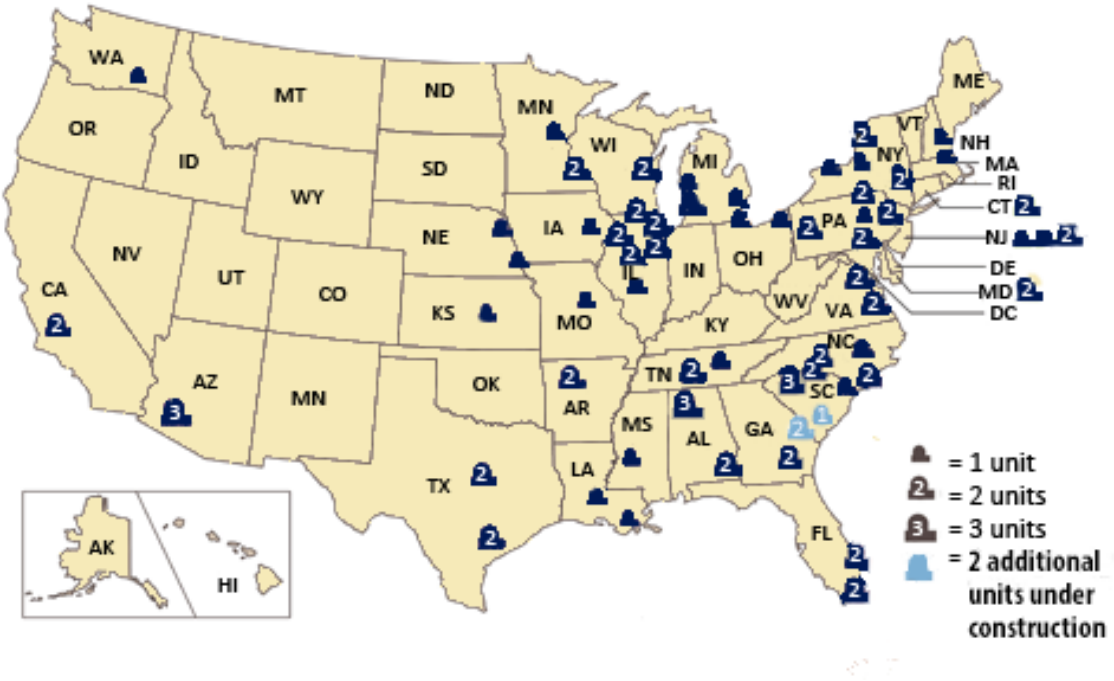
- Whether and how to use FERC's jurisdiction over interstate electricity markets to influence the economics of nuclear power plants or to accommodate or preempt state policies.
- How to prepare for and respond to the first applications to extend the life of existing nuclear units from 60 to 80 years.
- How to prepare for and respond to applications to construct and operate advanced nuclear technologies, including small modular reactors and non-light-water reactors.
- How to address nuclear waste in light of the Obama administration's attempt to abandon Yucca Mountain and move toward a consent-based siting process.

Nearly 60 years after the world's first full-scale nuclear power plant opened in Shippingport, Pennsylvania, the U.S. nuclear power industry is in flux. Nuclear plants operating in FERC-regulated RTOs are facing economic challenges due to low wholesale prices, which are contributing to a recent wave of retirements. The nation's nuclear fleet is aging and the Nuclear Regulatory Commission (NRC) will soon oversee the relicensing process for existing units that wish to operate beyond the terms of their current operating license. Nascent technologies promise lower costs, increased safety, and added flexibility but face their own set of regulatory and market challenges. Meanwhile, the DOE has yet to site a permanent repository for nuclear waste nearly two decades after the Nuclear Waste Policy Act's (NWPA) goal of commencing operation in 1998.[1]

Background

The first new reactor in two decades began operation in 2016. Four additional units are under construction in South Carolina and Georgia; all have faced significant delays and cost overruns.[2] No other new reactors will open in the near future. But if the Clean Power Plan proceeds, or other climate policies are deployed, the electricity sector would rely more heavily on zero-emission power plants. Federal policies could influence the role of nuclear and other technologies in meeting this need. Existing nuclear units currently provide more than 60% of carbon-free power in the United States.[3]

Figure 3. Commercial nuclear reactors



Source: NRC (Note image last updated November 2015).

Four nuclear power plants have retired since 2013, another five have announced plans to retire by 2019, and more are considered at risk of retirement.[4] Although several factors have contributed to plant closures, a number of retiring or at-risk plants are (1) located in RTO regions (see Figure 1) and (2) earning—or claim to be earning—insufficient revenue through wholesale markets to cover their operating costs. Low natural gas prices, federal tax credits for renewable energy, and relatively flat electricity demand have driven prices down in wholesale markets.[5] Nuclear power plants operating in RTO markets that are located in states that no longer regulate generation under cost-of-service ratemaking face direct competition from other electricity generators. Some observers argue that the retirements are a sign the markets are working—by discouraging ongoing operation of uneconomic plants in favor of more competitive generation—while others argue the retirements reflect flaws in the markets.[6]

Decision Points

NRC Appointments

The next president will have an opportunity to nominate at least three commissioners to the five-member NRC. Through their decisions about relicensing existing plants and permitting new advanced reactors, these new commissioners may shape the future of the nuclear power industry. FERC appointments will be critical as well, given that commission's role in regulating wholesale markets in which nuclear plants have been struggling to compete.

Retirements

The recent wave of retirements—and potential for additional retirements absent policy intervention—has prompted state policy responses and broad discussions of reliability and market design within RTO/ISOs

and at FERC. For example, in August 2016, New York regulators finalized a clean energy standard that requires distribution utilities to procure zero-emission credits (ZECs) from qualifying existing nuclear plants.[7] The program provides additional payments to nuclear plants to ensure their continued operation.[8] In the 2016 legislative session, stakeholders mounted an unsuccessful campaign for Illinois to enact a similar policy.[9]

At the RTO/ISO level, compensation for nuclear power plants has factored into broad discussions of resource adequacy. In 2014 and 2015, PJM and ISO-New England adopted new capacity market performance rules that are intended to provide bonus payments to high-performing resources, such as nuclear units.[10] The nuclear industry argues that these changes are insufficient to preserve struggling units because nuclear power plants earn most of their revenue through energy markets, rather than capacity markets.[11] More recently, stakeholder discussions in these market regions are vetting other mechanisms for ensuring a sufficient supply of zero-emission resources to meet state goals.[12]

In 2014, FERC initiated an inquiry into price formation in RTO markets for energy and ancillary services.[13] One analyst characterized the inquiry as a potential boon for the nuclear industry.[14] Any changes that cause energy prices to rise would provide substantial revenue to nuclear plants, which have large capacities and operate nearly year round. So far, FERC has proposed limited adjustments to rules governing offer prices (bids)—rules meant to prevent abuse of market power—but it has not moved forward with additional changes.

As discussed above in the section on federal regulation of electricity markets, FERC could weigh in on the nuclear subsidy debate by approving or disapproving proposed rule changes submitted by RTOs, responding to complaints about RTO rules and petitions requesting a declaratory order, weighing in on claims filed in federal and state courts by market participants or industry stakeholders, or acting on its own to require RTOs to adopt market rules that aim to preserve existing nuclear capacity.[15]

Beyond influencing FERC's oversight of wholesale markets, the next administration could affect the future of the existing nuclear fleet through its approach to climate policy. For example, pricing carbon through a carbon tax, an RTO carbon price, or another market-based policy would give value to the carbon-free attributes of nuclear-powered electricity.

Relicensing

The NRC has broad authority to license the production of nuclear power for commercial or industrial use.[16] The Atomic Energy Act and NRC regulations allow the NRC to issue initial operating licenses for 40 years and subsequent licenses in up to 20-year increments.[17] Most of the current fleet of nuclear power plants was built in the 1960s and 1970s; many are now operating under their first 20-year license extension. In 2019, the NRC is likely to receive its first application to extend the operating license of a nuclear power plant beyond 60 years; Dominion Virginia Power announced it would seek a second 20-year extension for its Surry Power Station units 1 and 2 at that time.[18]

The existing legal and regulatory framework allows for extensions beyond 60 years, and research by the Electric Power Research Institute (EPRI) and the DOE has identified no generic technical barriers to life extension.[19] However, the specific requirements for obtaining a subsequent license extension are not yet final. Under the Obama Administration, the NRC initiated an update to its relicensing guidance—

including its *Generic Lessons Learned for Subsequent License Renewal Report* and *Standard Review Plan for Review of Subsequent License Renewal Applications for Nuclear Power Plants*—with a goal of finalizing the guidance documents in July 2017.[20] The next administration could finalize this guidance or change course by, for example, deciding not to extend the life of these plants or agreeing only to extend the life of plants that can meet the requirements for initial re-licensing.

Advanced Reactors

The current fleet of U.S. nuclear power plants employs light-water-reactor (LWR) technology, which was initially developed in the 1950s to propel submarines and naval ships. In light-water reactors, energy released from splitting atoms is used to make steam, and the steam drives a turbine to produce electricity. These reactors use light (normal) water as a coolant. Emerging technologies have the potential to deliver safer, more secure, and more flexible nuclear power, including small modular reactors (SMRs)—also referred to as integral pressurized light-water reactors—and reactors that use a coolant other than water, such as molten salt or liquefied metal (advanced non-light-water reactors).[21]

The federal government may determine the future of advanced nuclear power technology through the NRC's role in licensing commercial reactors. The NRC expects to receive design certification and early site permit applications for small modular reactors by the end of 2016.[22] Over the next 5 to 10 years, the NRC anticipates applications to license advanced non-LWR technologies.[23]

Advanced nuclear technologies face many of the same barriers as new nuclear units with conventional light-water reactors, including long construction timelines, high construction costs, uncertainty regarding electricity demand, and competition from natural gas and renewable energy. In addition, because the NRC developed existing regulations for light-water reactors, some of the general design criteria are not applicable to advanced reactors.[24] The NRC's regulations provide for exemptions under certain circumstances, but some proponents of advanced nuclear technology argue that a streamlined, risk-based framework that targets advanced reactor licensing would better serve innovation and safety.[25] A 2012 NRC report to Congress suggests that the NRC agreed.[26]

Since 2012, the NRC has identified technical and policy issues associated with licensing advanced reactors, including small modular reactors and non-LWR designs, and has developed draft guidance on general design criteria for advanced non-light-water reactors. This guidance will aid applicants and NRC staff in interpreting existing regulations as applied to non-LWR designs.[27] However, the NRC has not yet articulated a process or initiated a rulemaking to develop a new framework for advanced non-LWR reactors. Stakeholders have pressed for legislation that would direct the NRC to create that framework.[28]

Beyond influencing the NRC's responsibility for licensing nuclear power plants, the federal government—especially the DOE—could help bring advanced reactors, including SMRs and non-light-water reactors, to market. The DOE and the Atomic Energy Commission played a critical role in commercializing the first generation of nuclear power plants, and some argue that successfully developing and deploying advanced reactors will similarly require federal involvement.[29]

The DOE hosts programs that support the licensing of SMRs—including partnerships with the Tennessee Valley Authority (TVA) and NuScale Power to pursue NRC early-site permits and design certification,

respectively, for a first-of-a-kind project at TVA's Clinch River site—and research, demonstration, and deployment of advanced non-light-water reactors and small modular reactors.[30]

Permanent Storage of Nuclear Waste

Nuclear waste complicates the picture for both existing and new nuclear power plants. The Nuclear Waste Policy Act (NWPA) of 1982 directs the DOE to establish and operate a deep geological repository for the permanent storage of civilian nuclear waste and requires operators of nuclear power plants to contract with the DOE to store used fuel.[31] The DOE has yet to site a permanent waste repository.

The NRC placed a temporary moratorium on the issuance of new or extended operating licenses for nuclear power plants from 2012 to 2014, after a court ordered the commission to consider the possibility that a permanent waste repository is never built.[32] In 2014, the NRC issued a new "continuous storage" rule that finds waste can be stored safely at the sites of existing nuclear power plants—replacing its previous "waste confidence" rule that anticipated a repository would be available by 2009—and resumed licensing activities.[33] The generic environmental impact statement that the rule relies on assumes existing plants remain operational for up to 80 years, reflecting a second 20-year license extension.

Owners and operators of nuclear power plants have successfully sued the federal government for the cost of managing used fuel absent a permanent repository.[34] The GAO estimates that federal liability for managing spent nuclear fuel—because the DOE has not met its contractual obligations to dispose of that fuel—is $21.4 billion through 2071.[35] In addition, the DOE currently holds more than $30 billion for a permanent storage facility in its Nuclear Waste Fund, paid into by nuclear plant operators until 2014.[36]

In 1988, Congress directed the DOE to consider Yucca Mountain in Nevada as the only possible site for the permanent waste repository.[37] In mid-2008, the Bush Administration submitted a license application to the NRC for the repository at Yucca Mountain, over Nevada's strong opposition.[38] The Obama Administration later abandoned the Yucca Mountain repository, declaring it unworkable and defunding its license application.[39] The Obama Administration attempted to revoke the 2008 license application, but in 2013, the D.C. Circuit Court of Appeals directed the NRC to resume consideration of the application with previously appropriated funds. The DOE subsequently proposed a new waste management agency and initiated a public outreach process on consent-based siting, with goals of opening a pilot interim storage facility in 2021, a full-scale interim storage facility in 2025, and a permanent waste repository in 2048.[40] Legislation is required to authorize this approach.

The next administration must determine how to move forward to address the growing volume of civilian nuclear waste, much of which is a byproduct of nuclear power production. Under President Obama, the DOE has taken steps to outline a process for consent-based siting, but moving forward with candidate sites other than Yucca Mountain requires new legislative authority. In the absence of a federal repository, the federal government's liability for the cost of storing nuclear waste on site continues to mount, and the long-term safety of waste storage remains an important factor in the role of nuclear power.

ENDNOTES

[1] 42 U.S.C. § 10222 (a)(5)(B).
[2] *See* U.S. EIA, *First New Nuclear Reactor in Almost Two Decades Set to Begin Operating*TODAY IN ENERGY, June 14, 2016, http://www.eia.gov/todayinenergy/detail.cfm?id=26652; *See also* Peter Maloney, *House Committee Votes to Lift 2020 Deadline on Nuclear Power Tax Credit,* UTILITY DIVE, Sept. 23, 2016, http://www.utilitydive.com/news/house-committee-votes-to-lift-2020-deadline-on-nuclear-power-tax-credit/426850 (stating that four nuclear units under construction in South Carolina and Georgia, originally expected online in 2016 and 2017, are currently slated to begin operating in 2019 and 2020).
[3]Total United States nuclear generation was 797,166,000 MWh in 2015. Nuclear plus renewable generation excluding biomass totaled 1,282,501,000 MWh. *See Electricity Data Browser: Net Generation for all Sectors, Annual*, U.S. EIA, http://www.eia.gov/electricity/data/browser/ (last visited Sept. 13, 2016).
[4]There are 61 commercial nuclear power plants in the United States operating 99 reactors as of mid-2016. Since 2013, plants that have retired include: Vermont Yankee (VT), San Onofre (CA), Crystal River (FL), and Kewaunee (WI). *See Frequently Asked Questions: How Many Nuclear Power Plants are There in the United States and Where are They Located?*, U.S. EIA, last updated Aug. 2, 2016, https://www.eia.gov/tools/faqs/faq.cfm?id=207&t=3. Plants that have announced retirement include: Pilgrim (MA), Oyster Creek (NJ), Fort Calhoun (OK), Quad Cities (IL), and Clinton (IL). For an overview of retiring and at risk plants, see Thomas Overton, *U.S. Faces Wave of Premature Nuclear Retirements*, POWER MAG., Jan. 14, 2015, http://www.powermag.com/u-s-faces-wave-of-premature-nuclear-retirements. Although some of these retirements have been attributed to economic headwinds, reactors have also retired as a result of maintenance issues. For example, Southern California Edison permanently closed its San Onofre Nuclear Generating Station following the unexpected degradation of tubes in its newly installed steam generators. After replacing its steam generators and discovering damage to the concrete containment building that surrounds the reactor vessel, Duke Energy closed its Crystal River Nuclear Plant. *See Plans for Decommissioning of San Onofre Nuclear Generating Station Units 2 and 3,* U.S. NRC (July 8, 2016), http://www.nrc.gov/info-finder/decommissioning/power-reactor/songs/decommissioning-plans.html; *see also Crystal River Unit 3 Nuclear Generating Plant,* U.S. NUCLEAR REG. COMM'N (Mar. 4, 2016), http://www.nrc.gov/info-finder/decommissioning/power-reactor/cr3.html.
[5] *See,* EIA, *Wholesale Power Prices Decrease Across the Country in 2015*, Jan. 11, 2015, http://www.eia.gov/todayinenergy/detail.php?id=24492.
[6] *Compare* Ellyn Fortino, *Should the State Legislature Boost Exelon's 'Economically Stressed' Nuclear Plants?*, PROGRESS ILL., Nov. 10, 2014, http://www.progressillinois.com/posts/content/2014/11/09/should-state-legislature-ratepayers-boost-exelons-financially-struggling (quoting an argument that the nuclear plants are simply uneconomic), *with* Jim Ostroff, *US Capacity Market Revamp not Sufficient to Aid Nuclear Power Units: Execs*, S&P GLOBAL PLATTS, June 24, 2015, http://www.platts.com/latest-news/electric-power/boston/us-capacity-market-revamp-not-sufficient-to-aid-21679761 (arguing that flawed market structures are contributing to under-valuation of nuclear capacity).
[7] NY Dept. Pub. Serv., Proceeding on Motion of the Commission to Implement a Large-Scale Renewable Program and a Clean Energy Standard, 15-E-0302, Aug. 1, 2016; NY Dept. Pub. Serv., Order Adopting a Clean Energy Standard.
[8] NY Dept. Pub. Serv., Staff White Paper on Clean Energy Standard, CASE 5-E-0302, Jan. 25, 2016; NY Dept,. Pub. Serv., Staff's Responsive Proposal for Preserving Zero-Emissions Attributes, July 8, 2016.
[9] *See* NEXT GENERATION ENERGY PLAN, http://www.nextgenerationenergyplan.com (last visited Sept. 13, 2016).
[10] FERC, Order on a Compliance Filing 149 FERC ¶ 61,009; FERC, Order on Proposed Tariff Revisions, 151 FERC ¶ 61,208 (2015).
[11] Ostroff, *supra* note 69. For nuclear plant capacity factors, see U.S. EIA, *Table 6.7.B Capacity Factors for Utility Scale Generators not Primarily Using Fossil Fuels, January 2013-June 2016,* ELECTRIC POWER MONTHLY, Aug. 24, 2016, https://www.eia.gov/electricity/monthly/epm_table_grapher.cfm?t=epmt_6_07_b.
[12] INTEGRATING MARKETS AND PUBLIC POLICY, http://nepool.com/IMAPP.php (last visited Sept. 13, 2016).
[13] FERC, Proceeding on Price Formation in Energy and Ancillary Service Markets Operated by Regional Transmission Organizations and Independent System Operators, AD14-14-000, June 19, 2014.
[14] Rebecca Kern, Michael Bologna, and Gerald B. Silverman, *Government Attempts to Save Nuclear Plants May Be Too Late,* BLOOMBERG GOVERNMENT, June 6, 2016.
[15] *See* Joel B. Eisen, *FERC's Expansive Authority to Transform the Electric Grid*, 49 U.C. DAVIS L. REV., 1783 (2016); *FERC Has Key Role in Meeting EPA Emission Goals*, NUCLEAR ENERGY INST. (Feb. 26, 2015), http://www.nei.org/News-Media/News/News-Archives/NEI-FERC-Has-Key-Role-in-Meeting-EPA-Emission-Goal.
[16] Atomic Energy Act of 1954, Pub. L. No. 83–703, 68 Stat. 919.
[17] 42 U.S.C. § 2133(c) (stating that the NRC may grant an operating license for no more than 40 years, which may be extended); 10 C.F.R. § 54.31(providing that a license renewal cannot exceed 20 years).
[18] DOMINION VIRGINIA POWER, *Dominion Informs NRC of Intent to Seek Second License Renewal for Surry Power Station, Nov. 6, 2015,* https://www.dom.com/residential/dominion-virginia-power/news/news-releases/137073.

[19] *See* DOE-NE LIGHT WATER REACTOR SUSTAINABILITY PROGRAM AND EPRI LONG TERM OPERATIONS PROGRAM – JOINT RESEARCH AND DEVELOPMENT PLAN, REVISION 4, U.S. DEP'T OF ENERGY OFF. OF NUCLEAR ENERGY (April 2015), http://www.energy.gov/sites/prod/files/INL-EXT-12-24562_LWRS-LTO_Joint_RD_Plan_Rev_4_0.pdf.
[20] *Subsequent License Renewal*, U.S. DOE OFF. OF NUCLEAR ENERGY, April 2016, http://www.nrc.gov/reactors/operating/licensing/renewal/subsequent-license-renewal.html. Note that the NRC staff recommended a rulemaking process to update the regulations governing relicensing to reflect challenges associated with licensing beyond 60 years. The NRC subsequently ruled that no rulemaking was necessary and directed the staff to move forward by updating the guidance. *See* NRC Memorandum to Mark A. Satorius, Executive Director Operations, Staff Requirements – SECY-14-0016 – Ongoing Staff Activities to Assess Regulatory Considerations for Power Reactor Subsequent License Renewal, Aug. 29, 2014, http://www.nrc.gov/reading-rm/doc-collections/commission/srm/2014/2014-0016srm.pdf
[21] EDWARD GEIST, RAND CORP., OVERCOMING OBSTACLES TO ADVANCED REACTOR TECHNOLOGIES (2015), http://www.rand.org/pubs/perspectives/PE156.html.
[22] *Advanced Non-Light Water Reactors and Small Modular Reactors*, U.S. NRC (JULY 28, 2016), http://www.nrc.gov/reactors/advanced.html.
[23] *Id.*
[24] 10 C.F.R. § 50.
[25] 10 C.F.R. § 50.12. For example, the Nuclear Innovation Alliance argues that companies are reluctant to apply for exemptions because of the appearance that they are attempting to circumvent safety standards. *See* ASHLEY E. FRAN, NUCLEAR INNOVATION ALL., ENABLING NUCLEAR INNOVATION: STRATEGIES FOR ADVANCED REACTOR LICENSING 56 (Apr. 2016), http://www.nuclearinnovationalliance.org/advanced-reactor-licensing.
[26] U.S. NRC, REPORT TO CONGRESS: ADVANCED REACTOR LICENSING 4 (2012), http://www.nrc.gov/reading-rm/doc-collections/congress-docs/correspondence/2012/frelinghuysen-08-22-2012.pdf.
[27] *Advanced Reactors and Small Modular Reactors*, U.S. NRC (Apr. 2016) http://www.nrc.gov/reactors/advanced.html.
[28] 10 C.F.R. § 50.12.
[28] FRAN, *supra* note 88; Nuclear Energy Innovation and Modernization Act, S. 2795, 114th Congress (2016); Advanced Nuclear Technology Development Act of 2016, H.R. 4979, 114th Congress (2016).
[29] SECRETARY OF ENERGY ADVISORY BOARD, TASK FORCE ON THE FUTURE OF NUCLEAR POWER DRAFT REPORT (2016), http://www.energy.gov/seab/downloads/draft-report-task-force-future-nuclear-power (proposing a 25 year, $11.5 billion program to commercialize advanced nuclear technologies); Todd Allen et al., *What is Missing in U.S. Nuclear? An Innovation Culture*, THIRD WAY, Mar. 29, 2016, http://www.thirdway.org/report/whats-missing-in-us-nuclear-an-innovation-culture (Arguing for DOE-seeded innovation centers to encourage public-private partnerships that drive new ideas in nuclear technology).
[30] *Small Modular Reactors*, US. DOE OFF. OF NUCLEAR ENERGY, http://www.energy.gov/ne/nuclear-reactor-technologies/small-modular-nuclear-reactors (last visited Sept. 14, 2016); *Advanced Reactor Technologies*, U.S. DOE OFF. OF NUCLEAR ENERGY, http://www.energy.gov/ne/nuclear-reactor-technologies/advanced-reactor-technologies (last visited Sept. 14, 2016).
[31] Nuclear Waste Policy Act of 1982, Pub. L. No. 97-425, 96 Stat. 2201, *amended by* The Nuclear Waste Policy Amendments Act of 1987, Pub.L. No. 100-203, 101 Stat. 1330, the Act of Oct. 18, 1988, Pub. L. No. 100-507, 102 Stat. 2541& The Energy Policy Act of 1992, Pub. L. No. 102-486, 106 Stat. 2776. (codified at 42 U.S.C. § 10101 *et. seq*).
[32] *See New York v. U.S. NRC*, 681 F.3d 471 (D.C. Cir. 2012); *see also Continued Storage for Spent Nuclear Fuel*, U.S. NRC (July 2015), http://www.nrc.gov/waste/spent-fuel-storage/wcd.html.
[33] U.S. NRC, Continued Storage of Spent Nuclear Fuel, 79 Fed. Reg. 56,238 (Sept. 19, 2014).
[34] U.S. GAO., SPENT NUCLEAR FUEL MANAGEMENT: OUTREACH NEEDED TO HELP GAIN PUBLIC ACCEPTANCE FOR FEDERAL ACTIVITIES THAT ADDRESS LIABILITY (2014), http://www.gao.gov/assets/670/666454.pdf.
[35] *Id.* at 12.
[36] *The Federal Government's Responsibilities and Liabilities Under the Nuclear Waste Policy Act*: *Hearing Before the H.R Subcomm. on the Env't and the Econ. Comm. on Energy and Commerce* 114th Congress (2015) (testimony of Kim Cawley, Chief, Nat. and physical Resources Cost Estimates Unit) https://www.cbo.gov/sites/default/files/114th-congress-2015-2016/reports/51035-NuclearWaste_Testimony.pdf.
[37] Pub. L. No. 100-203.
[38] U.S. NRC, *DOE's License Application for a High-Level Geological Waste Repository at Yucca Mountain*, http://www.nrc.gov/waste/hlw-disposal/yucca-lic-app.html (lasted updated June 2016); NRC, *Backgrounder on Licensing Yucca Mountain*, http://www.nrc.gov/reading-rm/doc-collections/fact-sheets/yucca-license-review.html (last updated Sept. 2015).
[39] U.S. NRC, *DOE's License Application for a High-Level Geological Waste Repository at Yucca Mountain*, *supra* note 101; NRC, *Backgrounder on Licensing Yucca Mountain*, *supra* note 101.
[40] U.S. GAO, supra note 97.

Nicholas Institute for Environmental Policy Solutions

The Nicholas Institute for Environmental Policy Solutions at Duke University is a nonpartisan institute founded in 2005 to help decision makers in government, the private sector, and the nonprofit community address critical environmental challenges. The Nicholas Institute responds to the demand for high-quality and timely data and acts as an "honest broker" in policy debates by convening and fostering open, ongoing dialogue between stakeholders on all sides of the issues and providing policy-relevant analysis based on academic research. The Nicholas Institute's leadership and staff leverage the broad expertise of Duke University as well as public and private partners worldwide. Since its inception, the Nicholas Institute has earned a distinguished reputation for its innovative approach to developing multilateral, nonpartisan, and economically viable solutions to pressing environmental challenges. www.nicholasinstitute.duke.edu

Center for Climate, Energy, Environment, and Economics (CE3)

CE3 at the UNC School of Law exists to provide advanced student education and policy and legal examination of issues surrounding the law of climate, energy, environment, and economic development, with particular attention to the intersection of these issues. Addressing this intersection requires engaging in (1) the holistic needs of communities; (2) the role of innovative technologies, finance, and the private sector in protecting our environment and providing for development; and (3) protecting the environment and climate systems upon which humanity relies. www.law.unc.edu/centers/ce3

Environmental Law Program (ELP)

ELP at Harvard Law School features dedicated students, innovative clinical instruction, and renowned professors with real-world expertise and passion for teaching. Together, we employ rigorous legal analysis and policy savvy to tackle today's most pressing environmental challenges. At ELP, students have the opportunity to explore cutting-edge environmental issues in the classroom, engage with experts at our special events and programs, and practice environmental law for real clients in the Emmett Environmental Law and Policy Clinic. With the establishment of the ELP Policy Initiative in 2012, ELP now offers a comprehensive approach to environmental problem-solving. www.environment.law.harvard.edu

Contact
Nicholas Institute, Duke University, P.O. Box 90335, Durham North Carolina 27708 • 919.613.8709 • nicholasinstitute@duke.edu • www.nicholasinstitute.duke.edu