The Nuclear Option: Securing Environmental Justice Benefits Through the Movement to Replace Coal Power Plants

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* Frank is endlessly thankful to his Energy and the Environment Writing Seminar classmates for their thoughtful critique and insightful commentary. Your passion for your own paper topics and your drive toward high achievement pushed me to be better. I am also thankful to all my legal writing teachers—those who wear the actual title and those who have taught me how to write even without an official position. A final thank you to Professor Warren for inspiring my interest in environmental justice communities and for encouraging me to delve deeper.

I. Introduction

Recent advances in nuclear technology provide the United States an opportunity to clean up more than its energy production. As part of the decarbonization effort, the United States has an opportunity to provide Environmental Justice (EJ) communities benefits historically not afforded to those communities. With coal's recent fall from favor due to its disproportionate production of greenhouse gases (GHG) relative to other fuels, its use appears limited. With carbon emission reduction adding cost to energy production, the political climate has begun a pivot from GHG reduction to elimination. This pivot creates the EJ opportunity.

Coal power plants (CPPs) have substantially burdened EJ communities. However, their presence creates a paradox for these communities. Despite the negative impact on physical and mental health, a CPP positively impacts the local economy through employment. Closing a CPP yields positive health impacts—and a global environmental impact—but retiring a CPP decimates the local EJ economy.

Replacing CPPs with Nuclear Power Plants (NPPs) accomplishes the opposite. Developments in nuclear reactor technology have made plants smaller, replicable, safer, and cheaper. Small modular reactors fit within CPP footprints. They provide local economic benefits a CPP cannot provide. NPPs have zero emissions. A CPP cannot compete with an NPP in the cost/benefit calculation.

Policymakers have signaled an appetite for change. The Biden Administration has established a policy "to secure environmental justice and spur economic opportunity for disadvantaged communities that have been historically marginalized and overburdened by pollution . . . ."[1] It recognizes that "[t]o secure an equitable economic future, the United States

[1] Exec. Ord. No. 14008: Tackling the Climate Crisis at Home and Abroad, 86 Fed. Reg. 7619, 7629 (Jan. 27, 2021).

must ensure that environmental and economic justice are key considerations in how we govern."[2] A 2022 Department of Energy (DOE) report identified more than 300 CPPs with appropriate surrounding characteristics to support an NPP. With bipartisan support for nuclear power at the federal level and many states increasingly considering nuclear power as a clean-energy option, it is time to transition from CPPs to NPPs.

The changing energy generation landscape has created a unique solution for EJ communities directly impacted by operating CPPs or those facing impending retirement. Replacing a CPP with an NPP can revitalize an EJ community. However, the federal statutes providing most of the financial incentives rapidly approach sunsets on funding and provide insufficient funding to replace every CPP with an NPP. Because of the short window, EJ communities must act quickly to secure their future. Recognizing that EJ communities have limited resources, EJ advocates must act quickly to help organize.

This Article proceeds in five parts. Part II introduces the historic burdens faced by EJ communities as victims of "fossil fuel racism." It describes the characteristics of CPP communities and why these communities so often fall into the EJ category. It also illustrates the environmental and economic risks created by proximity to CPPs. Part III provides an overview of the nuclear power industry's recent resurgence, the new technologies fueling that resurgence, and the shifting federal and state public policy making the nuclear option possible. Part IV reviews ownership benefits available from transitioning to NPPs. Part V identifies the EJ trade-offs associated with the transition, focusing on the differences in environmental impact and how the transition would impact the local economy. Finally, Part VI presents recommendations on how EJ communities can leverage the transition to their benefit with a focus on leveraging Clean Energy Financing authorized in the IRA.

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[2] *Id.*

II. Coal Power Legacy—An Environmental Justice Story

Fossil fuel infrastructure historically overburdens EJ communities.[3] The trend runs so deeply that a recent article separated it from the larger body of environmental racism and termed it "fossil fuel racism."[4] Not only does "fossil fuel racism" impact EJ communities in the traditional way—forcing these communities to bear a higher pollution burden locally—it impacts EJ communities disproportionally via climate change.[5] In short, the fossil fuel industry has created "sacrifice zones in Black, Brown, Indigenous and poor communities" as a direct result of the historical disregard for these populations.[6] This Part explores how proximity to a CPP creates and impacts EJ communities and how retiring CPPs without a replacement can exacerbate the economic disadvantage they already face.

CPPs are the most prolific and visible representatives of the fossil fuel burden. In 2021, 56% of CPPs had EJ communities living within three miles.[7] CPPs are "disproportionately located in low-income communities" rife with economic disadvantage and within "communities of color" who have historically faced oppression.[8] Sixty-eight percent of

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[3] Timothy Q. Donaghy et al., *Fossil Fuel Racism in the United States: How Phasing out Coal, Oil, and Gas Can Protect Communities*, ENERGY RSCH. & SOC. SCI, Vol. 100, May 11, 2023, at 2, https://www.sciencedirect.com/science/article/pii/S2214629623001640#bb0035. In general, EJ communities are "ethnic minorities, indigenous persons, people of color, and low-income communities" who bear a disproportionate burden of pollution. *Id.* Resulting from this disproportionate burden, the Department of Energy defines EJ as "the fair treatment and meaningful involvement of all people, regardless of race, color, national origin, or income, with respect to development, implementation, and enforcement of environmental laws, regulations, and policies." *Environmental Justice*, ENERGY, https://www.energy.gov/lm/environmental-justice# (last visited Dec. 9, 2023).

[4] Donaghy et al., *supra* note 3.

[5] *Id.* at 5.

[6] *Id.* at 3.

[7] *See Map of Power Plants Covered by EPA's Acid Rain Program and CSAPR Programs,* EPA, https://experience.arcgis.com/experience/b4fa4181c6b04bd4baed7706cd7c850c/page/Page/?views=Map (last visited Dec. 9, 2023). Though 75% of natural gas plants have EJ communities living within three miles, the pollution impact of CPPs grossly outweighs that of natural gas plants. *See id.*

[8] NAACP, COAL BLOODED: PUTTING PROFITS BEFORE PEOPLE 15 (Monique W. Morris, ed., 2012), https://naacp.org/resources/coal-blooded-putting-profits-people; *Map of Power Plants supra* note 7.

black Americans live within thirty miles of a CPP.[9] Communities surrounding CPPs have an average per capita income of $18,400, fifteen percent less than the United States average.[10] In an NAACP report on EJ impact, seventy-five CPPs earned failing grades.[11] Of the four million people living within three miles of these plants, 53% are non-white; average incomes are 25% lower than their local state averages.[12] Two million people live within three miles of the twelve highest offenders—76% of whom are people of color with an average per capita income of two-thirds of the U.S. average.[13] Though impacts caused by the historic policy of redlining have been reduced, the disparity persists.[14]

CPP emissions contain particulate matter, nitrogen oxides, sulfur oxides, arsenic, and mercury.[15] In 2011, 50% of mercury emissions in the United States came from CPPs.[16] A 2010 study by the National Research Council calculated 1,530 excess U.S. deaths attributable to particulate matter emitted by CPPs.[17]

For decades, CPPs utilized unlined ponds and landfills to dispose of coal ash, leading to toxins migrating into groundwater.[18] According to Earthjustice, among CPPs who self-monitor, at least 265 currently contaminate groundwater at levels above federal safe

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[9] NAACP, *supra* note 8, at 15. For a discussion of how redlining practices served as a future predictor of where power plants would be located, see also generally Lara J. Cushing et al., *Historical Red-Lining Is Associated with Fossil Fuel Power Plant Siting and Present-day Inequalities in Air Pollutant Emissions*, 8 NAT. ENERGY, Jan. 2023, https://www.nature.com/articles/s41560-022-01162-y.

[10] NAACP, *supra* note 8, at 15.

[11] *Id.* at 27. Grading methodology combined pollution impact with the impact on the local EJ community and did not factor CO_2 into the methodology. See *id.* at 86–92 for the grading methodology.

[12] *Id.* at 27.

[13] *Id.* at 30.

[14] Lara Cushing & Shiwen Li, *The Lingering Shadow of Redlining: Fossil Fuel Power Plants and Air Pollution*, SCI. BREAKER (Sep. 13, 2023), https://www.thesciencebreaker.org/breaks/earth-space/the-lingering-shadow-of-redlining-fossil-fuel-power-plants-and-air-pollution.

[15] Cushing et al., *supra* note 14, at 52; *Cleaner Power Plants*, EPA, https://www.epa.gov/mats/cleaner-power-plants (last visited Dec. 9, 2023).

[16] *Cleaner Power Plants*, *supra* note 15. Since the DOE finalized Mercury and Air Toxics Standards in 2012, by 2017 mercury emissions dropped by 86%. *Mercury and Air Toxics Standards*, EPA, https://www.epa.gov/stationary-sources-air-pollution/mercury-and-air-toxics-standards (last visited Dec. 9, 2023).

[17] NAACP, *supra* note 8, at 17.

[18] *Mapping the Coal Ash Contamination*, EARTHJUSTICE (Nov. 3, 2022), https://earthjustice.org/feature/coal-ash-contaminated-sites-map.

standards—the real number likely extends much higher.[19] Toxins from coal ash include "arsenic, boron, cadmium, chromium, lead, radium, [and] selenium," which can lead to heightened risks of "cancer, heart disease, reproductive failure, . . . stroke, and . . . lasting brain damage [in] children."[20] In the 1970s, contamination from coal ash killed 95% of the fish species in Belews Lake, NC.[21] According to the NAACP: "There is no silver bullet that will make these plants clean—the only truly effective way to stop coal fired power plants from polluting the communities in which they are located, is to close them."[22]

Shifting public policy places economic pressure on these EJ communities. With coal no longer sustainable from a policy or economic perspective, utilities plan to shift to clean technology; some anticipate retiring all coal by the mid-2030s.[23] Without a replacement alternative, EJ communities face an economic void.

In 2018, two plants in Adams County, OH closed on the same day.[24] At their peak, the two plants provided 700 jobs. Their closure eliminated from "one of the poorest corners of Ohio . . . [its] highest-paying jobs, its largest employers, its biggest taxpayers and, in many ways, its lifeblood."[25] The drop in county tax revenue led to budget cuts, drops in school

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[19] *Id.*

[20] *Id.*; *see also* Benjamin K. Sovacool & Christopher Cooper, *The Hidden Costs of State Renewable Portfolio Standards (RPS)*, 15 BUFF. ENVTL. L.J. 1, 20 (2007) ("America's 600 coal and oil-fired power plants produce more than one hundred million tons of sludge waste every year. Seventy-six million tons of these wastes are primarily disposed of on-site at each power plant in unlined wastewater lagoons and landfills that are seldom fully monitored by the Environmental Protection Agency. These wastes are highly toxic, containing concentrated levels of poisons such as arsenic, mercury, and cadmium that can severely damage the human nervous system. On the production side, the coal industry discharges between 70 million and 2.5 billion tons of fine coal into the nation's streams.").

[21] *Mapping the Coal Ash Contamination*, *supra* note 18. Duke Energy has identified he CPP at Belews Lake as one of four CPPs it plans to convert into an NPP now that North Carolina has converted its Renewable Portfolio Standard law into a Clean Electricity Standard. Terri Flagg, *Belews Creek Goes Nuclear in New Duke Energy Plan*, STOKES NEWS (Aug. 17, 2023), https://www.thestokesnews.com/news/belews-creek-goes-nuclear-in-new-duke-energy-plan/article_46afb186-3881-11ee-b351-a3bb96aeaa60.html.

[22] NAACP, *supra* note 8, at 47.

[23] J. HANSEN ET AL., INVESTIGATING BENEFITS AND CHALLENGES OF CONVERTING RETIRING COAL PLANTS INTO NUCLEAR PLANTS 8 (2022) [hereinafter DOE REPORT], https://fuelcycleoptions.inl.gov/SiteAssets/SitePages/Home/C2N2022Report.pdf.

[24] Brady Dennis & Steven Mufson, *In Small Towns Across the Nation, the Death of a Coal Plant Leaves An Unmistakable Void*, WASH. POST (Mar. 28, 2019, 12:52 pm), https://www.washingtonpost.com/national/health-science/thats-what-happens-when-a-big-plant-shuts-down-in-a-small-town/2019/03/28/57d62700-4a57-11e9-9663-00ac73f49662_story.html#. During the same year, nineteen coal-fired plants shut down. *Id.*

[25] *Id.*

enrollments, and cuts in county-funded services like teachers and sheriff's deputies.[26] Former workers fled the area for job opportunities; property values plummeted.[27] This represents the future for EJ communities when CPPs retire without a replacement.

Additionally, attempts to utilize innovative marketplaces and technology to encourage decarbonization while retaining local carbon-centric power production have failed to alleviate the EJ pollution problem. Two studies looked at the impact of California's decarbonization efforts. Though the state's cap-and-trade program reduced GHG by 20%, co-pollutants doubled overall; black community exposure to co-pollutants tripled.[28] Carbon capture requires additional energy consumption, leading to additional overall co-pollutants.[29] Within a cap-and-trade program like California's, heavy-polluting CPPs can source offsets on the market, eliminating the need to reduce local emissions.[30] For EJ communities proximate to power plants, these programs are essentially worthless.

Transitioning to natural gas provides limited benefits to EJ communities. The populations surrounding natural gas plants tend to have higher proportions of black and Hispanic populations than those surrounding CPPs and tend to have more density, leading to higher direct impacts.[31] Natural gas plants emit less than CPPs; however, they are not inert.[32] Though their sulfur dioxide emissions are nearly zero and NOx emissions are approximately 7% of those produced from coal,[33] natural gas emits carbon at 60% that of coal

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[26] *Id.*

[27] *Id.*

[28] BRIDGET DIANA ET AL., GREEN FOR ALL: INTEGRATING AIR QUALITY AND ENVIRONMENTAL JUSTICE INTO THE CLEAN ENERGY TRANSITION 11 (2021), https://peri.umass.edu/publication/item/1408-green-for-all-integrating-air-quality-and-environmental-justice-into-the-clean-energy-transition; Lara Cushing et al., *Carbon Trading, Co-pollutants, and Environmental Equity: Evidence from California's Cap-and-trade Program (2011–2015)*, PLOS MED. (July 10, 2018), https://journals.plos.org/plosmedicine/article?id=10.1371/journal.pmed.1002604.

[29] Donaghy et al., *supra* note 3, at 5.

[30] *Id.*

[31] *Id.* at 9

[32] *Id.*

[33] *See generally* J.A. de Gouw et al., *Reduced Emissions of CO_2, NOx, and SO_2 from U.S. Power Plants Owing to Switch from Coal to Natural Gas with Combined Cycle Technology*, 2 EARTH'S FUTURE, Feb 2014 (describing the emission cycle for natural gas plants).

and in 2021 accounted for 34% of total energy-related carbon emissions.[34] Additionally, the hydraulic fracturing necessary to meet natural gas demand requires large amounts of water, produces excessive amounts of contaminated wastewater, and releases methane into the environment, creating alternative negative effects.[35]

The United States has begun to shift in the right direction in an attempt to curb climate change. However, only focusing on carbon misses the forest for the trees—this utilitarian approach fails to consider the impacts on EJ communities. Eliminating fossil fuels without replacement or continuing to rely on fossil fuels while capturing carbon has no benefit for EJ communities.

Instead, the power generation industry should look at replacing CPPs. Nuclear power produces clean energy. Recent developments have made reactors smaller and safer. The United States has the opportunity to decarbonize while giving back to EJ communities, reversing the practice of taking from them. The next Part introduces how nuclear power has begun to feature more prominently in the decarbonization conversation.

III. Nuclear Power's Comeback

For the second half of the twentieth century, nuclear power positioned itself as the power of the future. However, interest waned.[36] Only one new reactor entered service between 1996 and 2023, and that only after a stumbling journey toward operation.[37] As of

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[34] *Natural Gas Explained,* EIA, https://www.eia.gov/energyexplained/natural-gas/natural-gas-and-the-environment.php# (last updated Nov. 7, 2022).

[35] *Id.*

[36] Though accidents at Chernobyl and Three Mile Island contributed to the decline in the United States, the high capital costs to build plants combined with a slowdown in electrical demand—leading to falling electrical prices—reduced the utility of new plants. Frank von Hippel, *Chernobyl Didn't Kill Nuclear Power*, SCI. AM. (April 1, 2016), https://www.scientificamerican.com/article/chernobyl-didn-apos-t-kill-nuclear-power/#.

[37] *First New U.S. Nuclear Reactor since 2016 Is Now in Operation*, EIA (Aug. 1, 2023), https://www.eia.gov/todayinenergy/detail.php?id=57280. Watts Bar Unit 2 came online in 2016; however, construction began in 1973, halted in 1985, and resumed in 2007. *Id.*

2020, nuclear power generates nearly 20% of the electricity consumed by the United States and accounts for more than 50% of zero-carbon generation.[38]

With the new push to decarbonize, federal and state policymakers have returned to nuclear power. 2023 saw the Vogtle 3 reactor coming online in Georgia, the first in more than two decades to receive a construction permit.[39] The DOE has identified hundreds of CPPs with optimal siting for an NPP. [40] If all identified sites convert from coal to nuclear, the DOE estimates an annual energy production of 263.3 GW—nearly tripling United States nuclear energy production and eliminating all need for coal power generation.[41] The Nuclear Regulatory Commission issued a final rule certifying the first Small Modular Reactor (SMR) effective February 21, 2023.[42] With nuclear no longer only coming in giga-size plants, utilities and industry have numerous options.[43] However, challenges still abound: licensing takes years; building nuclear power plants requires immense expense; Vogtle construction relied on an untrained workforce; and the United States has yet to solve the problem of nuclear waste storage. Despite this, nuclear power appears on the verge of reclaiming its former position as the energy of the future.

This Part provides an overview of recent advances in nuclear technology that make siting NPPs in CPP footprints possible. It also discusses rising support in industry, bipartisan

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[38] Narayan S. Subramanian, *Powering the Future: An Inclusive National Clean Energy Standard with Negative Emissions Technologies*, 45 COLUM. J. ENVTL. L. 631, 646 (2020).

[39] *Plant Vogtle Unit 3 Enters Commercial Operations, Bringing Carbon-Free Nuclear Energy to Millions*, ENERGY (July 31, 2023), https://www.energy.gov/lpo/articles/plant-vogtle-unit-3-enters-commercial-operations-bringing-carbon-free-nuclear-energy. The DOE estimates that Vogtle 4 will come online in early 2024. *Id.*

[40] DOE REPORT, *supra* note 23, at 2.

[41] *Id.*; *see, e.g.*, EIA, *supra* note 37.

[42] *NRC Certifies First U.S. Small Modular Reactor Design*, ENERGY (Jan. 20, 2023), https://www.energy.gov/ne/articles/nrc-certifies-first-us-small-modular-reactor-design.

[43] In Vogtle reactors 3 and 4, Westinghouse has deployed a grid-scale reactor. *See* EIA, *supra* note 37. The Tennessee Valley Authority has plans to deploy a GE Hitachi reactor with its eyes on scaling up, the NRC has certified a pair of small-scale SMRs from NuScale with a wide range of potential applications beyond utility-sized power generation, and the DOE is supporting development of microreactors capable of KW scale production. Aaron Larson, *Nuclear Power Is Making a Comeback: What Will It Take to See Meaningful Growth?*, POWER (Oct. 2, 2023), https://www.powermag.com/nuclear-power-is-making-a-comeback-what-will-it-take-to-see-meaningful-growth/Small scale production opens the door to industrial application.

support at the federal level, and states' increasing reliance on clean energy instead of renewable energy as a vehicle toward decarbonization.

A. The Future of Nuclear Power is Advanced and Small

In 1990, the United States hit its nuclear peak, with 112 reactors operating to produce a net summer capacity of 99 GW.[44] Between then and 2022, the system declined to a total of ninety-two operating reactors.[45] An additional twenty-one reactors are currently decommissioning.[46] Despite the apparent decline, recent developments demonstrate a renewed interest in nuclear. First, the Vogtle 3 reactor came online on July 31, 2023, the first since 2016 and only the second since 1996.[47] The same plant has another reactor projected to enter service in early 2024.[48] Second, the Nuclear Regulatory Commission (NRC) issued a final rule in February 2023 certifying the United States' first SMR design.[49]

i. The U.S. Deploys Its First Advanced Reactors in Vogtle 3 & 4

In February 2012, the NRC issued the first construction permit in thirty-four years, allowing the construction and operation of two reactors at the Vogtle Electric Generating Plant site.[50] The lone dissenting Commissioner pointed to the Fukushima disaster as a reason

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[44] *Nuclear Explained: U.S. Nuclear Industry*, EIA, https://www.eia.gov/energyexplained/nuclear/us-nuclear-industry.php# (last updated Aug, 24, 2023).

[45] *Id.*

[46] *Locations of Power Reactor Sites Undergoing Decommissioning*, NRC, https://www.nrc.gov/info-finder/decommissioning/power-reactor/index.html (last updated Sep. 5, 2023).

[47] EIA, *supra* note 44.

[48] *Id.*

[49] *NRC Certifies First U.S. Small Modular Reactor Design*, *supra* note 42.

[50] Andrew J. Burke, *Energy & Environmental Law - Nuclear Regulatory Commission Authorizes Inaugural Combined Licenses for Construction and Operation of Two Commercial Nuclear Power Plants - In re Southern Nuclear Operating Company*, 45 SUFFOLK U. L. REV. 1351, 1351–52 (2012). The expansion features the first deployment of the Westinghouse AP1000 Generation III+ reactor, which the DOE anticipates providing the standard design for U.S. utilities. *See Vogtle*, ENERGY, https://www.energy.gov/lpo/vogtle (last visited Dec. 9, 2023); ROGER SCHÉNE, THE WESTINGHOUSE ADVANCED PASSIVE PRESSURIZED WATER REACTOR, AP1000 (2009), https://inis.iaea.org/collection/NCLCollectionStore/_Public/42/026/42026956.pdf (describing it as "the safest and most economical nuclear power plant available in the worldwide commercial marketplace"). Once the second reactor comes online, the plant will constitute the largest NPP in the United States with a generative capacity of 4.6 GW. EIA, *supra* note 37.

why the NRC should require heightened safety standards before approving the permit, but the panel majority overwhelmingly rejected the concern.[51]

The industry learned hard lessons while building the first reactor in decades: costs more than doubled the original projections to over $30 billion,[52] construction required training a workforce,[53] and it delivered seven years late.[54] Despite all that, CEO and President Chris Womack stressed how quickly learned lessons converted into later efficiency.[55]

The DOE sees the Vogtle expansion as a means to an end. The project will "rebuild the nation's nuclear workforce" and serve as a training ground for "a new crop of engineers, technicians, welders and workers" ready to usher in nuclear power's next era.[56] Construction supported 9,000 jobs and the reactors will support 800 permanent local jobs.[57] As more projects embark, gained corporate knowledge will eliminate inefficiencies suffered during construction, leading to faster, more effective construction on future projects.

Each new reactor will prevent emissions of 10 million metric tons of CO_2, equivalent to removing nearly 2.5 million cars from the road.[58] That number accounts for nearly half of the CO_2 emissions of the James H. Miller Jr. coal power plant in Alabama, the highest emitting coal plant in the United States.[59] Once Vogtle 4 comes online, the two reactors

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[51] Burke, *supra* note 50, at 1359.

[52] Paul Day, *Vogtle's Troubles Bring US Nuclear Challenge into Focus*, REUTERS (Aug. 24, 2023, 10:57 a.m.), https://www.reuters.com/business/energy/vogtles-troubles-bring-us-nuclear-challenge-into-focus-2023-08-24/.

[53] *Id.*

[54] *Id.*

[55] *Id.*

[56] *5 Things You Should Know about Plant Vogtle*, ENERGY (April 18, 2019). https://www.energy.gov/ne/articles/5-things-you-should-know-about-plant-vogtle.

[57] *Id.*

[58] *Vogtle*, ENERGY, https://www.energy.gov/lpo/vogtle (last visited Dec. 9, 2023); *Greenhouse Gas Emissions from a Typical Passenger Vehicle*, EPA, https://www.epa.gov/greenvehicles/greenhouse-gas-emissions-typical-passenger-vehicle# (last updated Aug. 28, 2023).

[59] *Carbon Dioxide Emissions from the Most Polluting Power Plants in the United States in 2021 and 2022*, STATISTA, https://www.statista.com/statistics/1198665/emissions-most-polluting-power-plants-united-states/# (last visited Dec. 9, 2023).

combined will produce 80% of the energy the Miller plant produces with zero carbon emissions.[60]

ii. Small Modular Reactors, an Nth-of-a-Kind Technology

SMRs counter the idea that to widely distribute capital costs, nuclear power plants must be expansive in size.[61] The high cost associated with expansive plants came from those plants being first-of-a-kind[62]—just like the problems experienced at Vogtle.[63] Nth-of-a-kind projects avoid these problems. The ability to replicate models, rely on contractor expertise, learn from earlier mistakes, take advantage of extant supply chains, and benefit from the cost-reduction associated with competing actors within the marketplace, all combine to generate substantial efficiency.[64] Though the use of megawatt-scale SMRs sacrifices benefits obtained from economies of scale and requires additional reactors to match the output generated by their larger cousins, the process of factory-produced components and repetitive construction efforts leads to what the International Atomic Energy Agency has called the "economy of multiples."[65]

SMRs also promote a safer approach to nuclear power. Large, complex systems succumb to multiple failure points, especially when relying on human intervention or

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[60] *See Power Plant Profile: James H Miller Jr Power Plant, US*, POWER TECH., https://www.power-technology.com/data-insights/power-plant-profile-james-h-miller-jr-power-plant-us/?cf-view (last updated Nov. 10, 2023); *FAQs: How Much Carbon Dioxide Is Produced per Kilowatthour of U.S. Electricity Generation?*, EIA, https://www.eia.gov/tools/faqs/faq.php?id=74&t=11 (last updated Dec. 7, 2023).

[61] Bruce R. Huber, *The New Nuclear? Small Modular Reactors and the Future of Nuclear Power*, 1 NOTRE DAME J. EMERGING TECH. 458, 470 (2020).

[62] *Id.*

[63] Vogtle 3 & 4 utilizes modular reactors, meaning future projects can take advantage of the nth-of-a-kind benefits derived from the Vogtle construction. *Vogtle*, *supra* note 63. Unfortunately, other projects utilizing the same reactor are either overseas or ceased construction. *See, e.g.*, *Four Additional Westinghouse AP1000 Reactors Be Built in China*, WESTINGHOUSE (April 26, 2022), https://info.westinghousenuclear.com/news/four-westinghouse-ap1000-reactors-in-china; *Westinghouse Sees Progress in Turkey Nuclear Deal*, WESTINGHOUSE (Sep. 14, 2017, 1:00 p.m.), https://www.reuters.com/article/us-nuclear-westinghouse-turkey/westinghouse-sees-progress-in-turkey-nuclear-deal-idUSKCN1BP2OS; Matt Bowen et al., *Vogtle Unit 3 Has Started Commercial Operations. What's Next for the AP1000?*, CENTER ON GLOB. ENERGY POL'Y (July 31, 2023), https://www.energypolicy.columbia.edu/vogtle-unit-3-has-started-commercial-operations-whats-next-for-the-ap1000/.

[64] Huber, *supra* note 61, at 470–71.

[65] *Id.* at 472 (quoting INT'L ATOMIC ENERGY AGENCY, DEPLOYMENT INDICATORS FOR SMALL MODULAR REACTORS: METHODOLOGY, ANALYSIS OF KEY FACTORS AND CASE STUDIES 10 (2018)).

electrical power to prevent catastrophic accidents.[66] SMRs incorporate passive safety elements that trigger gravity-based cooling and avoid the problems associated with larger designs.[67] The nature of their small size removes the need for expansive cooling processes and allows simpler approaches.[68] The small size also creates opportunities to site below ground, reducing risks from human sabotage and natural hazards.[69]

The DOE promotes SMRs for several reasons beyond those identified above. Factory designs lead to quicker assembly on site, reducing the difficulty of adding additional modules to meet rising demand.[70] Smaller means cheaper.[71] Smaller means siting where larger plants cannot: "smaller electrical markets, isolated areas, smaller grids, sites with limited acreage, or unique industrial applications."[72] The DOE has specifically identified SMRs as candidates to replace retiring coal plants.[73] Utilities can pair SMRs with renewables to provide reliable, carbon-free electricity when renewable production experiences inevitable generation gaps.[74]

Utilizing an NRC-certified SMR removes the need to go through the multi-year process of certifying a reactor design.[75] With an NRC final rule certifying NuScale Power's SMR taking effect in February 2023, future nuclear power plant development can refer to NuScale's SMR design when seeking licenses to build and operate reactors.[76] Despite these advancements, three years into NuScale's first VOYGR SMR deployment, the project hit the

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[66] *Id.* at 474.

[67] *Id.*

[68] *Id.* at 474 & n.70 (quoting BAHMAN ZOHURI & PATRICK MCDANIEL ADVANCED SMALLER MODULAR REACTORS: AN INNOVATIVE APPROACH TO NUCLEAR POWER 58 (2019)).

[69] *Benefits of Small Modular Reactors (SMRs)*, ENERGY, https://www.energy.gov/ne/benefits-small-modular-reactors-smrs (last visited Dec. 10, 2023).

[70] *Id.*

[71] *Id.*

[72] *Id.*

[73] *Id.*

[74] *Id.*

[75] Huber, *supra* note 61, at 474–75.

[76] *NRC Certifies First U.S. Small Modular Reactor Design*, *supra* note 42; *see also* NuScale Small Modular Reactor Design Certification, 88 Fed. Reg. 3287 (Feb. 21, 2023). NuScale's reactor generates up to 50 MW and can be combined in the VOYGR power plan in groupings up to twelve reactors. NuScale has also applied to uprate the reactors to 77 MWs.

stumbling block most familiar to nuclear projects—rising costs. Plans to install six NuScale SMRs with 462 MW of generation at Idaho National Laboratory as part of the Carbon Free Power Project fell through when the project failed to reach necessary subscription levels.[77] The DOE acknowledged that this is the sort of difficulty first-of-a-kind projects encounter.[78]

The Tennessee Valley Authority (TVA) plans to utilize multiple SMRs. The TVA has chosen an SMR for its Clinch River site and has partnered with Canadian and Polish energy groups to shape a standard design for their chosen reactor with the hope of accelerating regulatory acceptance and future production.[79] Clinch River will serve as a template through which the TVA can refine the process: it plans to add three more reactors to the same site and eventually replicate the entire process at four additional sites.[80] TVA President and CEO Jeff Lynch stated that he wants "nothing to do with building one reactor, unless [he] can build 20—and 20 is the low estimate."[81]

Industry has shown interest. Nucor, the largest steel producer in North America, and NuScale have signed a memorandum of understanding whereby NuScale will site VOYGR reactors to power Nucor's Electric Arc Furnace steel mills, and Nucor will supply net-zero steel products to NuScale.[82] Standard Power will utilize twenty-four NuScale SMRs to power data centers in Ohio and Pennsylvania.[83] A Dow chemical plant outside Corpus Christi, TX,

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[77] Will Wade, *First US Small Nuke Project Canceled after Costs Surge 53%*, BLOOMBERG (Nov. 9, 2023), https://www.bloomberg.com/news/articles/2023-11-08/first-us-small-nuclear-project-canceled-after-costs-climb-53?leadSource=uverify%20wall; CARBON FREE POWER PROJECT, https://www.cfppllc.com (last visisted Dec. 10, 2023); *Timeline*, CARBON FREE POWER PROJECT, https://www.cfppllc.com/cfpp-timeline (last visisted Dec. 10, 2023).

[78] Wade, *supra* note 77.

[79] Aaron Larson, *TVA Head Wants Nothing to Do with Building One Reactor Unless He Can Build 20*, POWER (May 17, 2023), https://www.powermag.com/tva-head-wants-nothing-to-do-with-building-one-reactor-unless-he-can-build-20/.

[80] *Id.*

[81] *Id.*

[82] *NuScale Power and Nucor Corporation Sign Memorandum of Understanding to Explore Deployment of Small Modular Nuclear Reactors to Power Nucor Electric Arc Furnace Steel Mills*, NUSCALE (May 16, 2023), https://www.nuscalepower.com/en/news/press-releases/2023/nuscale-and-nucor-sign-mou-to-explore-using-smrs-to-power-electric-arc-furnace-steel-mills.

[83] *NuScale Selected to Power Data Centers*, NUCLEARNEWSWIRE (Oct. 10, 2023, 12:01 p.m.), https://www.ans.org/news/article-5432/nuscale-selected-to-power-data-centers/.

plans to install four Xe-100 SMRs with the combined generative power of 320 MWs with construction beginning in 2026 and operation commencing by 2030.[84]

With many different players interested in SMRs, eliminating first-of-a-kind inefficiencies appears a real possibility. Provided that early projects prove more successful than NuScale's first attempt, the second tier of SMR installations should yield nth-of-a-kind benefits. Incentives within federal statutes may also help the first projects come to fruition.

B. Nuclear Power Finds Bipartisan Federal Support When Little Else Does

The Biden administration has pushed for "a carbon pollution-free power sector by 2035 and net zero emissions economy by no later than 2050,"[85] backing up that push with a raft of legislation and executive support.[86] Congress included support for nuclear power as a means to reduce carbon emissions through the passage of the Inflation Reduction Act of 2022 and the Bipartisan Infrastructure Law (BIL) passed in 2021. Together, the two laws provide incentives for older reactors to continue operation while incentivizing future construction.

The Inflation Reduction Act (IRA) supports existing reactors while also looking to the future. Most importantly for this Article's purposes, the IRA provided significant financing opportunities for those interested in deploying advanced reactor technologies—opportunities that come with strings attached. Congress provided a $40 billion boost to the Clean Energy Financing Program which guarantees loans for innovative technology.[87] It also created and provided $250 billion in funding for the Energy Infrastructure Reinvestment (EIR) Program, which guarantees loans for projects that repurpose existing or retired infrastructure—

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[84] Sonal Patel, *X-Energy, Dow Unveil Texas Site for ARDP Nuclear Demonstration*, POWER (May 11, 2023), https://www.powermag.com/x-energy-dow-unveil-texas-site-for-ardp-nuclear-demonstration/.

[85] *Id.*

[86] *See Plant Vogtle Unit 3 Enters Commercial Operations*, *supra* note 43; *see also FACT SHEET: President Biden Sets 2030 Greenhouse Gas Pollution Reduction Target Aimed at Creating Good-Paying Union Jobs and Securing U.S. Leadership on Clean Energy Technologies*, THE WHITE HOUSE (April 22, 2021), https://www.whitehouse.gov/briefing-room/statements-releases/2021/04/22/fact-sheet-president-biden-sets-2030-greenhouse-gas-pollution-reduction-target-aimed-at-creating-good-paying-union-jobs-and-securing-u-s-leadership-on-clean-energy-technologies/.

[87] *Inflation Reduction Act of 2022*, ENERGY, https://www.energy.gov/lpo/inflation-reduction-act-2022 (last updated Sep. 22, 2023).

precisely overlapping the CPP to NPP path.[88] It also offers tax credits which vary from up to $15 per MWH for reactors in service in 2024, to the option for a clean energy credit of $25 per MWH for advanced reactors, or a 30% investment tax credit on new plants placed into operation in 2025 or later.[89] The IRA also created a $700 million investment into a fuel supply chain for advanced reactors.[90]

The BIL created the Civil Nuclear Credit Program (CNC).[91] This program provides $6 billion for currently operating nuclear plants nearing or at retirement age, but which the NRC certifies as safe for continued operations.[92] To qualify, a facility must demonstrate impending retirement due to financial reasons, and that retiring the facility would increase air pollutants.[93] DOE will distribute credits to those reactors selected for the program over four years; the selection period ends in 2031.[94] DOE has already identified a California nuclear power plant for the first round of distribution, granting it $1.1 billion in credits, saving 1,500 jobs at a plant that produces 15% of the state's electricity.[95] Applications for the second cycle of awards closed in March 2023.[96]

The CHIPS and Science Act provides funding authorizations to support existing relationships with institutions of higher learning, develop a new cohort of nuclear engineers, and foster a research environment within universities to design the nuclear technologies of

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[88] *Id.*

[89] *Inflation Reduction Act Keeps Momentum Building for Nuclear Power*, ENERGY (Sep. 8, 2022), https://www.energy.gov/ne/articles/inflation-reduction-act-keeps-momentum-building-nuclear-power.

[90] *Id.*

[91] See Civil Nuclear Credit Program, 42 U.S.C. § 18753.

[92] *Bipartisan Infrastructure Law*, ENERGY, https://www.energy.gov/gdo/bipartisan-infrastructure-law (last visited Dec. 10, 2023).

[93] *Civil Nuclear Credit Program*, ENERGY, https://www.energy.gov/gdo/civil-nuclear-credit-program (last visited Dec. 10, 2023).

[94] *Id.*

[95] *Biden-Harris Administration Announces Major Investment to Preserve America's Clean Nuclear Energy Infrastructure*, ENERGY (Nov. 21, 2022), https://www.energy.gov/articles/biden-harris-administration-announces-major-investment-preserve-americas-clean-nuclear.

[96] *Civil Nuclear Credit Program*, *supra* note 93.

the future.[97] CHIPS also includes Senator Joe Manchin's Fission for the Future Act which requires the DOE to prioritize certain impacted communities during the CPP to NPP transition.[98]

The DOE's Advanced Reactor Demonstration Program helps companies design the reactors of the future. With $3.2 billion planned for the program over seven years, the DOE intends to use the funds to promote the development of advanced reactors and has identified two companies as recipients.[99] The first, TerraPower, a Bill Gates-funded company, has announced it will cite its ARDP-funded Natrium reactor in Kemmerer, WY, near the Naughton Power Plant, a 774 MW CPP scheduled to retire in 2025.[100] The finished reactor will produce 345 MW with a molten salt-based energy storage system that can boost output to 500 MW.[101] The second ADRP project, X-Energy, announced it will site its four-unit, 320 MW XE-100 Reactor at a Dow Chemical plant in Seadrift, TX.[102]

Federal support creates the incentives to sustain existing infrastructure while developing and deploying new technologies. The embedded financial support demonstrates the federal government's vision of itself as a partner in this process. So, too, with the states, many of whom have turned—or are beginning to turn—to nuclear power as a strong option for decarbonization.

C. State Movement Supporting Nuclear Power

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[97] Mariana Ambrose et al., *CHIPS and Science Act Summary: Energy, climate, and Science Provisions,* BIPARTISAN POL'Y CTR. (NOV. 14, 2022), https://bipartisanpolicy.org/blog/chips-science-act-summary/.

[98] *Id.; see also Manchin Applauds Signing of CHIPS and Science Act*, SENATE COMM. ON ENERGY & NAT. RES. (Aug. 9, 2022), https://www.energy.senate.gov/2022/8/manchin-applauds-signing-of-chips-and-science-act#.

[99] Paul Day, *US Demonstration Reactor Finalists Champion Innovative Designs*, REUTERS (Oct. 20, 2020), https://www.reutersevents.com/nuclear/us-demonstration-reactor-finalists-champion-innovative-designs.

[100] *Project Will Bring a Fully Functioning Natrium Power Plant to Retiring Coal Generation Site*, TERRAPOWER (Nov. 16, 2021), https://www.terrapower.com/natrium-demo-kemmerer-wyoming/.

[101] *Id.*

[102] *Advanced Reactor Demonstration Projects*, ENERGY, https://www.energy.gov/oced/advanced-reactor-demonstration-projects-0 (last visited Dec. 10, 2023).

In 2023, state legislatures considered more than 200 nuclear-related bills, a substantial increase over previous years.[103] States anticipate more nuclear activity within their borders to accomplish the federal government's ambitious decarbonization goals.[104] States are adjusting utility electricity generation requirements, lifting prohibitions on new nuclear, and working to extend existing NPPs.[105]

Twenty-nine states plus Washington, D.C., have Renewable Portfolio Standards (RPS) which place a "binding requirement on retail electric suppliers to procure a minimum percentage of generation from eligible sources of renewable electricity."[106] Fifteen states have Clean Electricity Standards (CES) which contain targets "based on a broader set of eligible technologies."[107] Four additional states have CES requirements at the executive level but with no legislative requirement, and one has economy-wide emission mandates but nothing targeting electricity in particular.[108] Since the first RPS passed in 1983, the statutes have pushed toward renewables;[109] however, beginning in 2017, states began amending RPS statutes to convert them to CES statutes or enacted CES statutes separately.[110] Though the label of "renewable" versus "clean" might seem unimportant on its face, states do not include

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[103] Aaron Larson, *Bipartisan Support Makes Backing Nuclear Power an Administration-Proof Investment*, POWER (Oct. 6, 2023), https://www.powermag.com/bipartisan-support-makes-backing-nuclear-power-an-administration-proof-investment/.

[104] *See* Subramanian, *supra* note 38, at 647 ("Overall, among the decarbonization pathways studied for the United States to meet its baseline long- term goal of reducing GHG emissions by 80% below 1990 levels by 2050, nuclear power consistently plays a role in the electricity generation mix. Numerous other studies have also supported the view that any meaningful plan to fully decarbonize the US electricity sector must allow for nuclear power.").

[105] California's Diablo Canyon NPP received funding from the BIL's Civil Nuclear Credit Program, which is designed to prolong the life of existing reactors. Timothy Gardner, *U.S. Grants $1.1 Bln to Keep Diablo Canyon Nuclear Plant Open*, REUTERS (Nov. 21, 2022, 2:01 p.m.), https://www.reuters.com/business/energy/us-approves-conditional-funding-diablo-canyon-nuclear-power-plant-2022-11-21/.

[106] GALEN BARBOSE, U.S. STATE RENEWABLES PORTFOLIO & CLEAN ELECTRICITY STANDARDS 7–8 (June 2023), https://eta-publications.lbl.gov/sites/default/files/lbnl_rps_ces_status_report_2023_edition.pdf [hereinafter BERKELEY LAB. REP.].

[107] *Id.* at 7, 9.

[108] *Id.* at 9.

[109] BERKELEY LAB. REP., *supra* note 106, at 10.

[110] *Id.* Despite the general trend adding RPS or converting RPS to CES, eight states allowed their RPS to expire and Montana repealed its RPS in 2021. *State Renewable Portfolio Standards and Goals*, NAT'L CONF. OF STATE LEGISLATORS, https://www.ncsl.org/energy/state-renewable-portfolio-standards-and-goals (last updated Aug. 13, 2021)

nuclear power within the definition of "renewable" energy.[111] By shifting the label, states include nuclear power.[112]

In 2023, the North Carolina state legislature overrode the governor's veto to convert its RPS into a CES.[113] The bill passed with bipartisan support, although the veto override occurred on more partisan lines.[114] Though only making small changes, the bill's title makes the intent clear:

> AN ACT TO REDEFINE "RENEWABLE ENERGY" AS "CLEAN ENERGY," TO PROVIDE THAT THE TERM INCLUDES NUCLEAR RESOURCES AND FUSION ENERGY, AND TO ELIMINATE LANGUAGE IMPEDING CPCN ISSUANCE FOR NUCLEAR FACILITIES.

The legislature struck all instances of "renewable," replaced it with "clean," changed the statute's name to "Clean Energy and Energy Efficiency Portfolio Standard" and added an expanded definition section that includes nuclear power.[115] North Carolina already sources a third of its electricity from nuclear power.[116] It is home to the Wilmington-based GE Hitachi, a world leader in reactor technology.[117] Duke Energy has filed plans to replace a coal-fired power plant at Belews Creek with an SMR set to begin operation in 2034.[118] The plans include replacing an additional unnamed coal-fired plant with four more new reactors planned for the future.[119]

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[111] *See Renewable Energy Explained: Portfolio Standards*, EIA, https://www.eia.gov/energyexplained/renewable-sources/portfolio-standards.php# (last updated Nov. 30, 2022).

[112] *Id.* Some CES also include natural gas power plants, provided they have carbon capture systems. *Id.*

[113] Alex Baltzegar, *NC Legislature Adds to Growing List of Overriden Cooper Vetoes: Elections, Energy, and Regulatory Reform*, CAROLINA J. (Oct. 10, 2023), https://www.carolinajournal.com/nc-legislature-adds-to-growing-list-of-overridden-cooper-vetoes-elections-energy-and-regulatory-reform/#.

[114] *Id.*

[115] *See* Promote Clean Energy Bill, NCLEG, https://www.ncleg.gov/Sessions/2023/Bills/Senate/PDF/S678v0.pdf (session bill).

[116] *North Carolina*, EIA, https://www.eia.gov/state/?sid=NC (last visited Dec. 10, 2023).

[117] Kevin Garcia-Galindo, *Nuclear Would Be Labeled 'Clean Energy' under New Legislation*, CAROLINA J. (May 22, 2023), https://www.carolinajournal.com/nuclear-would-be-labeled-clean-energy-under-new-legislation/. The TVA nuclear expansion plans include reactors designed by GE Hitachi. Larson, *supra* note 79.

[118] Adam Wagner, *Should Nuclear Power Be Considered Clean Energy? Yes, Says Proposed NC Legislation,* NEWS & OBSERVER (Sep. 5, 2023, 8:32 p.m.), https://amp.newsobserver.com/news/politics-government/article278538019.html.; *see also supra* note 24 and accompanying text (impact of pollution into Belews Lake). The bill sponsor, Paul Newton, is a former state president of Duke Energy. Wagner, *supra*.

[119] Wagner, *supra* note 118.

State bans and restrictions on new nuclear have shifted. Though twelve states have restrictions on new builds, one has banned nuclear outright, and another has banned it in a particular area of the state, four states have repealed their restrictions since 2016: Wisconsin, Kentucky, Montana, and West Virginia.[120] Connecticut added an exemption to its statute which would allow the existing nuclear plant to add new reactors.[121] Illinois's attempt at repeal met a veto at the Governor's desk.[122]

To support existing NPPs, some states have created tradable Zero Emissions Credits, which serve to offset the cost of producing electricity in an NPP by providing credits based on their zero-GHG emissions.[123] Utilities in the state must purchase a certain amount of these credits from the NPPs.[124] New Jersey, Connecticut, Illinois, Ohio, and New York all operate some variation of this type of program.[125] The New York and Illinois programs have faced challenges but survived.[126]

As more states increase support for nuclear power via CES, they will have to source it from somewhere. A 2023 Berkeley Lab report on RPS/CES determines that, based on existing state RPS/CES ramping up clean energy requirements, by 2030 the United States will need an additional 300 TWh of *new* clean energy supply with that number climbing to 800 THw by 2050.[127] The report anticipates that existing hydro and NPP resources can meet

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[120] *States Restrictions on New Nuclear Power Facility Construction*, NAT'L CONF. OF STATE LEGISLATORS (Sep. 28, 2023), https://www.ncsl.org/environment-and-natural-resources/states-restrictions-on-new-nuclear-power-facility-construction.

[121] *Id.*

[122] *Id.*

[123] CONG. RSCH. SERV., "STAYING NUCLEAR"?: LEGAL CHALLENGES TO STATE SUBSIDIES FOR AGING NUCLEAR POWER PLANTS AND RELATED FERC ACTIONS 1–2 (Mar. 26, 2021), https://crsreports.congress.gov/product/pdf/LSB/LSB10585.

[124] *Id.* at 1.

[125] Herman K. Trabish, *State, Federal Actions Show Growing Push for a Nuclear Role in Reaching Net Zero Emissions*, UTILITYDIVE (Sep. 28, 2021), https://www.utilitydive.com/news/state-federal-actions-show-growing-push-for-a-nuclear-role-in-reaching-net/606107/.

[126] CONG. RSCH. SERV., *supra* note 123, at 2 (noting also that the Supreme Court declined certiorari in both cases); *see e.g.*, *Coal. for Competitive Elec., Dynergy Inc. v. Zibelman*, 906 F.3d 41 (2d Cir. 2018); *Elec. Power Supply Ass'n v. Star*, 904 F.3d 518 (7th Cir. 2018).

[127] BERKELEY LAB. REP., *supra* note 106, at 24.

roughly half of 2050 CES demand—but that assumes an aging fleet does not retire.[128] As more states include CES or convert existing RPS to CES, nuclear power will increasingly become an option for utilities.

With the federal government supporting technological development and the deployment of that technology, utilities will have the tools necessary to meet these increasing state demands. With industry expanding the siting of SMRs and other microreactor technology on-site, grid pressure will decrease. Increasing the use of SMR technology will lead to the naturally occurring efficiency nth-of-a-kind technologies offer, one of the benefits available with the transition from CPPs to NPPs. The next Part discusses this and other generalized benefits stemming from replacing CPP with NPP.

IV. Replacing Coal Plants With Nuclear Power Yields Long-term Benefits for Plant Owners

Transitioning from CPPs to NPPs provides certain benefits to plant owners. Besides the clean-energy benefits of swapping emissions-heavy CPPs for zero-emissions NPPs, SMR nameplate capacities can match CPP production.[129] Portions of existing CPP infrastructure can be recycled or repurposed into the NPP, plus the workforce trained to operate the CPP living in the area can transition to the new plant.[130] NPPs create reliability in energy generation and allow utilities to diversify their fuel sources within their portfolio.[131] They also occupy a smaller geographic footprint than CPPs, allowing the owner to make additional use of the unneeded land surrounding the plant—possibly for renewables, creating a heightened benefit for the environment.[132] Ultimately, this translates to cost reductions and

[128] *Id.*

[129] Nils Haneklaus et al., *Why Coal-Fired Power Plants Should Get Nuclear-Ready*, ENERGY, Vol. 280 (Oct. 2023), at 2, https://doi.org/10.1016/j.energy.2023.128169.

[130] *Id.*

[131] Subramanian, *supra* note 38.

[132] *Id.*

reduced lag time during the transition, with additional side benefits for the local and global environments.

This Part identifies the benefits of transitioning CPPs to NPPs for the CPP owner, recognizing that without these incentives, EJ communities will have little opportunity to benefit alongside. First, this Part discusses how the transition creates power generation cost reductions and produces generative stability, contrary to existing CPPs. It then explores the similarities of CPP and NPP footprints and the benefits deriving from that overlap.

A. Nuclear Is Cheaper Than Coal and the Clear Winner When it Comes to Reliability

On the whole, the flexibility in SMR generative output makes it an ideal candidate to replace CPPs. Nuclear power plants like NuScale's VOYGR offer the option to install up to twelve reactors within the plant, starting at four reactors with the ability to scale up as power needs change.[133] SMR flexibility provides the ability to match CPP output regardless of the number of boilers in use by the CPP.[134] The number of advanced reactor sizes from a variety of producers makes it possible to replicate the characteristics of any CPP-generating structure.[135]

Besides replicating the CPP's generative ability, NPP infrastructure overlaps with some CPP infrastructure and can reduce capital costs through reuse. Though fundamental differences exist in the structure of CPPs and NPPs, a 2021 report from Idaho National Laboratory identifies possible re-use of certain critical infrastructure, ranging from complete removal of the CPP and remediation of the site to retention of the power-generating

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[133] *Voygr Power Plants*, NUSCALE, https://www.nuscalepower.com/en/products/voygr-smr-plants (last visited Dec. 10, 2023).

[134] *See* GEORGE GRIFFITH, TRANSITIONING COAL POWER PLANTS TO NUCLEAR POWER 5 (2021) [hereinafter IDAHO NAT'L LAB. REP.], https://inldigitallibrary.inl.gov/sites/sti/sti/Sort_54812.pdf (providing examples of different types of SMRs and microreactors).

[135] *See id.* at 11.

infrastructure.[136] Overall, the DOE estimates capital cost savings from 15% to 35% compared to greenfield sites depending on the level of infrastructure repurposed into the NPP.[137]

With SMR production occurring primarily in factories, the more SMRs deployed, the cheaper each SMR becomes, triggering the "economy of multiples" effect.[138] This effect happens based not only on the factory production of components, but the efficiency gained through repetitive construction efforts. The DOE described its hope of utilizing the Vogtle construction workforce as a seed group for future construction efforts—this kind of workforce helps drive down costs for later projects through communal knowledge and increased productivity.[139]

A 2020 report by the International Energy Agency and the Nuclear Energy Agency articulated the value NPPs have to the producer and the consumer over CPPs. The report found that in the United States, the median cost of producing electricity from coal was more than 150% of the cost of producing electricity from nuclear energy—$110/MWh for coal versus $71/MWh for nuclear.[140] That value derives from nth-of-a-kind cost reductions; as the industry replaces more CPPs with NPPs, the combination of nth-of-a-kind technology with efficient reuse of infrastructure will continue to drive down the cost of producing electricity.[141]

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[136] The report identifies four major areas of cost savings: 1) a complete replacement scenario allows for all new equipment and a complete environmental cleanup, while still taking advantage of the grid switchyard and connection, saving millions of dollars and time by using existing transmission lines; 2) utilizing existing service-water supply and the CPPs heat sink, with the heat sink as "potentially one of the most-valuable features of a CPP"; 3) transferring the steam-handling system and turbine; and 4) utilizing existing systems such as security, firefighting, and medical, as well as non-power infrastructure—roads, railroads, onsite buildings, sewer lines, etc. *Id.* at 11–15.

[137] DOE REPORT, *supra* note 23, at 72.

[138] Huber, *supra* note 61, at 472 (quoting INT'L ATOMIC ENERGY AGENCY, DEPLOYMENT INDICATORS FOR SMALL MODULAR REACTORS: METHODOLOGY, ANALYSIS OF KEY FACTORS AND CASE STUDIES 10 (2018)).

[139] *See 5 Things You Should Know about Plant Vogtle*, *supra* note 56.

[140] IEA, PROJECTED COSTS OF GENERATING ELECTRICITY 2020, https://www.iea.org/reports/projected-costs-of-generating-electricity-2020 (median technology costs table available in online version). NuScale puts the levelized cost comparison at $73/MWh for coal and $64/MWh for its twelve-reactor SMR, making coal 15% pricier. NUSCALE, NUSCALE SMR TECHNOLOGY: AN IDEAL SOLUTION FOR REPURPOSING U.S. COAL PLANT INFRASTRUCTURE AND REVITALIZING COMMUNITIES 7 (2021), https://www.nuscalepower.com/-/media/nuscale/pdf/publications/nuscale-smr-technology-an-ideal-solution-for-coal-plant-replacement.pdf.

[141] IEA, *supra* note 140, at 14.

NPPs produce stable power compared to other sources. Between 2015 and 2022, nuclear power plants produced electricity 92% of the time, meaning "they operated 336 out of 365 days per year."[142] Contrast this with other sources: wind—35%, solar—24%, hydroelectric—36%,[143] coal—48%, and combined cycle natural gas—56%.[144] NPPs are "nearly 2 times more reliable as natural gas and coal units, and almost 3 times or more reliable than wind and solar plants."[145] For a single coal plant to generate the same electricity over a year as an NPP, it would have to have more than double the generative power because of its inconsistent operation.[146] No other source of generation comes close to the reliability of nuclear power.[147]

B. Siting Similarities and Smaller Footprints

CPP and NPP sites share similar features: land, water requirement—except for some advanced reactors—and the need to protect from flooding and ponding. Because of the similarity of siting, replacement becomes even more facile.[148] A 2022 report by the DOE identified 157 recently retired CPPs and 237 currently operating CPPs as having the geographic qualities necessary to site an advanced nuclear reactor.[149] Eighty percent of the identified CPPs had suitable surrounding population density to host an advanced nuclear

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[142] *Electric Power Monthly,* EIA, https://www.eia.gov/electricity/monthly/epm_table_grapher.php?t=epmt_6_07_b (last visited Dec. 10, 2023); Richard Rhodes, *Why Nuclear Power Must Be Part of the Energy Solution*, YALEENVIRONMENT360 (July 19, 2018), https://e360.yale.edu/features/why-nuclear-power-must-be-part-of-the-energy-solution-environmentalists-climate.

[143] *Electric Power Monthly*, *supra* note 142.(2022 numbers).

[144] *Id.* (2022 numbers).

[145] *Nuclear Power Is the Most Reliable Energy Source and It's Not Even Close*, ENERGY, https://www.energy.gov/ne/articles/nuclear-power-most-reliable-energy-source-and-its-not-even-close (updated July 2022).

[146] *Id.*

[147] Rhodes, *supra* note 142 ("Nuclear is a clear winner on reliability.").

[148] *See* IDAHO NAT'L LAB. REP., *supra* note 134, at 16–17. See also DOE REPORT, *supra* note 23, at 79–88, for how the DOE identified which CPPs contained the right geographical characteristics for NPP siting. As of this Article's writing, the comment period had recently closed on an amended version of the NRC's siting criteria which allowed SMRs and other small reactors to use different reactor-specific methodology to determine appropriate siting. *Compare* U.S. NUCLEAR REGUL. COMM'N OFFICE OF NUCLEAR REGUL. RSCH., REGULATORY GUIDE 4.7, GENERAL SITE SUITABILITY CRITERIA FOR NUCLEAR POWER STATIONS (2014), https://www.nrc.gov/docs/ML1218/ML12188A053.pdf, *with* Draft Regul. Guide: Gen. Site Suitability Criteria for Nuclear Power Stations, 88 Fed. Reg. 71777 (Oct. 18, 2023), https://www.federalregister.gov/documents/2023/10/18/2023-22980/draft-regulatory-guide-general-site-suitability-criteria-for-nuclear-power-stations.

[149] DOE REPORT, *supra* note 23, at 9, 22. The report broke out the retired sites into five regions: Midwest—60; Northeast—18; Southeast—50; Southwest—13; West—16. *Id.*

reactor, a total of 315 sites.[150] The coal capacity output for all the combined sites is 263.3 GW.[151]

However, CPPs and SMRs do not require the same space, which opens up additional land within the property for alternative use. SMRs need approximately 50 acres, whereas a standard CPP uses between 200 and 250 acres; a CPP using carbon capture and sequestration technology uses around 400 acres.[152] The additional space creates the opportunity to develop additional industry onsite, install renewable generation or power storage, or partner with the surrounding EJ community.[153] Additionally, the space could harness the heat generated by the NPP by incorporating Integrated Energy Systems with high energy requirements—hydrogen production, desalination, or industrial heating—creating more economic opportunity for the area.[154]

Advanced NPPs utilize water differently than CPPs or older model NPPs. Some advanced reactors utilize molten salt, liquid metals, or helium gas for cooling instead of water.[155] In identifying which CPPs would align with an NPP's needs, the DOE did not consider these alternative cooling methods; that means the potential for an even larger number of potential CPP sites for NPPs with the above cooling methods.[156] Additionally, those reactors that do not use water as heat sinks will face fewer obstacles in procuring water

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[150] *Id.* at 17, 22. The DOE utilized a density cap of four miles based on an NRC permit provided to the TVA's Clinch River site and acknowledged the conservative nature of the four-mile cap, and that each reactor technology will have its own independent cap. *Id.* at 11.

[151] DOE REPORT, *supra* note 23, at 2.

[152] SMR START, OPPORTUNITIES FOR SMALL MODULAR REACTORS IN ELECTRIC UTILITY RESOURCE PLANNING 8 (2020), https://smrstart.org/wp-content/uploads/2020/02/SMR-Start-Public-SMRs-in-IRPs-APPROVED-2020-02-28.pdf; LANDON STEVENS ET AL., THE FOOTPRINT OF ENERGY: LAND USE OF U.S. ELECTRICITY PRODUCTION 2 (2017), https://docs.wind-watch.org/US-footprints-Strata-2017.pdf..

[153] IDAHO NAT'L LAB. REP., *supra* note 134, at 18.

[154] *Id.* at 18–19. The report suggested the attached industries and the NPP could form an agreement where power generation fluctuates based on grid requirements. *Id.* at 19.

[155] *Id.* at 4. Utilizing non-water-cooling sources also enhances the heat producing power of the plant, which can lead to the "potential to provide heat for non-power industrial applications" on site. *Id.* Additionally, non-water-cooling sources can offer heightened safety as they require lessened internal pressures to produce power than traditional reactors. *Id.*

[156] DOE REPORT, *supra* note 23, at 85–86.

rights and will likely encounter more community acceptance due to a reduced risk of water leaks and the lowered specter of irradiated water supplies.[157]

Pre-existing rail lines for coal distribution can facilitate delivery of the factory-produced SMR components where extant roads suffice to provide fuel to the NPP.[158] Additionally, if the NPP owner built additional plants onsite with the extra space, both the rail lines and the roads could serve to move new products to market.[159]

Because of the larger footprint of CPPs versus SMRs, and because of the reduced need for a low-population zone around these types of reactors, many of the CPPs analyzed by the DOE contained the entirety of the required zone within their property boundaries.[160] The reduced distance required between an NPP featuring an SMR and dense populations means considering CPPs nearer to dense population centers for replacement.[161] NuScale has also achieved certification for its methodology of determining the local emergency planning zone (EPZ) for its SMR; as a result, instead of the 10-mile radius usually required for older reactor technology, the NuScale type reactor's EPZ would only extend to the site boundary.[162]

With NPPs presenting cost-saving benefits—especially as more deploy—and generative stability unmatched by any other power source, CPPs cannot compete. The possibility of utilizing space currently occupied by CPP infrastructure for community benefit or for additional power or industry projects efficiently uses the property for further benefit.

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[157] IDAHO NAT'L LAB. REP., *supra* note 134, at 17.

[158] *Id.*

[159] *Id.* ("Industrial transportation would also allow coproducts from integrated energy systems (IESs), like hydrogen and ammonia, to be moved away from the site to market.")

[160] DOE REPORT, *supra* note 23, at 10–12.

[161] *Id.* at 11.

[162] Chris Charles, *NRC Staff Agrees Small Modular Reactors Won't Need Large-Scale Emergency Zones,* NEI (Aug. 22, 2018), https://www.nei.org/news/2018/nrc-staff-agrees-smrs-wont-need-large-epzs; *see also* U.S. Regul. Comm'n Advisory Comm. on Reactor Safeguards, Safety Evaluation for NuScale Topical Report, TR-0915-17772 (Oct. 19, 2022), https://www.nrc.gov/docs/ML2228/ML22287A155.pdf.

Though these benefits would pass through to the local EJ community, the primary benefit to that community comes from luring CPP owners to consider transitioning to an NPP.

The next Part addresses the direct impacts replacing a CPP with an NPP would have on the local EJ community.

V. Environmental Justice Trade-offs

Living near any power plant comes with some risks. EJ endeavors to ensure that the communities never given a choice in bearing those risks have a voice in the decision-making process and reap a portion of the benefits that come with the risks. The intersection between the rising support for NPPs and the energy industry's withdrawal from CPPs creates a window of opportunity for EJ communities. Replacing CPPs by siting SMRs within their existing footprint inverts the typical EJ story—SMRs eliminate the pollution concerns faced by the communities and increase their future economic opportunity.[163] However, as with anything, risks remain.

This Part focuses on the two primary benefits available to the local EJ community. First, as described above in Part II, CPPs create significant environmental impacts that affect the local community. NPPs have none of these same impacts. NPP impacts—while important to consider—are minimal when compared to those of the CPP. Second, this Part discusses the significant economic benefits available from the transition. When compared to retirement or carbon capture, the benefits associated with replacing a CPP with an NPP substantially outweigh the risks.

A. A Cleaner Environment Comes with Minimal Risk

[163] Subramanian, *supra* note 38, at 646.

The primary thrust for replacing CPPs with NPPs comes from the decarbonization benefit, which yields a global benefit rather than an exclusively local one.[164] From the carbon perspective, "switching from coal to nuclear power is radically decarbonizing."[165] Though the process of producing nuclear power through fission does not in itself produce emissions, greenhouse cases only emit "from the ancillary use of fossil fuels during . . . construction, mining, fuel processing, [and] maintenance."[166] In sum, the total carbon emissions match that of solar, or 1/20th of a natural gas-fired plant.[167] The DOE determined that a CPP to NPP transition would result in a direct 99% reduction of carbon emissions.[168] However, when factoring in the additional economic activity resulting from higher employment levels and the ancillary activity described above, that reduction drops to 86%, a still not-insignificant number.[169]

More important to local EJ communities, emissions reductions account for more than just reduced GHG. NPPs do not produce the toxic soup of NOx, SO_2, PM, and other chemicals released into the local environment from burning coal.[170] For example, NuScale anticipates some small emissions of NOx and SO_2 during a plant's lifecycle; however, when compared to emissions from CPPs, those emissions only account for .2% and .16% per MWh respectively with negligible PM emissions.[171]

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[164] Though this Article focuses on the local EJ impacts surrounding the CPP to NPP transition, it is important to note climate change's substantial impact on global communities worldwide who are disproportionately impoverished and non-white: "[T]he people and communities most vulnerable to climate-related impacts and disasters are those living in the global south, low-lying coastal zones, small island nation states, agricultural-dependent nations, and especially those living in poverty. Even under the best-case scenario, hundreds of millions will face food insecurity, forced migration, disease and death." Donaghy et al., *supra* note 3, at 3. Therefore, successful local efforts to decarbonize will yield huge impacts on global EJ populations.

[165] Rhodes, *supra* note 142.

[166] *Id.*

[167] *Id.*

[168] DOE REPORT, *supra* note 23, at 62.

[169] *Id.*

[170] *See supra* Part II.

[171] NUSCALE, *supra* note 140, at 7.

The transition to an NPP would also result in the removal or remediation of coal ash ponds. In describing the difference between nuclear waste and waste produced by CPPs, one commentator noted that while nuclear waste decays over time (albeit a long time), "[t]he toxic stew in the oceans of fly ash slurry adjacent to coal-fired power plants all around the world will remain toxic forever."[172] Coal ash is radioactive; any left within the proximity of the NPP "would interfere with radiation control and pose a disposal risk to the new NPP," therefore requiring stringent remediation requirements to meet NRC site radiological limits.[173] The added costs of removing all coal ash from the site instead of just capping it could lead CPP owners to site the NPP far enough away that the coal ash radioactivity does not interfere. However, the EPA Coal Combustion Residuals rule limits capping depending on the potential intrusion of coal ash toxicity into groundwater—the most significant EJ concerns stemming from coal ash ponds.[174] No matter the option, the transition from CPP to NPP requires some level of remediation benefitting the local community.

EJ communities should consider three major environmental concerns near an NPP—radioactive emissions from day-to-day operations, catastrophic accidents, and nuclear waste storage.[175] Radioactive emissions come from venting gas and discharging water, which introduce a small amount of radiation into the environment.[176] A dispute exists about

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[172] Don Howard, *The Moral Imperative of Green Nuclear Energy Production*, 1 NOTRE DAME J. EMERGING TECH. 65, 89 (2020).

[173] Maria Hvistendahl, *Coal Ash Is More Radioactive Than Nuclear Waste*, SCI. AM. (Dec. 13, 2007), https://www.scientificamerican.com/article/coal-ash-is-more-radioactive-than-nuclear-waste/; IDAHO NAT'L LAB. REP., *supra* note 134, at 14–15; DOE REPORT, *supra* note 23, at 98–99

[174] Frank Holleman, *Cap Coal Ash in Place? Duke and Others Have Learned Better*, UTILITY DIVE (Feb. 24, 2020), https://www.utilitydive.com/news/cap-coal-ash-in-place-duke-and-others-have-learned-better/572755/; *see also Disposal of Coal Combustion Residuals from Electric Utilities Rulemakings*, EPA, https://www.epa.gov/coalash/coal-ash-rule (last updated Nov. 7, 2023).

[175] Eric Jantz, *Environmental Racism with A Faint Green Glow*, 58 NAT. RES. J. 247, 254–55 (2018). An important issue not addressed by this Article, but of concern, is how uranium mining impacts Native American EJ communities—the majority of U.S. uranium mining is located within these communities. Jeanne Marie Zokovitch Paben, *Green Power & Environmental Justice-Does Green Discriminate?*, 46 TEX. TECH L. REV. 1067, 1086–87 (2014).

[176] Jantz, *supra* note 175. Jantz also points to risks EJ communities face regarding an aging nuclear reactor fleet which should not be a concern for EJ communities converting from a CPP to NPP. *Id.* (highlighting "radiation exposure from cooling system leaks, plant fires, and other small-scale accidents" as a concern of aging nuclear plants). For an example of this kind of concern, see Kaitlyn Radde, *A Nuclear Power Plant Leaked Contaminated Water in Minnesota. Here's What We Know*, NPR

whether the typical radiation encountered within the community leads to a higher incidence of cancers—the World Nuclear Association and the NRC claim that exposure to low levels of radiation is difficult to detect; however, numerous scientific studies suggest a relationship between proximity to an NPP during normal operations and detectable radiation.[177] This Article does not attempt to resolve that dispute.

EJ communities should consider two important factors when evaluating this risk. A 1978 Oak Ridge National Laboratory paper compared the radioactive impacts of living near a CPP to living near an NPP and found that CPP communities received between three and six times the radiation exposure as those near an NPP due to coal ash.[178] Food grown near CPPs showed evidence of radiation doses between 50% and 200% higher.[179] The question EJ communities should ask themselves: "Which is better?" CPPs create a demonstrably higher incidence of radiation for the local population. Additionally, the DOE altered its population density parameters to account for the anticipated reduced radiation exposure to the local community from SMR deployment.[180] That adjustment does not reflect zero risk of day-to-day exposure, but it means less exposure than from a CPP.

The second major concern stems from the potential for catastrophic accidents. Risk always exists, but history has shown that accidents of significant impact occur rarely.[181]

(Mar. 19, 2023), https://www.npr.org/2023/03/19/1164588882/minnesota-nuclear-power-plant-leak-contaminated-water (describing a leak of water containing tritium, which the article indicates commonly occurs among aging plants, but which also threatens no harm to the public at these levels).

[177] Dean Kyne & Bob Bolin, *Emerging Environmental Justice Issues in Nuclear Power and Radioactive Contamination*, INT'L J. ENV'T RSCH. PUB. HEALTH, 2016, at 3, https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4962241/pdf/ijerph-13-00700.pdf.

[178] Hvistendahl, *supra* note 173.

[179] *Id.*

[180] DOE REPORT, *supra* note 23, at 10–11. Despite the altered population density requirements, the DOE Report issued prior to the NRC commission's approval of NuScale's methodology to determine a site-boundary based EPZ. *See supra* note 162 and accompanying text. It also utilized the NRC methodology in the 2014 Regulatory Guide, not the pending amendment. *See supra* note 148.

[181] In the nearly seventy-five years of nuclear power plant operation, only three events have been categorized as having an accident with consequences beyond the property line—Chernobyl and Fukushima. *See generally* Yuri Rojavin et al, *Civilian Nuclear Incidents: An Overview of Historical, Medical, and Scientific Aspects*, 4 J. EMERGENCIES, TRAUMA, SHOCK 260, https://journals.lww.com/onlinejets/fulltext/2011/04020/civilian_nuclear_incidents__an_overview_of.18.aspx. Though the article discusses Goiania, radiation release occurred because a radiotherapy device from a clinic was sold as junk without protection, spreading radiation around the area. *Id.*

Lower-scale incidents may occur more frequently but rarely impact beyond the borders of the plant. Of the three worst nuclear accidents—Chornobyl, Fukushima Daiichi, and Three Mile Island—only Chornobyl had a significant direct, local impact, with higher incidences of thyroid cancer among a specific subset of the population who were adolescents at the time of the accident, who did not evacuate, and who drank contaminated milk.[182] Beyond this group, no long-term health consequences manifested.[183] The same goes for Fukushima and Three Mile Island.[184]

SMR technology means that surrounding EJ communities should not worry about even a Three Mile Island-type accident. The NRC issued a final rule titled "Emergency Preparedness Requirements for Small Modular Reactors and Other New Technologies," which took effect December 18, 2023.[185] The rule amends how the NRC evaluates emergency preparedness requirements for SMRs, recognizing

> Advances in design and technological advancements embedded in design features[,] . . . safety enhancements in evolutionary and passive systems[,] and . . . the potential benefits of smaller sized reactors and non-LWRs associated with postulated accidents, including slower transient response times, and relatively small and slow release of fission products.[186]

Additional safety features make SMRs appropriate for siting nearer to population centers: "a reduced core damage frequency, elimination of large-break loss-of-coolant accident sequences, smaller source term, reduced early release fraction, reactor vessels and

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[182] Rhodes, *supra* note 142.

[183] *Id.*

[184] Residents around Three Mile Island experienced less additional radiation than if they had received a chest x-ray. *Id.*; *see also Backgrounder on the Three Mile Island Accident*, NRC, https://www.nrc.gov/reading-rm/doc-collections/fact-sheets/3mile-isle.html (last updated Nov. 15, 2022). Ninety-eight percent of residents around Fukushima received a similar amount. Rhodes, *supra* note 142.

[185] Emergency Preparedness for Small Modular Reactors and Other New Tech., 88 Fed. Reg. 80050 (Dec. 18, 2023), https://www.federalregister.gov/documents/2023/11/16/2023-25163/emergency-preparedness-for-small-modular-reactors-and-other-new-technologies.

[186] *Id.* at 80050; see also U.S. NUCLEAR REGUL. COMM'N, REGULATORY GUIDE 1.242, PERFORMANCE-BASED EMERGENCY PREPAREDNESS FOR SMALL MODULAR REACTORS, NON-LIGHT-WATER REACTORS, AND NON-POWER PRODUCTION OR UTILIZATION FACILITIES (2023), https://www.nrc.gov/docs/ML2322/ML23226A036.pdf (instituting an emergency preparedness (EP) program for SMRs which is "performance-based, technology-inclusive, risk-informed, and consequence-oriented approach to EP as an alternative to [existing] EP requirements").

containment vessels that are located entirely underwater or below grade, and reactor buildings that are located partially or totally below grade."[187] The surrounding EJ community has significantly less to worry about because, even if an accident occurs, it will not impact the surrounding community like previous accidents.

The third concern stems from the United States' lack of nuclear waste storage. Currently, NPPs utilize dry-cask storage onsite instead of disposing waste in a common national storage area.[188] The Nuclear Waste Policy Act of 1982 directed the federal government to determine a permanent storage solution, but efforts to utilize Yucca Mountain in Nevada failed.[189] Without a nuclear waste storage plan, EJ communities around NPPs should plan for the generational problem of localized nuclear waste.[190] However, in the short term, dry-cask storage protects from any localized radiation contamination.[191]

Removing a CPP creates immense environmental benefits for the EJ community. Replacing it with an NPP creates some risk, though substantial gains made in reactor safety mitigate that risk. When compared to the day-to-day impacts of a CPP, an NPP presents a substantial upgrade. Though this Article argues the environmental benefits NPPs offer to EJ communities, it recognizes that environmental trade-offs exist. When weighing the trade-offs in total, the economic benefits discussed below ultimately tip the scale in favor of replacement.

B. Substantial Economic Benefit with Little Downside

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[187] DOE REPORT, *supra* note 23, at 83.

[188] Rhodes, *supra* note 142.

[189] James W. Moeller, *Public Utilities and Environmental Justice: Electric Restructuring and Deregulation and Low-Income Communities*, 21 U. D.C. L. REV. 1, 15–16 (2019). Though not addressed by this Article, the problem of nuclear waste storage additionally impacts Native American EJ communities as "sixty Native American communities have been targeted for storage or disposal of high-level radioactive wastes." Zokovitch Paben, *supra* note 175.

[190] *See generally* Cory Ehlenbach, A Radioactive Reality: Tackling the Ongoing Crisis of Nuclear Waste in America, (Dec. 13, 2023) (unpublished manuscript) (on file with author) (offering methods to tackle the problem of nuclear waste storage).

[191] Mitch Jacoby, *As Nuclear Waste Piles up, Scientists Seek the Best Long-Term Storage Solutions*, CHEM & ENG'G NEWS, Mar. 30, 2020, at 28, https://cen.acs.org/environment/pollution/nuclear-waste-pilesscientists-seek-best/98/i12

The transition from a CPP to an NPP will provide substantial benefits to a local EJ community primarily through benefits derived from plant-to-plant employment opportunities. The Idaho National Laboratory (INL) conducted a case study on Colstrip, MT, and found that replacing the CPP there with an NPP "offers the potential to support local families and the community over the long term."[192] The INL study determined that "much of the existing staff will be able to be retrained to work at an NPP" with "some specialized staff, such as trained technical nuclear staff and senior plant managers" coming from outside the area.[193]

A DOE case study arrived at similar conclusions by analyzing a hypothetical Midwestern town based on a composite of twelve CPPs in that area.[194] The DOE specifically reviewed the transitional impact "[t]hrough the lens of social and environmental justice" and found that "job growth and increased economic activity suggest an improved quality of life in the region."[195] The study found "additional economic activity on the order of $275 million, implying a 92% tax revenue increase from the NPP for the local county."[196] This economic increase comes from approximately a net increase of "653 new jobs to the region, distributed across the NPP, the supply chain, and the local community."[197] These numbers include approximately 250 full-time NPP jobs for the entire duration of the NPP's lifetime.[198] A separate report suggests that nearly a third of the NPP positions could transition directly from CPP work with minimal training.[199]

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[192] IDAHO NAT'L LAB. REP., *supra* note 134, at 19–25.

[193] *Id.* at 21.

[194] DOE REPORT, *supra* note 23, at 20.

[195] *Id.* at 73

[196] *Id.* at 2–3. This dollar amount does not account for economic influx from construction dollars during the transition. *Id.*

[197] *Id.* at 56, 69–70.

[198] *Id.* at 56.

[199] SCOTT MADDEN, GONE WITH THE STEAM: HOW NEW NUCLEAR POWER PLANTS CAN RE-ENERGIZE COMMUNITIES WHEN COAL PLANTS CLOSE 9 (Oct. 2021) ("[T]he vast majority of jobs in a SMR have coal plant equivalents that would likely require low to medium levels of retraining."), https://www.scottmadden.com/content/uploads/2021/10/ScottMadden_Gone_With_The_Steam_WhitePaper_final4.pdf.

Because NPP jobs pay more than CPP jobs do, "median income and median housing value . . . will experience upward pressure, thereby increasing the economic well-being of members of the community."[200] Additionally, the DOE identified an additional side benefit, an increase in high school graduation rates, which will lead to an increase in college graduates.[201]

The above economic benefits do not include any value added during demolition, remediation, or construction. Estimates on SMR construction suggest somewhere between 900 and 1,600 jobs over four years.[202] Because the transition will take years, these construction jobs can function as a bridge for many CPP employees during the transition. Of course, the trade-off here is that not all CPP jobs will transition to an NPP. Some people will lose their jobs. Additionally, the transition will take years, depending on how much remediation the site needs before NPP operations can commence. For many, uncertainty will dominate. However, as U.S. public policy shifts towards decarbonization, CPPs will inevitably close; the question for the EJ community is when. The plant closures in Adams County, OH, highlighted in Part II present a vision of the future for communities with no plan to replace their CPP.

Though a transition from a CPP to an NPP has trade-offs, the positive impacts on the EJ community are too substantial to ignore. With advances in reactor technology, support at the federal and state level, and growing interest in private industry, this presents an opportunity for EJ communities to invert the narrative they have suffered through for decades.

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[200] DOE REPORT, *supra* note 23, at 56.

[201] *Id.*

[202] SMR START, *supra* note 152 ("Construction and operation of a 600 megawatt SMR plant with multiple reactors is estimated to employ about 900 manufacturing and construction workers for about 4 years."); NUSCALE, *supra* note 140 ("Approximately 1,600 jobs will be created over the construction period of the plant.").

Taking advantage requires savvy. Most importantly it takes organization, both on the local level and nationally among EJ advocates. Through organization, EJ communities can leverage activity at the federal level specifically targeting them. The next Part provides recommendations on how the EJ community can take advantage of the opportunities available and what those opportunities might look like.

VI. Securing EJ Benefits for the Future

This Article could make innumerable recommendations relating to how to protect EJ communities during the transition from CPPs to NPPs such as creating NEPA enforcement authorization,[203] approaches to solving the U.S. nuclear waste problem,[204] or requiring the NRC to conform to Executive Order 12898's mandate to address adverse human health and environmental impacts on minority and low-income populations.[205] While these certainly deserve discussion, this Article provides recommendations utilizing a framework currently available and tied directly to the transition.

Justice40 creates the most direct way to access benefits from the transition. Because Justice40 ties to methods for leveraging financing available through the DOE via the IRA, EJ communities can leverage this financing requirement to their benefit. First, the Biden Administration's Justice40 initiative "directs 40% of the overall benefits of certain Federal investments . . . to flow to disadvantaged communities."[206] Second, under the Title 17 Clean Energy Financing Program, the DOE distributes loans for transitioning projects, under which the transition from CPPs to NPPs falls.[207] These loans require applicants to include a

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[203] *See* Jantz, *supra* note 140, at 272 (suggesting that, instead of relying on NEPA's "constricted view" of EJ, the NRC use the Atomic Energy Act's language requiring the protection of "health and safety of the public" as a mechanism to more effectively evaluate and protect EJ concerns).

[204] *See* Ehlenbach, *supra* note 190.

[205] *See* Kyne & Bolin, *supra* note 177, at 7 (explaining that because EO 12898 does not require independent federal agencies such as the NRC to comply, the NRC voluntarily performs the assessment during the Supplemental Environmental Impact Assessment for license renewals, leaving the significance of each issue to the NRC's discretion).

[206] *Justice40 Initiative*, ENERGY, https://www.energy.gov/justice/justice40-initiative (last visited Dec. 11, 2023).

[207] *Inflation Reduction Act of 2022*, *supra* note 87.

Community Benefits Plan (CBP) which, if developed with the right focus, can provide EJ communities with benefits available from the transition.[208]

A. An Organized Community Speaks with a Louder Voice

The first step in ensuring the right benefits flow to the right people, the EJ community needs to organize immediately. Stakeholders need to begin a dialogue within the community, first to determine if their community contains a CPP in consideration for transition to an NPP; and second, if the CPP is not in consideration, how to lobby the CPP owner to include it. The benefits described in this Article only derive from the CPP to NPP transition. Protecting the EJ community from a CPP shutdown or some less beneficial transition—like the carbon capture efforts described above—begins with organization.

In 2009, two of Chicago's worst offending CPPs shuttered early.[209] This came as the result of multiple organizations grouping into the Chicago Clean Power Coalition which instigated a multi-pronged approach challenging the presence of the CPPs within the city.[210] In the 2012 report on how to fight against CPPs, the NAACP stressed the importance of education, organization, and building coalitions between EJ communities.[211] With the CPP to NPP conversion movement in its nascency, banding together now creates the strongest opportunity to have a voice in the process. Communities identified in the DOE report as having CPPs with the highest potential for siting an NPP should immediately begin lobbying anyone involved in the decision-making process to site an NPP locally. This would place the community within the stakeholder conversation from the outset.[212]

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[208] *LPO's Updated Title 17 Clean Energy Financing Program Guidance Connects Eligible Projects to New Financing Opportunities as Part of President Biden's Investing in America Agenda*, ENERGY (May 19, 2023), https://www.energy.gov/lpo/articles/lpos-updated-title-17-clean-energy-financing-program-guidance-connects-eligible.

[209] NAACP, *supra* note 8, at 51.

[210] *Id.* at 52-54.

[211] *Id.* at 56.

[212] *See* OFF. OF MGMT. & BUDGET, EXEC. OFF. OF THE PRESIDENT, MEMORANDUM ON INTERIM IMPLEMENTATION GUIDANCE FOR THE JUSTICE40 INITIATIVE 7–8 (2021), https://www.whitehouse.gov/wp-content/uploads/2021/07/M-21-28.pdf (describing how Justice40 incorporates stakeholder consultations).

Admittedly, the above recommendation assumes a community has the information available to organize. The Chicago example cited by the NAACP report does not reflect the reality of the primarily non-urban, economically depressed communities that surround CPPs. Outside EJ advocates need to engage with these communities and advocate on their behalf. The DOE's Climate and Economic Justice Screening Tool provides an excellent resource for EJ advocates to quickly identify which EJ communities fall within the areas where an NPP might replace a CPP.[213] Additionally, though the DOE report does not name the CPPs it has identified, it does provide regional data, a listing of retired CPPs per state that would qualify, and its methodology for determining ideal CPPs for the transition.[214]

Organizing has proven effective at yielding the results a community desires. EJ communities can benefit from partners who have their best interests in mind. Together, stakeholders can leverage the benefits available through the Justice40 Initiative and Clean Energy Financing.

B. Leveraging Justice40 Through the Community Benefits Plan

In the context of this Article, Community Benefits Plans (CBPs) function as the first driver for an EJ community to derive benefits from the CPP to NPP transition. A CBP represents the outward expression of the future agreement struck between a project developer and the community.[215] The DOE intends for the CBP to be "intentionally flexible to generate the best approaches from the applicants and their partners" and requires that

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[213] The Administration created the Climate and Economic Justice Screening Tool which maps the location of communities falling within Justice40's targets. *See Climate and Economic Justice Screening Tool*, COUNCIL ON ENV'T QUALITY, https://screeningtool.geoplatform.gov/en/#3/33.47/-97.5 (last visited Dec. 11, 2023).

[214] *See* DOE REPORT, *supra* note 23, at 8–23.

[215] For a general discussion of Community Benefits Agreements—a cousin to the CBP—see Vicki Been, *Community Benefits Agreements: A New Local Government Tool or Another Variation on the Exactions Theme?* 77 U. CHICAGO L. REV. 5 (2010). For the purposes of Clean Energy Financing, a CBP will likely include multiple Community Benefits Agreements with different groups, or it will include agreements in place which will later become Agreements. Regardless, the CBP becomes a contractual obligation. *About Community Benefits Plans*, ENERGY, https://www.energy.gov/infrastructure/about-community-benefits-plans (last visited Dec. 11, 2023).

they be "specific, actionable, and measurable."[216] The DOE expects a project to engage "with a wide range of local stakeholders such as labor unions, local governments, Tribal governments, and community-based organizations that support or work with disadvantaged communities."[217] It encourages "[p]roactive engagement with these stakeholders" to create "stronger project plans, increased transparency, and [reduce] or [eliminate] certain associated risks."[218]

The CBP serves as the vehicle by which Justice40 benefits flow to the EJ community. Stakeholders within the EJ community should anticipate the process and prepare a model CBP from which negotiations can commence.[219] This Section discusses how the Justice40 Initiative is tied to DOE financing programs through CBP requirements and how EJ communities should proceed.

The Justice40 initiative originates from Executive Order 14008, which seeks to "ensure that environmental and economic justice are key considerations in how we govern."[220] To accomplish this goal, the Biden Administration intends to "invest[] and build[] a clean energy economy that creates well-paying union jobs, turning disadvantaged communities—historically marginalized and overburdened—into healthy, thriving communities, and [to] undertake[] robust actions to mitigate climate change while preparing for the impacts of climate change across rural, urban, and Tribal areas."[221] The executive order created a requirement calling on certain federal offices to publish "recommendations on how certain Federal investments might be made toward a goal that 40 percent of the overall benefits flow

[216] *About Community Benefits Plans*, *supra* note 215.

[217] *Id.*

[218] *Id.*

[219] The DOE provides a CBP template from which stakeholders and project owners can produce a CBP. *See id.* (providing a template).

[220] Exec. Ord. No. 14008: Tackling the Climate Crisis at Home and Abroad, 86 Fed. Reg. 7619, 7629 (Jan. 27, 2021).

[221] *Id.*

to disadvantaged communities."[222] Those recommendations can include utilizing existing agency power or potential legislation.[223] Justice40 targets "investments in the areas of clean energy and energy efficiency" and includes in its list "the remediation and reduction of legacy pollution."[224] Offices making recommendations "shall consult with affected disadvantaged communities."[225]

Specifically, Executive Order 14008 aims to help "energy communities" which it defines as "coal, oil and gas, and power plant communities."[226] But the 40% benefit goal does not always mean a tangible or financial boon. Identified benefits that may related to CPP communities include:

- GHG emission and local pollution reduction
- addressing the needs of impacted communities
- deployment of clean energy projects
- community microgrids
- energy burden reduction
- clean energy job training programs
- reduction of criteria and toxic air pollutants
- brownfield redevelopment and superfund remediation[227]

Each program individually calculates benefits associated with the program and determines how those benefits accrue. The agency administering the program is supposed to "consult with stakeholders . . . to ensure public participation and that the community stakeholders are meaningfully involved in what constitutes the 'benefits' of a program."[228] Additionally, the agency should consult with the community in the event a benefit occurs

[222] *Id.* at 7632.

[223] *Id.*

[224] *Id.*

[225] *Id.* The Office of Management and Budget issued interim guidance defining "disadvantaged communities" as being analogous with other federal and state language providing funding to communities tied to EJ. OFF. OF MGMT. & BUDGET, *supra* note 212, at 2–3. The report identifies a non-exhaustive list of specific characteristics which overlap significantly with communities surrounding CPPs. *Id.* As a result of the Justice40 Initiative, the Council on Environmental Quality created the "Climate and Economic Justice Screening Tool" which uses census data to map the locations of communities which qualify as "disadvantaged" under this definition. *See Climate and Economic Justice Screening Tool*, *supra* note 213.

[226] Tackling the Climate Crisis at Home and Abroad, 86 Fed. Reg. EO 14008 sec. 217–218.

[227] OFF. OF MGMT. & BUDGET, *supra* note 212, at 4-6.

[228] *Id.* at 7.

outside of the community.[229] However, the OMB admits "[i]t may not be possible to accurately measure the allocation of covered program benefits based solely on the geography where the program expenditures occur."[230]

Two DOE Title XVII Clean Energy Financing loan guarantee programs include Justice40 benefits applicable during the CPP to NPP transition.[231] First, as part of the Innovative Energy Loan Guarantee Program, DOE can "help finance projects that bring innovative nuclear energy technologies to commercial scale" which includes advanced nuclear reactors and SMRs.[232] The IRA added $40 billion of load authority under this section.[233] Second, the transition from retired CPPs to NPPs specifically operating SMRs falls within the EIR Program, which Congress initiated under the IRA.[234] The EIR program appropriates $5 billion through September 2026 with a ceiling guaranteeing $250 billion in loans.[235] As of the DOE Loan Program Office's February 2024 activity report, $72 billion remained available for financing under the Title XVII Clean Energy program and $60 billion remained for the EIR Program.[236]

Loan applicants under this program must submit a CBP which the DOE expects the CBP to serve as the main vehicle for achieving the Justice40 requirements.[237] The applications must demonstrate how the project will support:

1) community and labor engagement leading to negotiated agreements;

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[229] *Id.* at 7.

[230] *Id.* at 7 n. 9.

[231] *DOE Justice40 Covered Programs*, ENERGY, https://www.energy.gov/diversity/doe-justice40-covered-programs (last visited Dec. 11, 2023).

[232] *Id.*; *Innovative Energy and Innovative Supply Chain,* ENERGY, https://www.energy.gov/lpo/innovative-energy-and-innovative-supply-chain (last visited Dec. 11, 2023).

[233] *Inflation Reduction Act of 2022*, *supra* note 87.

[234] DEPT. OF ENERGY, PROGRAM GUIDANCE FOR TITLE 17 CLEAN ENERGY FINANCING PROGRAM 28–29 (2023), https://www.energy.gov/lpo/articles/program-guidance-title-17-clean-energy-program.

[235] *Inflation Reduction Act of 2022*, *supra* note 87.

[236] *Monthly Application Activity Report*, ENERGY, https://www.energy.gov/lpo/monthly-application-activity-report (updated monthly) (last visited Dec. 11, 2023).

[237] DEPT. OF ENERGY, *supra* note 234, at 44.

2) job quality and workforce continuity;

3) diversity, equity, inclusion, and accessibility; and

4) the Justice40 initiative goal that 40% of the overall benefits from certain federal investments flow to disadvantaged communities.[238]

The DOE will consider the proposed CBP as one factor in its loan application evaluation.[239] As an example, the DOE guidance illustrates that "indications in project planning of community support and a strategy to recruit and prepare an adequate and skilled workforce demonstrate higher likelihood of additional project approvals and completion."[240] The DOE requires large deployment projects—like transitioning from a CPP to an NPP—to include "the most robust plans" in their CBP.[241]

Once the applicant submits the CBP during Part II of the application process, the DOE will conduct a preliminary evaluation followed by an evaluation conducted during due diligence.[242] In the event an application contains an "incomplete or otherwise inadequate" CBP, the project "may not be invited to proceed to due diligence."[243] The DOE will post a summary of the CBP publicly for "transparency and accountability."[244] Most importantly, the DOE will consider the CBP "part of the contractual obligation of the funding recipient."[245]

EJ communities need to utilize CBPs to procure Justice40 benefits needed within their community. Because the transition from a CPP to an NPP will not take place overnight, the EJ community needs to negotiate employment guarantees protecting the community's already fragile economy. First, the EJ community needs to seek transitional employment

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[238] DEPT. OF ENERGY, TITLE 17 CLEAN ENERGY FINANCING PROGRAM: PART II APPLICATION INSTRUCTIONS 16 (2023), https://www.energy.gov/lpo/articles/title-17-clean-energy-financing-program-part-ii-application-instructions.

[239] DEPT. OF ENERGY, *supra* note 234, at 44.

[240] *Id.*

[241] Id.

[242] DEPT. OF ENERGY, *supra* note 238, at 16.

[243] *Id.*

[244] *Id.*

[245] *About Community Benefits Plans, supra* note 215.

guarantees. These would take the form of guaranteed employment for a certain percentage of the employees currently working at the CPP—assuming an operating CBP still exists in the area. Additionally, transitional employment guarantees should target guaranteed employment during the transition, possibly within the remediation or construction teams or through temporary relocation to other sites. Because these communities already face economic disadvantages, the goal here would be to protect those individuals from falling through the cracks during the transition.

Second, as an investment benefitting the local community as well as the NPP owner, seek the establishment of a training and scholarship program for local students. The primary focus of the scholarship would be to develop future nuclear engineers. Currently, the bulk of nuclear engineers are over the age of 47 with a significant gap between the ages of 38-47; an increasing number of engineers occupy the younger range.[246] With nuclear power ramping up again in the US, the industry will need additional engineers. Further, an "insufficient number of maintenance and radiation protection professionals" are entering the workforce to offset those retiring.[247] The training center would help backstop this problem as well as assist in training the workforce as it transitions from CPP to NPP. Done well, the NPP could begin operations with a localized, home-grown workforce.

In addition to employment guarantees, the EJ community should seek power-related benefits in the CBP. First, the community should seek a rate passthrough by which the community receives a discounted rate on electricity sourced from the NPP. This would reduce the costs to a community already dealing with economic disadvantage. Second, the

[246] Lawrence W. Townsend et al., *Nuclear Engineering Workforce in the United States,* 23 J. APPLIED CLINICAL MEDICAL PHYSICS, Dec. 2022, at 3, https://www.ncbi.nlm.nih.gov/pmc/articles/PMC9880971/#.

[247] *Id.*

community should seek the creation of a local microgrid to protect it from any external power fluctuations.

Finally, the community should engage in discussions regarding how the NPP owner plans to utilize the excess land. First, the community should insist on complete remediation. Second, a portion of the land should be utilized as some sort of community space. Third, the community should seek input on any further development the NPP owner plans, whether to develop renewables, construct hydrogen plants, or site other industry within its bounds.

Ultimately, because the DOE requires the NPP owner to engage with the community, these conversations will happen. The NPP owner will have their ideas of how to proceed. EJ communities in the surrounding area need their voices heard; having their ideas prepared beforehand will strengthen that chance.

C. Expand and Extend IRA Clean Energy Financing and Codify the Justice40 Initiative

As described above, the benefits available to EJ communities derive wholly from the Clean Energy Financing program. When Congress added funding to the Clean Energy Financing program and created the EIR Program, it included a sunset—the additional loan guarantees expire on September 30, 2026. As of the DOE's Loan Program Office report from March 2024, applications seeking financing would exhaust the entire remaining loan authority included in all financing programs.[248]

As demonstrated by the Vogtle plant experience described in Part III, developing an NPP takes many years and many billions of dollars. Acknowledging the decarbonization benefits provided by NPPs and the need for the U.S. power industry to decarbonize, Congress must expand the financing available for these clean energy projects and extend the timeline

[248] *See Monthly Application Activity Report*, *supra* note 236. The Loan Programs Office does not break the loan applications into their respective loan authority categories, nor does it indicate how likely the applicants are to receive financing, preventing this Article from determining how quickly the funding might exhaust.

past 2026. The IRA funding presents a good first step in the direction of protecting our environment and our EJ communities; to accomplish the goals tied to that funding, Congress must go bigger.

Further, in recognition of the burden borne by EJ communities, Congress should codify the Justice40 Initiative and require that 40% of federal investments in these categories must go to EJ communities: "climate change, clean energy and energy efficiency, clean transit, affordable and sustainable housing, training and workforce development, remediation and reduction of legacy pollution, and the development of critical clean water and wastewater infrastructure."[249] Congress has the opportunity to reverse the long history in the United States of requiring certain minority and economically disadvantaged populations to disproportionately bear the pollution and energy burden.

Ultimately, power plant owners engaging in the transition from a CPP to an NPP and utilizing DOE financing under the Clean Energy Financing Program will have to engage with the stakeholders in the EJ community. The key is to make sure the EJ community comes prepared, with ideas of its own, and with support from EJ advocates familiar with the battle. The federal government has begun to take steps to undo the problem of EJ. However, a later presidential administration could easily rescind Justice40, and the financing available for the transition insufficiently meets the nation's decarbonization goals in full and has rapidly approaching sunsets. Fully addressing the problem requires more steps.

Conclusion

The opportunity to utilize nuclear power in the transition away from coal presents an opportunity for both environmental justice communities but also the United States. The confluence of advanced reactor technologies—smaller and safer than before—with bipartisan

[249] *Justice40 Initiative*, *supra* note 206.

federal and state support, provides the United States an avenue to cement its status as the world leader in decarbonization. The United States can also demonstrate its recognition of the disproportionate burden it has historically placed on certain communities and will now do something to reverse that history.

In the final analysis, transitioning coal power to nuclear power serves the goals and needs of the nation as a whole as well as those of environmental justice communities. This alignment provides opportunities for which those communities need to prepare. Ensuring their readiness requires more than just local movement, it requires national initiative. Advocating for those communities on the local level while also advocating for them at the national level will secure the benefits available far into the future.