THIRD WAY

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Nuclear Closures Undo Years' Worth of Climate Progress

Ryan Fitzpatrick
Senior Director of Domestic Policy, Climate and Energy Program
@rdfitzpat

What if I told you that half the world's wind power might be taken off the grid over the next several years? If you cared about climate change, you'd be apoplectic—and rightfully so. At a time when we're struggling to increase our generation of zero-carbon electricity as fast as possible, recovering from this kind of setback would take years that we just don't have. Thankfully, we aren't really facing a loss of half the world's wind energy. But the world might lose even more zero-carbon power if something isn't done to stop nuclear plant closures right here in the United States.

> *In 2015, nuclear facilities in the U.S. alone generated as much zero-carbon electricity as all the wind turbines on the planet combined.*

And because so many of these nuclear plants are facing real financial challenges due to cheap natural gas, more than half of the country's nuclear power could go offline at some point in the near future. Regardless of what technology is producing it, the threat of losing this much zero-carbon energy *should* make climate advocates apoplectic.

We're Already Losing Some of our Strongest Climate Assets

Ideally, we'd want nuclear reactors to generate zero-carbon power throughout a 60-year lifespan, or even longer if they're able to continue operating safely. But fierce competition from natural gas (along with the failure of state and federal policies to adequately reward the climate benefits of nuclear power) is causing plants to retire much sooner than that. The U.S. has lost six nuclear reactors since 2013. An additional six reactor closures were narrowly averted, thanks to swift action by New York and Illinois to protect their respective fleets. Still, roughly 1/5 of the nation's nuclear fleet is scheduled for early retirement.

Table 1: Recent and announced retirements of U.S. nuclear reactors

Reactor	Capacity (MW)	State	Market Region	Primary Owner	Age (yrs)*	Retirement Date
Crystal River 3	860	FL	Southeast	Duke Energy	36	February 2013
Kewaunee	556	WI	MISO	Dominion	39	May 2013
San Onofre 2	1,070	CA	California	SCE & SDG&E	30	June 2013
San Onofre 3	1,080	CA	California	SCE & SDG&E	29	June 2013
Vermont Yankee	620	VT	New England	Entergy	42	December 2014
Fort Calhoun	469	NE	SPP	Omaha PPD	43	October 2016
FitzPatrick	847	NY	New York	Entergy	42	2017 (h)
Ginna	582	NY	New York	Exelon	46	2017 (h)
Nine Mile Point 1	637	NY	New York	Exelon	47	2017 (h)
Clinton	1,065	IL	MISO	Exelon	30	2017 (h)
Quad Cities 1	934	IL	PJM	Exelon	44	2018 (h)
Quad Cities 2	937	IL	PJM	Exelon	44	2018 (h)
Three Mile Island 1	837	PA	PJM	Exelon	43	2019 (p)
Oyster Creek	608	NJ	PJM	Exelon	47	2019 (p)
Pilgrim	677	MA	New England	Entergy	44	2019 (p)
Davis-Besse	889	OH	PJM	FirstEnergy	38	2020 (p)
Indian Point 2	1,032	NY	New York	Entergy	43	2020 (p)
Indian Point 3	1,051	NY	New York	Entergy	41	2021 (p)
Perry	1,231	OH	PJM	FirstEnergy	29	2021 (p)
Beaver Valley 1	970	PA	PJM	FirstEnergy	41	2021 (p)
Beaver Valley 2	920	PA	PJM	FirstEnergy	30	2021 (p)
Palisades	800	MI	MISO	Entergy	45	2022 (p)
Diablo Canyon 1	1,118	CA	California	PG&E	32	2024 (p)
Diablo Canyon 2	1,122	CA	California	PG&E	31	2025 (p)
Salem 1	1,174	NJ	PJM	PSEG	40	after 2019 (?)
Salem 2	1,130	NJ	PJM	PSEG	36	after 2019 (?)
Hope Creek	1,059	NJ	PJM	PSEG	31	after 2019 (?)
Millstone 2	882	CT	New England	Dominion	41	no date (?)
Millstone 3	1,155	CT	New England	Dominion	31	no date (?)
Total retired	4,655					
Total pending	21,657					
Total	26,312					

* Age reported at date of retirement for closed reactors; current age for operating reactors
(h) - previously announced retirement on hold due to pending state policy action
(p) - planned retirement date
(?) - economic retirement under consideration
Updated March 30, 2018

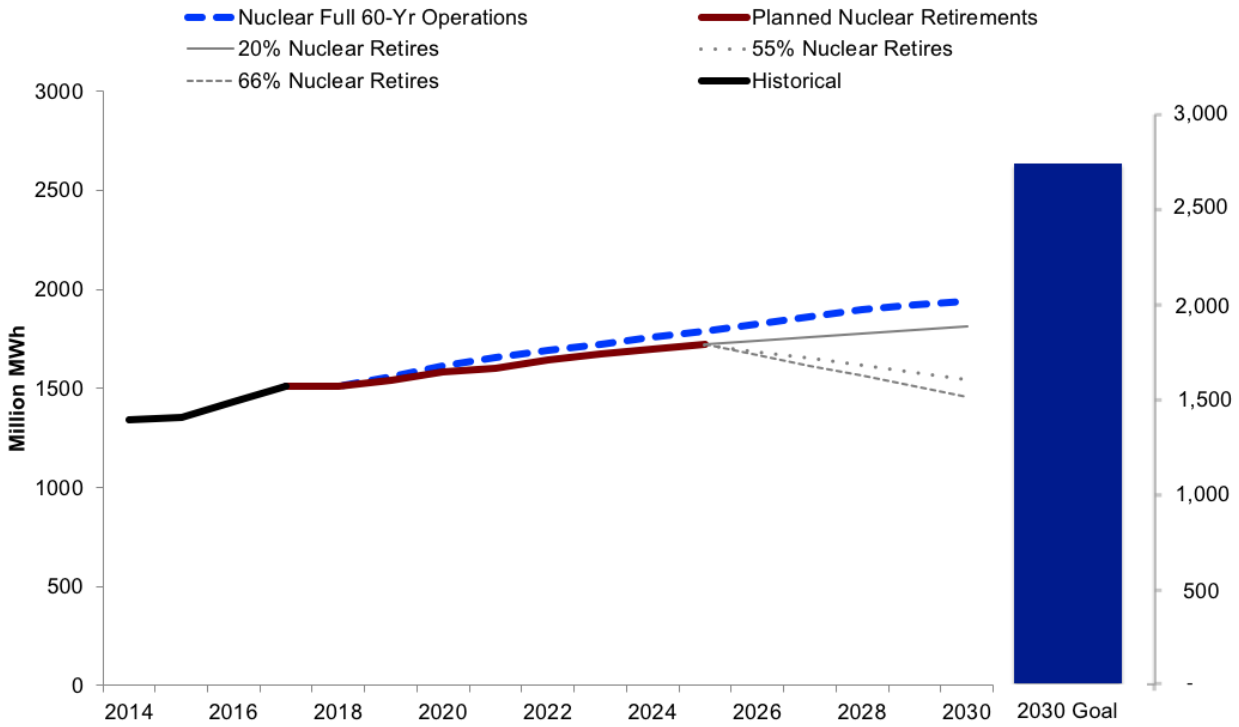
Courtesy of Jesse Jenkins

And that's likely just the tip of the iceberg. Bloomberg New Energy Finance (BNEF) estimates that 55% of the U.S. fleet is operating at a loss in current market conditions and at risk of premature closure, while research from MIT suggests that number could be as high as 66%. Even if just 20% is retired early, it's still a huge loss of clean energy and a blow to climate efforts.

Nuclear Closures Lead to 'Wasted' Renewables

Each and every scenario for achieving America's long-term climate goals calls for a massive increase in zero-carbon power, as we transition more of our energy needs toward electricity while simultaneously eliminating fossil fuel use. According to analysis behind the Obama Administration's "Mid-Century Strategy for Deep Decarbonization," the U.S. electricity sector will need to produce roughly 2,750 million MWh of zero-carbon electricity annually by 2030 to stay on track toward 2050 emissions targets. In the chart below, we've combined generation from nuclear energy with the latest growth projections for renewables from BNEF. Even in the best case scenario, where nuclear plants run for a full 60 years, our total zero-carbon generation in 2030 *still* doesn't hit the mark. If this tells us anything, it's that we must *accelerate* the pace of new clean energy deployment, and keep *all* of our existing clean energy resources online.

Total Low-Carbon Electricity Needed to Be on Track for Mid-Century Decarbonization Goals



Notes: Historical data from U.S. EIA; Projected wind and solar through 2025 based on Bloomberg New Energy Finance forecasted annual capacity additions and average capacity factor by resource type from 2014-2016; projection for 2026-2030 based on extrapolation of annual average capacity edition from BNEF forecast for 2021-2025 period. Planned nuclear retirements scenario includes all retirements announced as of April 1, 2018 and excludes closures that have been averted by state policy action in New York and Illinois. 20% retirement scenario is based on extrapolation of currently announced retirements trend. 50% and 66% retirement scenarios based on portion of U.S. nuclear fleet currently operating at a loss as estimated by BNEF (2016), "Reactors in the red: financial health of the US nuclear fleet" and Haratyk (2017), "Early nuclear retirements in deregulated U.S. markets: Causes, implications and policy options" respectively. Projected hydro assumed to continue at 2012-2017 annual average generation level. Projected other renewables assumed to continue to grow at annual average percent growth rate over 2012-2017 period (1.9% per year). 2030 low-carbon goal is from "Reference 80%" scenario in PNNL "GGCAM USA Analysis of U.S. Electric Power Sector Transitions," May 2017 performed in support of the White House "United States Mid-Century Strategy Strategy for Deep Decarbonization" report.

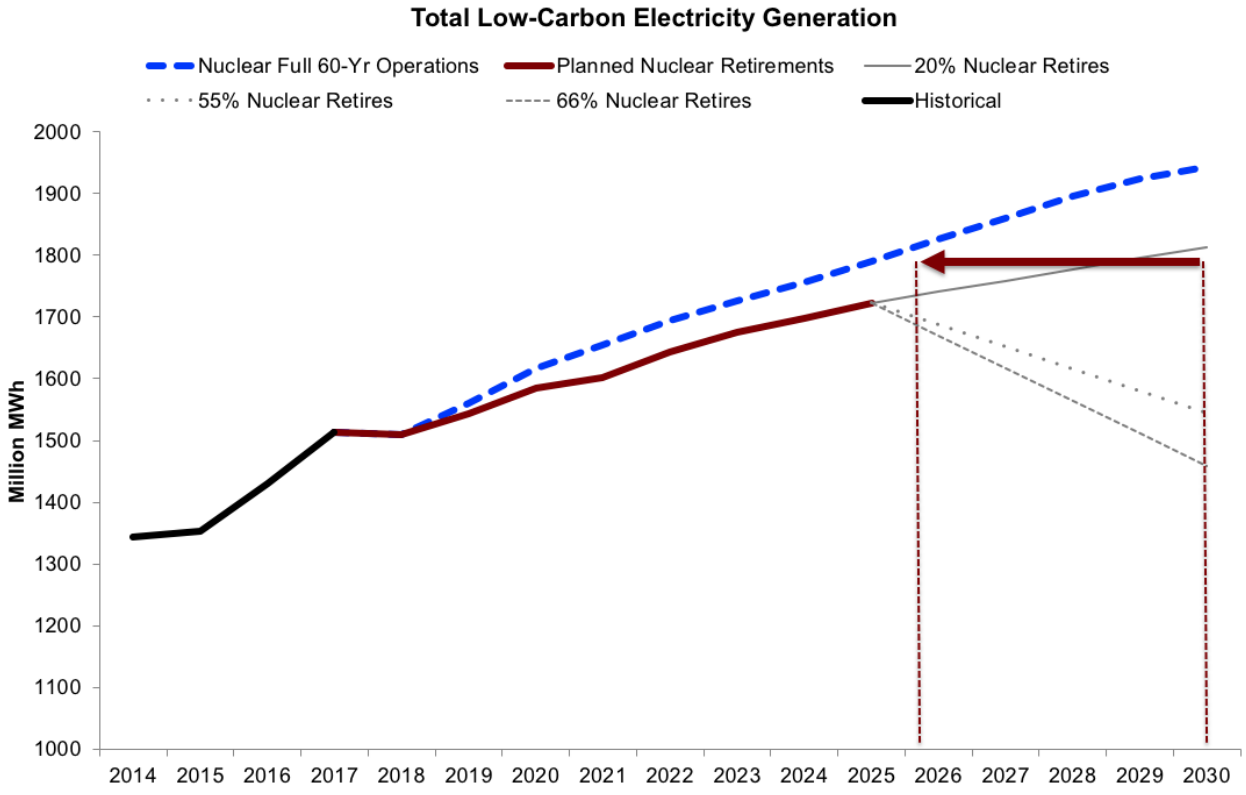
> *As nuclear plants get shut down, new renewables will have to pay-off that zero-carbon debt before they actually start increasing our totals again.*

Some argue that continuing to operate nuclear power plants is more expensive than building new renewable energy, so we should let these large sources of zero-carbon electricity retire and just build more wind or solar. The reality is more complex. First, in nearly all cases, keeping a nuclear power plant operating requires less public policy support than it does to build new wind or solar. Second, much of the zero-carbon generation we lose from nuclear retirements will invariably be replaced by fossil fuels like natural gas, and emissions will rise as a result. And finally, even if we were able to replace retired nuclear solely with renewables, it's still a setback in the climate fight. The only way we win is if we *grow* the amount of zero-carbon energy we're producing. As nuclear

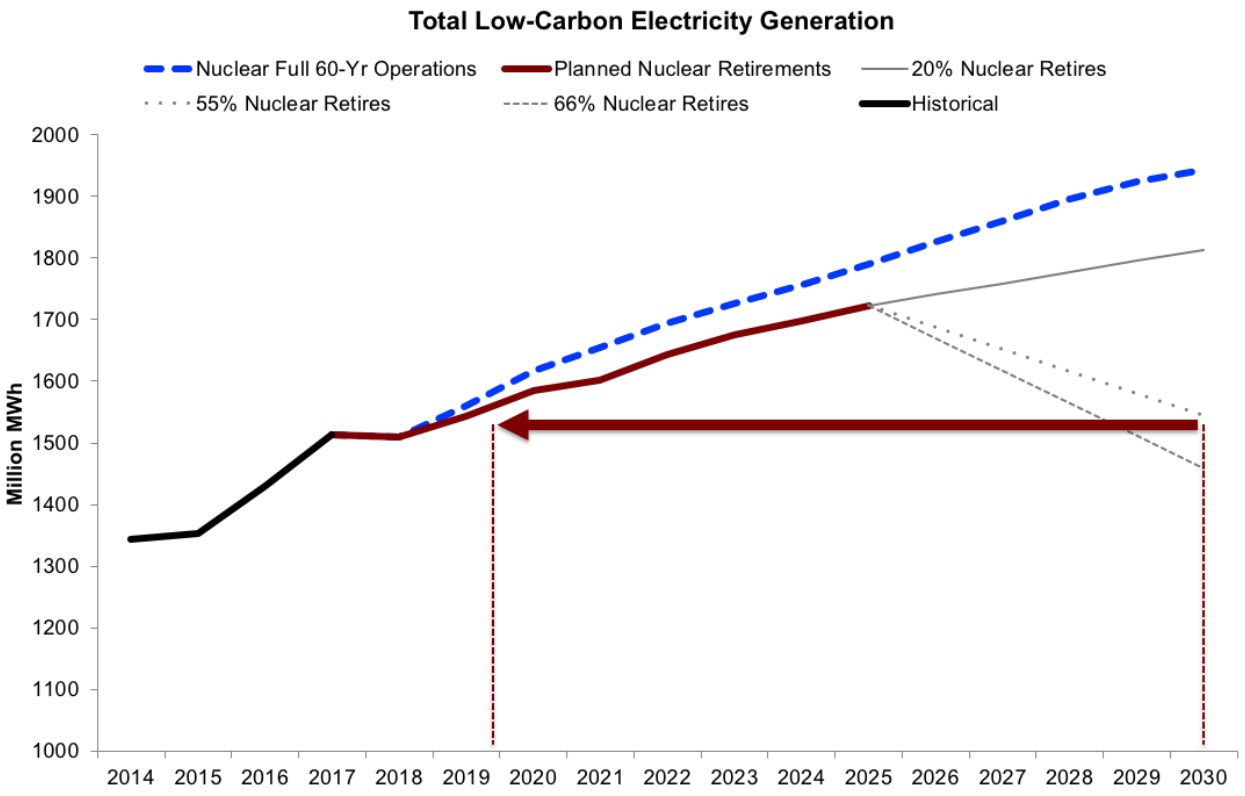
plants get shut down, new renewables will have to pay-off that zero-carbon debt before they actually start increasing our totals again. That's a big waste of renewable energy and, most importantly, time.

Undoing Our Climate Progress with Each Nuclear Retirement

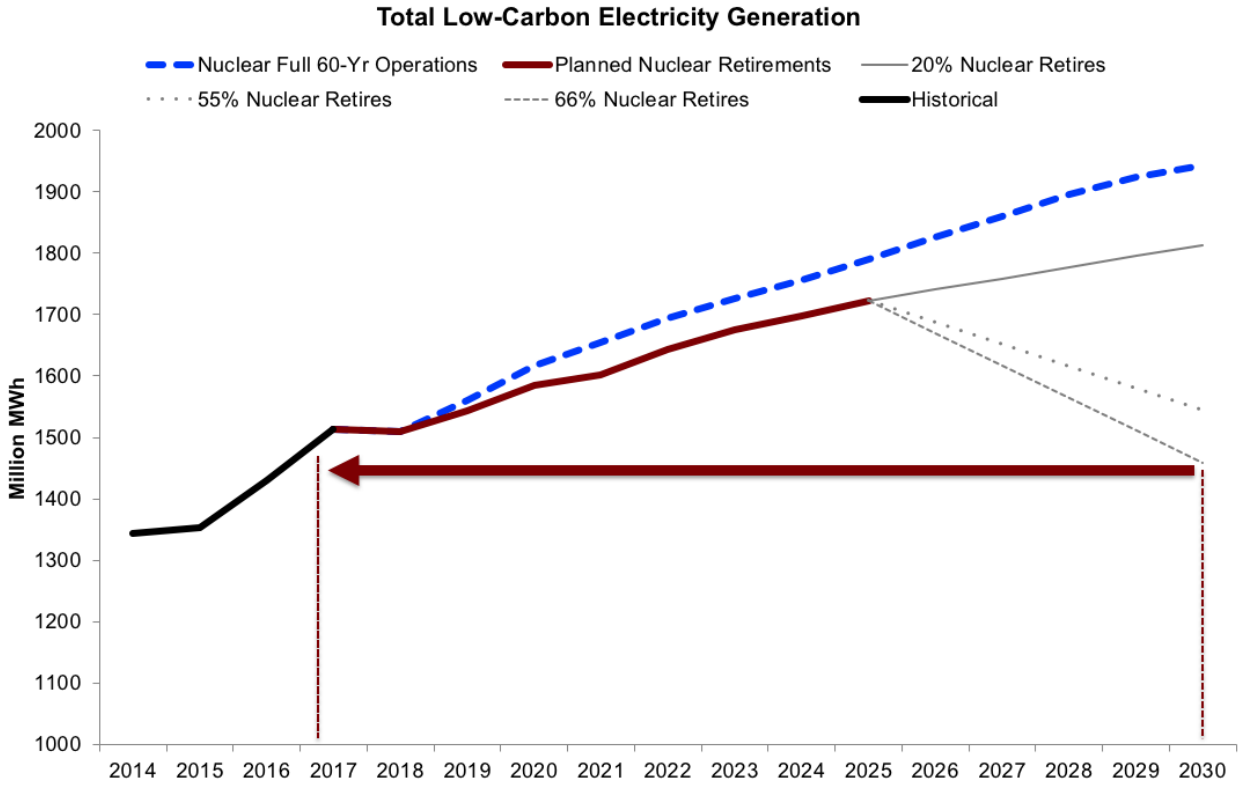
In fact, allowing nuclear plants to retire puts us years behind schedule in terms of scaling-up our zero-carbon power. Even if we limit the loss of nuclear generation between now and 2030 to just 20%, that's a setback of 4.5 years' worth of clean energy growth.



If we lose all the at-risk plants in the BNEF scenario (55% of the fleet), clean energy progress will be set back by *eleven* years. In other words, all renewable energy growth after 2018 would be wasted replacing nuclear, erasing all zero-carbon energy progress over this period.



> *And if we allow the worst-case scenario of 66% of at-risk plants to retire, we set our efforts back by a full thirteen years.*



Today's Nuclear and Tomorrow's Renewables: It's Not an Either/Or

At the end of the day, two things really matter in the fight against climate change: growing our total zero-carbon energy production so we can shift away from fossil fuels, and doing it quickly. If we allow today's zero-carbon nuclear power to disappear from the grid, much of the growth in renewable power that we're working so hard to accelerate will be wasted, and precious years will be lost in the process. State and federal policy can promote new clean energy *and* support the clean generation we already have. In fact, if we want to get anywhere close to our climate goals, our policies absolutely *must* take both into account.

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