INCENTING GREEN TECHNOLOGY: THE MYTH OF MARKET-BASED COMMERCIALIZATION OF NO- AND LOW-CARBON ELECTRICITY SOURCES

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As the United States attempts to increase the percentage of no- and low-carbon electricity sources in the fuel mix, one consideration is whether these sources are more expensive than carbon intensive sources or are capable of being competitive in the market without subsidies. This Article explores the types of federal subsidies that exist for nuclear, wind, solar, hydropower, and other no- and low-carbon electricity sources. No source is currently solely market driven.

After discussing how the federal regulatory and legislative treatment varies, this Article discusses the potential rationales for the disparity in treatment between different energy technologies. While it was expected in 1962 that nuclear power would become a market-based, commercial technology, subsidies to be used for "emerging" technologies are still being granted to new nuclear power plants. Looking specifically at loan guarantees, this Article examines how different no- and low-carbon electricity sources use the subsidy, and how vertically-integrated utilities use loan guarantees to further entrench their position against disruptive technologies. Finally, the treatment of no- and low-carbon sources under the EPA's Clean Power Plan demonstrates how incentives, if not legislative or regulatory policy, may be shifting.

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"Because of the public health and safety factors associated with the use of atomic energy and the continuing needs of the military, a detailed and intricate body of law and regulation governing its industrial use has been established. . . . [I]t is clear that the day is not too far off when a client will walk into a law office and ask counsel either to advise him of the requirements necessary to the handling of radioactive materials, or, to the construction, ownership or operation of a nuclear facility."

—Robert P. Garbarino, from *How a Lawyer Builds a Nuclear Power Plant*, 1962[1]

INTRODUCTION

In 2014, governments around the world spent more than five trillion dollars on energy subsidies,[2] mostly for fossil fuels. For

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1 Robert P. Garbarino, *How a Lawyer Builds a Nuclear Power Plant*, 7 VILL. L. REV. 587, 587 (1962). Unfortunately, with the exception of one attempt at reclamation regulation and establishing the federal government's responsibility for nuclear waste, the laws have not changed much since then.

2 *See* David Coady et al., *How Large Are Global Energy Subsidies?* 5 (Int'l Monetary Fund, Working Paper No. 15/105, 2015), http://www.imf.org/external/pubs/ft/wp/2015/wp15105.pdf. This study includes the value of implicit subsidies given to energy producers where they are not forced to internalize

countries in the G-20, fossil fuels are currently subsidized by over $1,000 per citizen.[3] In the United States, the total amount of subsidies for oil and gas reach almost $7 billion annually, mainly in the form of tax write-offs and deductions.[4] While there is some discussion of fossil fuel and coal subsidies which make up the vast majority,[5] much of the recent press and legislative debate regarding energy subsidies discusses supporting no- and low-carbon sources of electricity, specifically renewables, and when those energy sources will be competitive in the marketplace without subsidies.

With the release of the EPA's Clean Power Plan, no- and low-carbon electricity sources will become increasingly important to our energy mix,[6] and, therefore, our national economic well-being. How we treat these sources from a federal regulatory and legislative perspective could significantly influence what sources will be developed over the next ten to fifteen years.

Currently, federal legislative treatment and federal government subsidies for the four main sources of no- and low-carbon electricity—nuclear, wind, solar, and hydro—vary substantially, with nuclear receiving more than all other no- and low-carbon sources combined.[7] This is even though renewable

(through a tax or some other mechanism) the externalities they produce. *See id.* at 4–5. Direct government spending on subsidies are about one-tenth of the global $5 trillion number, or roughly $500 billion. *See id.* at 21 figs.6 & 7.

3 *See* Damian Carrington, *G20 Countries Pay over $1,000 per Citizen in Fossil Fuel Subsidies, Says IMF*, GUARDIAN (Aug. 4, 2015), http://www.theguardian.com/environment/2015/aug/04/g20-countries-pay-over-1000-per-citizen-in-fossil-fuel-subsidies-say-imf.

4 *See* Jordan Weissman, *America's Most Obvious Tax Reform Idea: Kill the Oil and Gas Subsidies*, ATLANTIC (Mar. 19, 2013), http://www.theatlantic.com/business/archive/2013/03/americas-most-obvious-tax-reform-idea-kill-the-oil-and-gas-subsidies/274121/.

5 *See* Hannah Northey, *Senate Democrats Revive Effort to Target Oil, Gas Subsidies*, GREENWIRE (Aug. 4, 2015), http://www.eenews.net/greenwire/2015/08/04/stories/1060022969. *See generally* Joshua Fershee, *Promoting an All of the Above Approach or Pushing (Oil) Addiction and Abuse?: The Curious Role of Energy Subsidies and Mandates in U.S. Energy Policy*, 7 ENVTL. & ENERGY L. & POL'Y J. 125 (2012) (discussing an overview of oil and gas subsidies). Unfortunately, these subsidies may be increased. *See generally* Offshore Production and Energizing National Security Act of 2015 (OPENS Act), S. 2011, 114th Cong. (2015).

6 Scott Detrow & Elizabeth Harball, *Final Clean Power Plan Shifts Toward Renewables and away from Natural Gas*, CLIMATEWIRE (Aug. 4, 2015), http://www.eenews.net/stories/1060022944.

7 *See infra* Section III. By one estimate, federal subsidies for nuclear power

energy sources (excluding hydropower) produce more electricity than nuclear plants in countries representing almost half of the world's population.[8]

To attempt to understand the disparity in federal energy subsidies for no- and low-carbon electricity sources, this Article will start by discussing the federal subsidy schemes in place for nuclear, wind, solar, and hydro, followed by a short discussion of other low- and no-carbon sources. It will then show that, while rationales may have existed for originally, the same does not hold true today. In 1962, nuclear was expected to fairly rapidly become a market-based, commercial technology. Yet federal loan guarantees, supposedly only to be used for "emerging" technology, continue to be available to nuclear projects over fifty years later.[9] They represent a valuable case study of whether federal government subsidies, at least in one area, are equitably distributed, and how markets view no- and low-carbon sources of electricity and the risk associated with them. This Article will conclude by discussing the Environmental Protection Agency's Clean Power Plan's (CPP) potential for no- and low-carbon sources, regulatory treatment of those sources under the CPP, and other specifics on how federal subsidies could be equitably distributed and markets enabled to incent green technology development and adoption.

totaled $145.4 billion between 1947 and 1999. The federal subsidies for wind and solar during the same time period was $5.7 billion. *Renewable Energy is Capable of Meeting Our Energy Needs*, PUBLIC CITIZEN 1, 3 (last visited Mar. 23, 2017) https://www.citizen.org/documents/RenewableEnergy.pdf. From 1999 to 2007, energy subsidies which went to renewables increased from 17% of federal subsidies to 29% in 2007, leading to the 2007 federal subsidies for renewables equaling $4.87 billion. U.S. ENERGY INFO. ADMIN., FEDERAL FINANCIAL INTERVENTIONS AND SUBSIDIES IN ENERGY MARKETS 2007, xi–xii (2008), https://www.eia.gov/analysis/requests/2008/subsidy2/pdf/subsidy08.pdf. Another study has suggested that, on an "apples-to-apples comparison," the federal spending committed to nuclear was more than ten times greater than that for renewables. *See* NANCY PFUND & BEN HEALY, WHAT WOULD JEFFERSON DO? THE HISTORICAL ROLE OF FEDERAL SUBSIDIES IN SHAPING AMERICA'S ENERGY FUTURE 6 (2011), https://www.dri.edu/images/stories/foundation/forums/What-Would-Jefferson-Do-HANDOUT.pdf.

8 These include Japan, China, and India. *See* Aaron Sheldrick, *Renewables Outpace Nuclear in Economies Making up 45 Percent of World Population: Report*, REUTERS (July 15, 2015), http://www.reuters.com/article/2015/07/15/us-nuclear-industry-decline-idUSKCN0PP0AX20150715.

9 Garbarino, *supra* note 1, at 587.

I. FEDERAL SUBSIDIES FOR NUCLEAR POWER

Overall, federal subsidies for nuclear power are more significant, widespread, and longer-lasting than for any other no- or low-carbon source of electricity. Various direct and indirect federal subsidies exist throughout reactor design, financing and construction, operation, and the fuel supply chain, including mining, enrichment, fuel fabrication and reprocessing, and spent fuel storage.[10]

A. *Mining*

The majority of the mining subsidies stem from the Mining Law of 1872.[11] This legislation provides specific subsidies for hardrock mining, which includes uranium mining: first, it provides the ability to privatize federal land where uranium is found for a minimal fee established in 1872;[12] and secondly, it provides—for uranium mined on federal land which is not privatized—the ability to pay very low fees for the right to mine and no royalties on the uranium extracted.[13] Additionally, while the federal government has recognized the potential environmental hazard from

10 While it may appear that indirect subsidies are only included for nuclear, the same indirect subsidies simply do not exist for other low- and no-carbon sources, and this list is not intended to be exhaustive. For example, I have not attempted to value Bureau of Land Management (BLM) land that hosts low- or no-carbon sources or the value of BLM land which hosts indirect activities which relate to low- or no-carbon sources, although the value of these activities could be debated to be a subsidy.

11 *See* Mineral Lands and Regulations in General, 30 U.S.C. §§ 22–42 (2012).

12 "Notwithstanding any other provision of law, for every unpatented mining claim, mill or tunnel site located after the date of enactment of this subtitle [enacted Aug. 10, 1993], to the extent provided in advance in Appropriations Acts, pursuant to the Mining Laws of the United States, the locator shall, at the time the location notice is recorded with the Bureau of Land Management, pay to the Secretary of the Interior a location fee, in addition to the claim maintenance fee required by section 10101 [30 U.S.C. § 28f], of $25.00 per claim." 30 U.S.C. § 28g (2012).

13 Combined with other hardrock mining, a report concluded that at least $40 million in royalties was lost annually. *See* THE PEW CAMPAIGN FOR RESPONSIBLE MINING, REFORMING THE U.S. HARDROCK MINING LAW OF 1872: THE PRICE OF INACTION 3 (2009) [hereinafter REFORMING THE U.S. HARDROCK MINING LAW], http://www.pewtrusts.org/~/media/legacy/uploadedfiles/peg/publications/report/Reforming20Mining20Lawpdf.pdf. The same report found that $29 million in reclamation fees were also lost annually which would be collected if the same reclamation fee for coal were required for hardrock minerals. *Id.*

radioactive tailings left at mine sites and has attempted to address the issue,[14] the bonding requirements are still insufficient to pay for what would need to be spent on reclamation to protect the environment.[15] Federal tax subsidies also exist for uranium mining operations: companies are allowed to "deduct a set amount from their taxable income each year, regardless of the amount of their investment in the mine."[16] This amount can exceed the amount of the investment.[17] In 2006, the number of uranium mining claims increased from fewer than 4,300 in 2004 to more than 32,000 in 2006 in four states alone.[18]

14 The Uranium Mill Tailings Radiation Control Act of 1978 "establishe[d] programs for the stabilization and control of mill tailings at uranium and thorium mill sites, both active and inactive, in order to prevent or minimize . . . the diffusion of radon into the environment." 42 U.S.C. § 7901(a) (2012). One of the listed purposes of the Act was to "stabilize and control such tailings in a safe and environmentally sound manner and to minimize or eliminate radiation health hazards to the public[.]" § 7901(b). Uranium mining is one type of hardrock mining. *See Hardrock Mining on Federal Lands*, U.S. GOV'T ACCOUNTABILITY OFFICE, http://www.gao.gov/key_issues/hardrock_mining_federal_lands/issue_summary (last visited Mar. 1, 2017). Hardrock minerals include gold, silver, molybdenum, zinc, and copper. *See Hardrock Mining*, RED LODGE CLEARING HOUSE (Aug. 31, 2010), http://rlch.org/content/hardrock-mining#hardrock. Unfortunately, the Animas River spill at the Gold King mine demonstrated the inadequacy of hardrock mining clean-ups. *See* Richard Parker, *A River Runs Yellow*, ATLANTIC (Aug. 21, 2015), http://www.theatlantic.com/national/archive/2015/08/a-river-runs-yellow/401966/. The mine originally produced gold and silver until ceasing operations in 1922. *See* U.S. EVNTL. PROT. AGENCY, GOLD KING MINE WATERSHED FACT SHEET, https://www.epa.gov/sites/production/files/2015-08/documents/goldkingminewatershedfactsheetbackground.pdf. The EPA does not even have a full, detailed list of locations that could be problematic, much less the funding to adequately stop pollution. The U.S. Geological Survey maintains a database listing up to 260,000 sites, although the number may be closer to 500,000. *See* Manuel Quinones, *EPA's Spill Pales in Comparison to Everyday Mine Leaks*, GREENWIRE (Sept. 8, 2015), http://www.eenews.net/greenwire/2015/09/08/stories/1060024348.

15 Taxpayers funded $2.6 billion in reclamation efforts between 1998 and 2007, with a potential need to spend an additional $20–$54 billion for other hardrock sites, including uranium mines. *See, e.g.*, REFORMING THE U.S. HARDROCK MINING LAW, *supra* note 13; DOUG KOPLOW, UNION OF CONCERNED SCIENTISTS, NUCLEAR POWER: STILL NOT VIABLE WITHOUT SUBSIDIES 59–62 (2011), http://www.ucsusa.org/sites/default/files/legacy/assets/documents/nuclear_power/nuclear_subsidies_report.pdf.

16 REFORMING THE U.S. HARDROCK MINING LAW, *supra* note 13, at 4–5.

17 *See id.*

18 *See* KOPLOW, *supra* note 15, at 58.

B. *Enrichment and Fuel Fabrication*

Mined uranium ore typically contains only seven-tenths of one percent of the uranium isotope needed to fuel reactors.[19] In order to increase this level to the 3.5 percent necessary for commercial reactors, the fuel must be enriched.[20] Federal subsidies support enrichment in several ways. Until enrichment was privatized in 1998, enriched uranium was supplied to utilities by the government, which also provided enriched uranium for military use.[21] The cost charged to commercial reactors was lower than the average production cost,[22] and may have decreased the cost to produce electricity by between eight and twenty-two cents per kilowatt-hour.[23] The privatized company, the U.S. Enrichment Corporation, was transferred contracts worth at least $7.2 billion through 2009.[24]

The government also provided research and development funding for both enrichment and fuel fabrication, as well as fuel reprocessing. Overall, nuclear power "captured almost 54 percent of all federal [energy] research dollars between 1948 and 2007."[25] Between 1950 and 1993, the figure was 62 percent, even excluding military programs or reactors.[26] Nuclear remains the largest single beneficiary of the Department of Energy's (DOE) research and development fund, attaining 28.3 percent of the fund's disbursements between 1998 and 2007.[27] DOE expects to continue to fund about $500 million of research per year,[28] recently announcing up to $40 million in cost-sharing opportunities for advanced reactor concepts.[29]

19 See *id.* at 62.

20 *See id.* at 62.

21 The U.S. Uranium Enrichment Enterprise was part of the Department of Energy and first served commercial customers in 1969. *See id.* at 63.

22 *See id.* at 20.

23 *See id.* at 64.

24 *See id.* at 67.

25 *Id.* at 19.

26 *See id.* at 46. This is six times the support for all renewable technologies put together over the same time period. *See id.*

27 *See id*. at 47.

28 *See id.* at 48.

29 *See* Ben Panko, *DOE Offers Funding for Advanced Reactor Designs*, GREENWIRE (July 31, 2015), https://pressfolios-production.s3.amazonaws.com/uploads/story/story_pdf/154146/1541461438700077.pdf.

C. *Reactor Construction, Liability, and Indemnity*

In addition to helping finance reactors with loan guarantees (see Section IV below), the federal government also limits the liability of private parties for meltdowns or other nuclear disasters. The nuclear industry's liability paradigm, codified in the Price-Anderson Act,[30] establishes three tiers of liability depending on the severity of the incident: 1) primary individual liability insurance, 2) an industry fund, and 3) federal government indemnification.[31] A utility with a nuclear reactor must maintain only $375 million of private liability insurance, and make annual payments of $15 million or less into a secondary insurance pool.[32] By legislation, each new license issued by the Nuclear Regulatory Commission (NRC) binds the NRC "to indemnify and hold harmless the licensee . . . from public liability arising from nuclear incidents which is in excess of the level of financial protection required of the licensee."[33] The combined primary and secondary insurance coverage is about $12 billion.[34] Should an accident or other incident occur, the federal government pays for all further damages above this number.[35]

This situation came about because in the early period of the nuclear industry, private insurers would not fully insure private utilities for the risk associated with nuclear power.[36] There simply

30 *See* 42 U.S.C. § 2210 (2012).

31 *See id*.

32 *See e.g.*, *Nuclear Liability Insurance (Price-Anderson Act)*, NAT'L ASS'N OF INS. COMM'RS, http://www.naic.org/cipr_topics/topic_nuclear_liability_insurance.htm (last updated Nov. 11, 2014); CTR. FOR NUCLEAR SCI. AND TECH. INFO., THE PRICE-ANDERSON ACT: BACKGROUND INFORMATION 1 (2005), http://www.ans.org/pi/ps/docs/ps54-bi.pdf.

33 42 U.S.C. § 2210(c).

34 *See* NAT'L ASS'N OF INS. COMM'RS, *supra* note 32. The second tier creates a liability fund when an incident occurs; at the time of the incident, the entire industry starts paying into the fund on a prorated basis, based on all other nuclear reactors being assigned a portion of the liability for the accident over the $300 million. *See* NUCLEAR INSURANCE AND DISASTER RELIEF FUNDS (United States Nuclear Regulatory Commission, 2008), http://www.nrc.gov/reading-rm/doc-collections/fact-sheets/funds-fs.pdf.

35 *See* 42 U.S.C. § 2210. The Act provides that "Congress will thoroughly review the particular incident . . . and will . . . take whatever action is determined to be necessary (including approval of appropriate compensation plans and appropriation of funds) to provide full and prompt compensation to the public for all public liability claims resulting from a disaster of such magnitude." § 2210(e)(2).

36 *See* Sean Hecht, *The Story of the Price-Anderson Act: How Congress*

was not enough data to calculate a statistically valid likelihood of a disaster.[37] While that may have been true in the 1950s—Price-Anderson was passed in 1957[38]—it is hard to argue that the same is true today. Insurance companies provide private, market-based coverage for products with a far shorter history than 65 years,[39] and to industries that are also risky, like private rocket launches.[40] No other private, for profit industry is provided this type of extensive government insurance for standard operating risks.[41]

Made Nuclear Power Financially Viable in the U.S. By Eliminating Accountability for Risk, LEGAL PLANET (May 10, 2011), http://legal-planet.org/2011/05/10/the-story-of-the-price-anderson-act-how-congress-made-nuclear-power-financially-viable-in-the-u-s-by-eliminating-accountability-for-risk/.

37 *See id.*

38 *See* Pub. L. No. 85-256, 71 Stat. 576 (1957) (codified as amended at 42 U.S.C. ch. 23).

39 One example: during a promotion for the MIR space station, "Taco Bell took out insurance in case a falling piece . . . hit a promotional bulls eye in the ocean. If it worked, everyone in America would get a free taco." Vince Veneziani, *The 15 Most Bizarre Insurance Policies Ever Written*, BUS. INSIDER (Mar. 18, 2010, 9:17 AM), http://www.businessinsider.com/10-of-the-worlds-craziest-insurance-policies-2010-3?op=1. The MIR space station has obviously been in existence for less than 65 years.

40 *See* Ian Simpson & Irene Klotz, *Space Station Supply Rocket That Exploded Insured for $50 Million*, INS. J. (Oct. 29, 2014), http://www.insurancejournal.com/news/national/2014/10/29/345363.htm.

41 One might think that the national flood insurance program could be a parallel. However, in that case, insurance companies only pulled back from providing coverage when customers were unwilling to pay for the true cost of the risk they were incurring by living in a flood plain. The government then stepped in and created the National Flood Insurance Program. *See* FED. EMERGENCY MGMT. AGENCY, NATIONAL FLOOD INSURANCE PROGRAM, PROGRAM DESCRIPTION 1 (2002), https://www.fema.gov/media-library-data/20130726-1447-20490-2156/nfipdescrip_1_.pdf. Unfortunately, the federal government has done a poor job ensuring that premiums collected will cover the risk; the NFIP is $24 billion in debt. *See Commentary: National Flood Insurance Program Drowning in Debt*, BUS. INS. (March 30, 2014 12:01 AM), http://www.businessinsurance.com/article/20140330/NEWS04/303309980.
Rather than continuing to insufficiently calculate risk, Congress could require those with flood insurance to pay premiums which actually reflect the risk of living at the coast or in floodplains, and could require nuclear plants to purchase insurance which would cover the full loss. Natural catastrophes caused $386 billion of damages in 2011, with the insured losses that year at $110 billion. *See* Sebastian von Dahlen & Goetz von Peter, *Natural Catastrophes and Global Insurance – Exploring the Linkages*, BIS Q. REV. 24 (Dec. 2012), http://www.bis.org/publ/qtrpdf/r_qt1212e.pdf. Around half of these insured losses were covered by reinsurance. *See id*; *see generally* SWISS RE, THE ESSENTIAL GUIDE TO REINSURANCE 12 (2010), http://media.swissre.com/documents/The_Essential_Guide_to_Reinsurance_EN.pdf. Given the large

While periodic increases in private insurance have occurred, all coverage currently comes from one source: ANI (American Nuclear Insurers).[42] Even with increasing private coverage, the subsidy from the continuation of Price-Anderson was estimated at $22 million per reactor per year.[43] Given the insurance products available and the ability of economists to quantify the risks of nuclear power, the industry should be required to procure private insurance at market rates.[44]

The industry argues that the $12 billion combined insurance coverage is sufficient.[45] However, that is incorrect. The disaster at Fukushima is expected to result in at least 10,000 extra cancer deaths, and, five years later, 4,500 square miles of land still registers radiation levels above Japan's allowable exposure rate.[46]

amount of reinsurance available for natural catastrophes, it is unlikely that, should the government remove the cap for privately-insured nuclear liability, insurance coverage would be unavailable.

42 *See* AMERICAN NUCLEAR INSURERS, http://www.amnucins.com/ (last visited Apr. 31, 2016).

43 *See* Jeffrey A. Dubin & Geoffrey S. Rothwell, *Subsidy to Nuclear Power Through Price-Anderson Liability Limit*, 8 CONTEMP. POL'Y ISSUES 73, 76 (July 1990). This was a decrease from before the 1988 Price Anderson amendments; the subsidy had been $60 million per reactor per year before 1982. *See id*. Interestingly, the Nuclear Regulatory Commission has admitted that Price Anderson counts as a subsidy; it concluded "that the subsidy is real but any estimate of its magnitude with respect to any period is open to criticism." *Id.* at 74 (quotations omitted).

44 The United States is not the only country with nuclear power that is in this position. Switzerland, for example, raised its liability cap per reactor to 1.8 billion Swiss francs (from 1 billion), but the country estimates a Chernobyl-like disaster could cost up to 4 trillion francs. *See* Juergen Baetz, *Insurance Cost vs. Nuclear Power Risk*, TRIBLIVE (May 1, 2011), http://triblive.com/x/pittsburghtrib/business/s_734814.html. Germany is in a similar position; although each reactor is required to have insurance of $3.7 billion, a worst-case disaster is estimated to cost up to $11 trillion. *See id*.

45 *See, e.g.*, *Three Mile Island—Looking Back on 30 Years of Lessons Learned Before the S. Subcomm. on Clear Air & Nuclear Safety of the S. Comm. on Env't & Pub. Works*, 111th Cong. 127 (2009) (statement of Marvin S. Fertel, President and CEO, Nuclear Energy Institute) ("The [Three Mile Island] accident demonstrated the ability of this insurance to effectively provide care for the public."), https://www.gpo.gov/fdsys/pkg/CHRG-111shrg94022/pdf/CHRG-111shrg94022.pdf.

46 *See* Ben Panko, *Watchdog Predicts Thousands of Fukushima-Related Cancer Deaths*, ENVTL. & ENERGY NEWS (March 9, 2016), http://www.eenews.net/eenewspm/2016/03/09/stories/1060033719. For comparison, the state of Connecticut is 4,845 square miles. *See* STATE SYMBOLS USA, http://www.statesymbolsusa.org/symbol-official-item/national-us/uncategorized/states-size (last visited Apr. 31, 2016).

TEPCO, the company responsible for operating the Fukushima plant, estimates that they have paid out approximately ¥ 6,991 billion.[47] In Chernobyl, 30 years after the nuclear disaster there, children are still drinking radioactively contaminated milk.[48] Additionally, the indemnification exists even in cases of recklessness or gross negligence.[49] The liability cap distorts the market by not internalizing the risks of the activity into the price of electricity generated by nuclear reactors.[50]

There are currently 104 reactors operating[51] at 65 plants around the United States.[52] Many are close to major population

47 *See* TEPCO, RECORDS OF APPLICATIONS AND PAYOUTS FOR INDEMNIFICATION OF NUCLEAR DAMAGE, http://www.tepco.co.jp/en/comp/images/jisseki-e.pdf (last updated Feb. 24, 2017). This is the equivalent of approximately USD 61 billion, using the conversion rate at the date of writing. In December 2016, the projections of the cost of the disaster increased to $188 billion. *Japan: Government Found Liable in Fukushima Disaster*, GREENWIRE (Mar. 17, 2017), http://www.eenews.net/greenwire/2017/03/17/stories/1060051641.

48 *See* Andrew Osborn, *Locals Eating Radioactive Food 30 Years After Chernobyl: Greenpeace Tests*, REUTERS (March 9, 2016, 1:50 AM), http://www.reuters.com/article/chernobyl-fukushima-radiation-idUSKCN0WB0B7.

49 PUB. CITIZEN, PRICE-ANDERSON ACT: THE BILLION DOLLAR BAILOUT FOR NUCLEAR POWER MISHAPS 3–4 (2004), http://www.citizen.org/documents/Price%20Anderson%20Factsheet.pdf.

50 *See id.* The liability caps also go against the main tenet of law that the one who creates a hazardous condition is the one who should pay for the results when the hazard materializes, noted as far back as 1868: "We think that the true rule of law is, that the person who, for his own purposes, brings on his land and collects and keeps there anything likely to do mischief if it escapes, must keep it in at his peril; and if he does not do so, is prima facie answerable for all the damage which is the natural consequence of its escape. . .it seems but reasonable and just that the neighbour who has brought something on his own property (which was not naturally there), harmless to others so long as it is confined to his own property, but which he knows will be mischievous if it gets on his neighbour's, should be obliged to make good the damage which ensues if he does not succeed in confining it to his own property. But for his act in bringing it there no mischief could have accrued, and it seems but just that he should at his peril keep it there, so that no mischief may accrue, or answer for the natural and anticipated consequence. And upon authority this we think is established to be the law, whether the things so brought be beasts, or water, or filth, or stenches." Rylands v. Fletcher [1868] L.R. 3 (HL) 330 (appeal taken from Eng.).

51 *See Nuclear Liability Insurance (Price-Anderson Act)*, NAT'L ASS'N OF INS. COMM'RS, http://www.naic.org/cipr_topics/topic_nuclear_liability_insurance.htm (last updated Jan. 5, 2016).

52 *See How Many People Live Near a Nuclear Power Plant in the USA?*, ZEIT ONLINE, http://opendata.zeit.de/nuclear-reactors-usa/#/en/fullmap (last visited Apr. 31, 2016).

centers. Almost 110 million people, 36 percent of the total population, live within 50 miles of a nuclear reactor.[53] Over 17.1 million people live within 50 miles of New York's Indian Point plant alone.[54] After the disaster at Fukushima, all people within 18 miles of the site were evacuated—1.3 million people live within the same distance of Indian Point, and would need to be evacuated if a similar incident occurred.[55] Perhaps more pressing, about 5 million people live within 50 miles of the Pilgrim plant outside Boston, which recently had its safety rating downgraded to the second lowest safety rating in the NRC's categorization system.[56] Private coverage of $12 billion to cover losses from these levels of population density seems to indicate that the federal government would be picking up a large amount indeed. The liability provisions of the Price-Anderson Act were extended by another 20 years in 2005.[57]

D. *Production Tax Credit*

In addition to the favorable financing and liability treatment, new nuclear reactors also receive a production tax credit (PTC) of 1.8 or 2.1 cents per kilowatt hour for the first eight years of operation.[58] Two new reactors under construction in South

53 *See id*.

54 *See id*. A 2009 report estimated that the cost of a nuclear meltdown at Indian Point could cost up to $416 billion. *See* Jeurgen Baetz, *Insurance Cost v. Nuclear Power Risk*, TRIBLIVE (May 1, 2011) http://triblive.com/x/pittsburghtrib/business/s_734814.html.

55 *See How Many People Live Near a Nuclear Power Plant in the USA?: Indian Point*, ZEIT ONLINE, http://opendata.zeit.de/nuclear-reactors-usa/#/en/indian-point-2 (last visited Apr. 31, 2016). Additionally, the nuclear industry is requesting that the NRC not implement new regulations around proposed safety upgrades. *See* Ben Panko, *Industry Urges NRC to Scrap New Regs*, GREENWIRE (Sept. 16, 2015), http://www.eenews.net/greenwire/2015/09/16/stories/1060024794.

56 *See Faulty Safety Valves Prompts Feds to Downgrade Pilgrim Nuclear Plant's Performance Rating*, WGBH NEWS (Sept. 3, 2015), https://news.wgbh.org/post/faulty-safety-valves-prompt-feds-downgrade-pilgrim-nuclear-plants-performance-rating; David Abel, *Pilgrim Nuclear Plant Says It May Shut Down*, BOS. GLOBE (Sept. 17, 2015), http://www.bostonglobe.com/metro/2015/09/17/pilgrim-nuclear-plant-officials-mull-whether-spend-millions-safety-upgrades/K2vbcLNJLwZDyj2FZReo2M/story.html.

57 *See* 42 U.S.C. §§ 15801, 2210 (2012).

58 This was capped at the first 6,000 Megawatts. *See* 42 U.S.C. § 15801; *U.S. Nuclear Power Policy*, WORLD NUCLEAR ASS'N, http://www.world-nuclear.org/info/Country-Profiles/Countries-T-Z/USA—Nuclear-Power-Policy/ (last updated June 2015).

Carolina are expected to receive a PTC credit totaling around $2 billion.[59]

E. *Spent Fuel and Waste Storage*

Arguably one of the largest federal subsidies—due to the lack of an end date—is the federal government's assumed responsibility for providing a place for permanent disposal of nuclear waste. Although generators are supposed to bear these costs themselves,[60] they have the ability to "sell" their waste to the federal government for disposal.[61] Also, while a Nuclear Waste Fund was established to pay for the costs of developing any repository,[62] the nuclear industry sued to stop collections for the fund, and it has been suspended.[63] In 2008, the DOE issued a revised cost estimate of $96.2 billion dollars for research, construction and operation of repositories. This represented a substantial increase from the last estimate in 2001, when the project was estimated to cost $57.5 billion.[64] Due to the rapid increase, quantification of the amount taxpayers will end up spending on long-term waste storage is truly impossible, but given that it will need to include safety measures for tens of thousands of years, the figure will likely dwarf any current program's costs eventually.[65]

59 *See* Kristi E. Swartz, *Reactor Delays Lead to Another Rate Increase in S.C.*, ENERGYWIRE (Sept. 24, 2015), http://www.eenews.net/energywire/2015/09/24/stories/1060025203.

60 *See* 42 U.S.C. § 10131(a)(4) (2012). Generators are to "have the primary responsibility to provide for, and the responsibility to pay the costs of, the interim storage" of nuclear waste. § 10131(a)(5).

61 *See* 42 U.S.C. § 10222 (2012).

62 *See* 42 U.S.C. § 10131(b)(4).

63 *See* Nat'l Ass'n of Regulatory Util. Comm'rs v. U.S. Dep't of Energy, 736 F.3d 517, 518, 521 (D.C. Cir. 2013).

64 *See Yucca Mountain Cost Estimate Rises to $96 Billion*, WORLD NUCLEAR NEWS (Aug. 6, 2008), http://www.world-nuclear-news.org/WR-Yucca_Mountain_cost_estimate_rises_to_96_billion_dollars-0608085.html

65 Continued signage, for example, will need to be in place to ensure that future generations do not accidentally or intentionally breach the containment. As noted about another project, the Waste Isolation Pilot Plant in New Mexico, "[d]isposal sites shall be designated by the most permanent markers, records, and other passive institutional controls practicable to indicate the dangers of the wastes and their location . . . . The period of regulatory concern is 10,000 years. . . . The efficacy of the markers in deterring inadvertent human intrusion was estimated to decrease with time, with the probability function varying with the mode of intrusion (who is intruding and for what purpose) and the level of technological development of the society." KATHLEEN M. TRAUTH ET AL., EXPERT JUDGMENT ON MARKERS TO DETER INADVERTENT HUMAN INTRUSION

Even with the fund to pay for a repository suspended, the federal government continues to spend money on the issue of waste.[66] As arguments continue over the best way to deal with high-level radioactive waste,[67] the DOE is taking the first step toward potentially storing waste in deep boreholes, with proposals requested for a five-year test of the technology.[68] Congress has also been attempting to advance a pilot program for interim storage. The nuclear industry, originally supportive, now appears focused again on Yucca Mountain, despite a lack of willingness to move forward with Yucca Mountain in Congress.[69] At some point, a plan will need to be developed to deal with the approximately 57,000 tons of spent fuel already in existence.[70]

All these costs and subsidies do not even take additional decommissioning costs into account.[71] Decommissioning,[72] which

INTO THE WASTE ISOLATION PILOT PLANT i (1993), http://www.wipp.energy.gov/picsprog/test1/SAND%2092-1382.pdf (internal quotations omitted). Aside from pictorial graphics depicting horror and sickness, "messages are repeated seven times: the six languages of the United Nations (Arabic, English, Spanish, French, Russian and Chinese), Navajo, and blank. The blank area is so the message can be inscribed in another language when these grow too ancient to read comfortably." *Id.* at F-13.

66 *See* Hannah Northey, *DOE Takes First Steps Toward a Post-Yucca Future*, GREENWIRE (Sept. 9, 2015), http://www.eenews.net/greenwire/2015/09/09/stories/1060024406.

67 *See* SHANNON O'NEIL, GETTING TO THE CORE OF THE PROBLEM: POLICY ALTERNATIVES FOR LONG-TERM STORAGE OF HIGH-LEVEL NUCLEAR WASTE 1–2 (2015), http://studentorgs.law.unc.edu/documents/elp/2015/oneilelp.pdf.

68 *See* Hannah Northey, *DOE Moves Forward with Deep Borehole Test for Storage*, E&ENEWS PM (July 13, 2015), http://www.eenews.net/eenewspm/2015/07/13/stories/1060021708.

69 *See* Hannah Northey, *Yucca Mountain: Key Senator Calls Industry Shift an 'Unwelcome Surprise'*, E&E DAILY (Aug. 4, 2015), http://www.eenews.net/eedaily/2015/08/04/stories/1060022934.

70 *See Backgrounder on Licensing Yucca Mountain*, U.S. NUCLEAR REGULATORY COMM'N, http://www.nrc.gov/reading-rm/doc-collections/fact-sheets/yucca-license-review.html#bg (last updated July 21, 2015). Even if built, Yucca Mountain could only store a maximum of 70,000 tons of waste; just moving what already exists would fill up 81% of its capacity. *See id.*

71 Even for the federal government labs, which originally developed nuclear technology, waste disposal is problematic. The reopening of an underground New Mexico waste depository, closed in 2014 after a fire and radiation leak, has been delayed by safety concerns and equipment issues. Scheduled to be closed a year and a half and originally estimated to cost $500 million, the upgrades are now behind schedule and will be pricier than anticipated. *Watchdogs Accuse Feds of Causing WIPP Delays*, GREENWIRE (Aug. 24, 2015), http://www.eenews.net/greenwire/2015/08/24/stories/1060023817. The Santa Susana Field Lab in Southern California experienced several nuclear accidents

the Nuclear Regulatory Commission allows to continue for up to sixty years after a plant is closed,[73] is estimated by the NRC to cost between $300 and $400 million per reactor.[74] Although owners of nuclear plants are supposed to determine likely decommissioning costs and "provide reasonable assurance that funds will be available for the decommissioning process,"[75] some sites are finding decommissioning costs well above what the estimates

and may have released radiation across Los Angeles; Boeing, the current owner, is "working" on the cleanup of the site. *See* Joel Grover & Matthew Glasser, *LA's Nuclear Secret*, NBC4, http://data.nbcstations.com/national/KNBC/la-nuclear-secret/ (last visited Oct. 7, 2015). Aside from the material left over from the national labs, the largest storage site current is Hanford, WA; Hanford once produced much of the country's plutonium. *See* Joby Warrick, *Leaked Report Cites Design Flaws in Plant Built to Treat Nuclear Waste*, WASH. POST (Aug. 26, 2015), http://www.washingtonpost.com/national/health-science/leaked-report-cites-design-flaws-in-plant-built-to-treat-nuclear-waste/2015/08/25/2c924 2f0-4b6d-11e5-bfb9-9736d04fc8e4_story.html. However, the facility designed to treat the radioactive byproducts and encapsulate them in glass has design flaws that could threaten operation. *See id*. It also doesn't address the international legacy left behind by the United States; the Runit Dome in the Marshall Islands holds 111,000 cubic yards of radioactive waste from American nuclear tests, and the concrete is starting to crack. *See* Coleen Jose, Kim Wall & Jan Hendrik Hinzel, *This Dome in the Pacific Houses Tons of Radioactive Waste – and It's Leaking*, GUARDIAN (July 3, 2015), http://www.theguardian.com/world/2015/jul/03/runit-dome-pacific-radioactive-waste. Located directly on the Pacific Ocean, radioactive waste is already leaking underground, and, with the cracks, there is the possibility that the waste could disperse into the Pacific with a strong storm or rising sea levels. *See id*.

72 The Nuclear Regulatory Commission defines decommissioning as "safely removing a facility or site from service and reducing residual radioactivity to a level that permits "either the release of the property for unrestricted use and the termination of the license or release of the property for restricted use and termination of the license." U.S. NUCLEAR REGULATORY COMM'N, DECOMMISSIONING OF REGULATORY FACILITIES, http://www.nrc.gov/waste/decommissioning.html

73 However, this time frame appears to be flexible. The GE-VBWR reactor in Alameda, CA, was shut down in 1963. *Backgrounder on Decommissioning Nuclear Power Plants*, U.S. NUCLEAR REGULATORY COMM'N, http://www.nrc.gov/reading-rm/doc-collections/fact-sheets/decommissioning.html (last updated May 14, 2015). It will stay in maintenance decommissioning status ("SAFSTOR") until all ongoing nuclear activities at the site are complete and the entire site can be decommissioned, rather than being rehabilitated by 2023. *See id*. A similar situation exists at Indian Point Unit 1, which was shut down in October, 1974, where Unit 2 is still operational, and Peach Bottom Unit 1, where Units 2 and 3 are still operational. *See id*. It is expected that the shuttered units will be decommissioned on the same schedule as the ones that remain currently operational, despite the (much) earlier shutdown dates. *See id*.

74 *See id*.

75 10 C.F.R. § 50.75(a) (2015).

were.[76] For reactors like Vermont Yankee, which operated for 42 years, decommissioning is expected to take 59 years from the shutdown of the facility[77]—longer than the plant was operational—and the current estimate of the cost to decommission is double the amount the utility owner currently has saved up for that purpose.[78] Given that energy companies may shed their solvency in far less time than sixty years, current lax decommissioning regulations are themselves a subsidy for the nuclear industry.[79]

76 Entergy expects cleanup of the Vermont Yankee site to cost at least $1.24 billion, and is planning on using stock market gains to fund the cleanup. *See Vermont Yankee: Decommissioning Cost $1.24 Billion*, BURLINGTON FREE PRESS (Dec. 19, 2014, 3:44 PM), http://www.burlingtonfreepress.com/story/news/local/vermont/2014/12/19/vermont-yankee-decommissioning-cost/20650891/.

77 *See* Transcript of Record at 48, Vermont Yankee, No. 50-271 (N.R.C. Feb. 19, 2015), *available at* http://necnp.org/wp/wp-content/uploads/2012/04/PSDAR-VY-Public-Meeting-Quality-Inn-Brattleboro-VT-02.19.2015-ML15070A234-C149753.pdf.

78 *See Estimate: Vermont Yankee Shutdown Will Cost $1.24 Billion*, N.H. PUB. RADIO (Oct. 17, 2014), http://nhpr.org/post/estimate-vermont-yankee-shutdown-will-cost-124-billion.

79 *See* Fairewinds Energy Educ. Corp., Comments on Vermont Yankee Nuclear Power Station Post-Shutdown Decommissioning Activities Report 2, 4 (Mar. 23, 2015), http://www.leg.state.vt.us/jfo/envy/2015-03-23%20Post-Shutdown%20Decommissioning%20Activities%20Report.pdf. The federal government has faced a similar problem with coal generators and has recently issued guidance requesting that states limit coal companies' ability to self-bond for remediation. *See* Michael Corkery, *Regulators Fear $1 Billion Coal Cleanup Bill*, N.Y. TIMES (June 6, 2016), https://www.nytimes.com/2016/06/07/business/dealbook/regulators-fear-1-billion-coal-cleanup-bill.html; Judith Kohler, *NWF Welcomes Feds' Landmark Guidance on Coal-Mine Bonding*, NAT'L WILDLIFE FED'N (Aug. 10, 2016) https://www.nwf.org/News-and-Magazines/Media-Center/News-by-Topic/Global-Warming/2016/08-09-2016-NWF-Welcomes-Feds-Landmark-Guidance-on-Coal-Mine-Bonding.aspx.

Additionally, the same concerns do not exist with other no- or low-carbon sources. For example, common solar lease provisions require the developer to disassemble the array and remove all the equipment, leaving the land in its original condition. *See Rowan's future in solar farms looks sunny*, NC CLEAN ENERGY, https://nccleantech.ncsu.edu/rowans-future-in-solar-farms-looks-sunny (last visited Jan. 11, 2017). Due to the fact that the materials involved have value, PV panels are recycled. *See* Alex Heard, *First Solar Fires Back on Recycling Charges and Decommissioning Costs*, GREENTECH MEDIA, http://www.greentechmedia.com/articles/read/First-Solar-Fires-Back-On-Recycling-Charges-and-Decommissioning-Costs (Aug. 28, 2013). *See also PV Recycling*, SOLAR ENERGY INDUSTRIES ASS'N, http://www.seia.org/policy/environment/pv-recycling (last visited Jan. 11, 2017).

F. *Other Costs*

These federal subsidies are, of course, in addition to all the less tangible ones, such as the costs of running the Nuclear Regulatory Commission, the Office of Civilian Radioactive Waste Management, the Office of the Nuclear Waste Negotiator, and the Nuclear Waste Technical Review Board.[80] Additionally, most reactors also use public waterways for cooling water, killing fish in the process[81] and returning the water at elevated temperatures. This use will become more problematic with climate change.[82] Cooling towers could solve the fish kill problem, at the cost of about $1 billion each.[83] Of course, once the reactor is built and operational, it uses mined and enriched uranium—which ends up as nuclear waste.

80 The Nuclear Regulatory Commission, based on the FY 2016 budget, will obtain around $929 million of its $1.032 billion budget from license fees and approximately $103 million from the federal government. *See* FRED UPTON, VIEWS AND ESTIMATES ON THE PRESIDENT'S BUDGET FOR FISCAL YEAR 2016, at 5 (2015), https://energycommerce.house.gov/sites/republicans.energycommerce.house.gov/files/analysis/ECFY2016ViewsEstimates.pdf. The Office of the Civilian Radioactive Waste Management (OCRWM) has effectively been dismantled due to lack of progress on Yucca Mountain, and currently receives no federal funding. *See* MARK HOLT, CONG. RESEARCH OFFICE, CIVILIAN NUCLEAR WASTE DISPOSAL (2015). The Office of the Nuclear Waste Negotiator (ONWN) expended around $8 million, also as part of the Yucca Mountain project, between 1983 and 2009. *See* OCRM, SUMMARY OF PROGRAM FINANCIAL & BUDGET INFORMATION 11–12 (2010). Over the same period, the Nuclear Waste Technical Review Board (NWTRB) spent over $55 million. *See id.* The activities of the OCRWM, ONWN, and NWTRB are on hold due to the lack of a permanent national repository. There are no similar costs for other no- or low-carbon sources. If there is a siting decision, lease sale, or Environmental Impact Statement required for a solar project, for example, there is no solar-only office that deals with these matters in the federal government; all other no- and low-carbon sources share those federal resources, both amongst themselves and with coal, oil, and natural gas.

81 The most contested example of this is at Indian Point. *See* Patrick McGeehan, *Fire Prompts Renewed Calls to Close the Indian Point Nuclear Plant*, N.Y. TIMES (May 12, 2015), http://www.nytimes.com/2015/05/13/nyregion/fire-prompts-renewed-calls-to-close-the-indian-point-nuclear-plant.html?_r=0.

82 Turkey Point in Florida has already had to ask for a waiver for two summers. *See* Jenny Staletovich, *Feds OK Hotter Water to Operate Turkey Point Nuclear Reactors*, MIAMI HERALD (Aug. 5, 2015), http://www.miamiherald.com/news/local/community/miami-dade/article1978565.html.

83 *See* Bill Gallo, Jr., *Large Support, but Some Vocal Dissent for PSEG Nuclear Delaware River Water Use Permit*, NJ.COM (Aug. 5, 2015, 7:10 PM), http://www.nj.com/salem/index.ssf/2015/08/large_support_but_some_dissent_for_pseg_nuclear_de.html.

Older reactors are now starting to go through the relicensing process. Most were originally designed for a life span of 40 years, and the mean age for reactors worldwide is about 29.[84] Continuing operation beyond forty years will cost between $1 billion and $5 billion per reactor.[85] Relicensing decisions will be complicated by either perceived or real safety issues.[86] Long-term studies could have placated at least some of these concerns. However, the

84 *See* Katherine Tweed, *Around the World, Nuclear Can't Compete with Growing Renewables*, GREENTECH MEDIA (July 16, 2015), https://www.greentechmedia.com/articles/read/renewables-outpace-nuclear-in-major-economies.

85 *See id.*

86 Examples include recently discovered earthquake faults at the Diablo Canyon plant on California's coast, *see* Ben Panko, *Calif.'s Diablo Canyon Faces License Renewal Challenge*, GREENWIRE (July 10, 2015), http://www.eenews.net/greenwire/2015/07/10/stories/1060021607; Eric Wesoff, *NRC to Consider Relicensing Diablo Canyon Nuclear Plant Through 2045*, GREENTECH MEDIA (July 13, 2015), https://www.greentechmedia.com/articles/read/NRC-to-Consider-Relicensing-Diablo-Canyon-Nuclear-Plant-Through-2045; potentially brittle concrete at an Entergy plant on Lake Michigan, *see* Ben Panko, *Operator of Mich. Plant Ordered to Disclose Reactor Safety Risks*, GREENWIRE (July 10, 2015), http://www.eenews.net/greenwire/2015/07/10/stories/1060021608; cooling water pump issues at a plant in New Jersey, *see* Bill Gallo, Jr., *Large Support, but Some Vocal Dissent for PSEG Nuclear Delaware River Water Use Permit*, NJ.COM (Aug. 5, 2015), http://www.nj.com/salem/index.ssf/2015/08/large_support_but_some_dissent_for_pseg_nuclear_de.html; failing equipment at a plant in Illinois, *see* Ben Panko, *NRC Boosts Oversight of Ill. Power Station*, GREENWIRE (Aug. 13, 2015), http://www.eenews.net/greenwire/2015/08/13/stories/1060023426; and the potential of being too close to exploding crude-by-rail trains, *see* Blake Sobczak, *Combined Risk of Crude and Nuclear Alarms Minn. Tribe*, ENERGYWIRE (Aug. 17, 2015), http://www.eenews.net/energywire/2015/08/17/stories/1060023515. Especially with Diablo Canyon, the public near the plant is shocked that the NRC will not even be looking at the seismic risks associated with the plant during relicensing. *See Diablo Canyon Review Won't Address Quake Risks*, GREENWIRE (Aug. 17, 2015), http://www.eenews.net/greenwire/2015/08/17/stories/1060023543. For the recently-shuttered San Onofre plant, nuclear waste will be stored long-term approximately 100 feet inland from the Pacific Ocean. *See* Anne C. Mulkern, *Closed Calif. Plant's spent fuel to be stored near ocean*, GREENWIRE (Oct. 7, 2015), http://www.eenews.net/greenwire/2015/10/07/stories/1060026008. A landfill fire, smoldering since 2010, could reach a uranium Superfund site, potentially resulting in radioactive fallout around the St. Louis area. *See Officials Quietly Hatch Emergency Plan for Fire near Landfill*, GREENWIRE (Oct. 7, 2015), http://www.eenews.net/greenwire/2015/10/07/stories/1060025995. Administrative challenges to the NRC's procedures regarding environmental review are difficult. *See* Jeremy P. Jacobs, *NRDC Presses Judges on Challenge to Pa. Plant Relicensing*, GREENWIRE (Sept. 17, 2015). Cybersecurity has also become an issue. *See* Sam Jones, *Nuclear Power Plants in 'Culture of Denial' over Hacking Risk*, FIN. TIMES (Oct. 5, 2015).

government declined to assess the health risks of those living near commercial nuclear reactors because such studies would be too great a financial and time investment.[87]

G. *What Do These Subsidies Provide the Nuclear Industry?*

These federal subsidies shift the costs of producing nuclear energy away from utilities. Therefore, as utilities determine what mix they were going to commit to providing customers in the future, it makes more sense to complete nuclear plants than to invest in other forms of energy. As Southern Company's promotional materials for Plant Vogtle tout, "[n]uclear energy is the most cost-effective, reliable and environmentally responsible fuel source available today . . . . It's a proven technology that produces no greenhouse gas emissions and can relieve cost uncertainty caused by coal and natural gas prices."[88] In addition to being financially important, utilities use the cost savings provided by subsidies as a competitive advantage in the market for public approval.

This seemingly lower nuclear cost is in stark contrast with the perceived costs of other no- and low-carbon electricity sources. According to the Energy Information Administration, the levelized cost in 2020 of geothermal, wind, hydroelectric, natural gas and conventional coal will still all be below the cost of nuclear.[89] While the levelized cost does include permanent tax treatment, it does not include tax credits which will expire in or before 2020 or other subsidies like loan guarantees.[90] While the prices of non-

87 *See* Ben Panko, *Agency Stops Study of Cancer Risks near Nuclear Plants*, GREENWIRE (Sept. 8, 2015), http://www.eenews.net/greenwire/2015/09/08/stories/1060024349.

88 GA. POWER CO., PLANT VOGTLE UNITS 3 AND 4, at 1, http://www.southerncompany.com/content/dam/southern-company/pdf/public/Vogtle-Nuclear-Brochure.pdf (last visited Mar. 2, 2017).

89 Levelized costs includes both capital to build and operational costs. *See Levelized Cost and Levelized Avoided Cost of New Generation Resources in the Annual Energy Outlook 2015*, U.S. ENERGY INFO. ADMIN., http://www.eia.gov/forecasts/aeo/electricity_generation.cfm (last visited Oct. 3, 2015). This is true looking at a mid-level estimate for the cost of Vogtle's new reactors based on levelized costs over the life of the reactors even without the production or investment tax credit for renewables. *See* MAX CHANG ET AL., BIG RISKS, BETTER ALTERNATIVES: AN EXAMINATION OF TWO NUCLEAR ENERGY PROJECTS IN THE U.S. 4 (2011), http://www.ucsusa.org/sites/default/files/legacy/assets/documents/nuclear_power/Big-Risks-Better-Alternatives.pdf.

90 *See id*. And these differences are playing out in decisionmaking. As the

nuclear low- and no-carbon sources of electricity have decreased to the point of market competitiveness, the federal subsidies and research dollars allocated to them continue to pale in comparison to nuclear.

II. FEDERAL SUBSIDIES FOR OTHER CARBON-FREE ENERGY SOURCES

A. *Wind*

The primary federal subsidies for wind energy are the production tax credit (PTC) or permission for PTC-eligible facilities to claim an Investment Tax Credit (ITC).[91] Most recently,

Department of Energy noted in relation to wind, "[t]he average levelized long-term price from a sample of wind power sales agreements signed in 2014 (and admittedly concentrated in the lowest-priced central region of the country) fell to just 2.35¢/kWh. These prices are below the bottom of the range of nationwide wholesale power prices, and compare very favorably to a range of projections of the fuel costs of gas-fired generation." Eric Wesoff, *5 Takeaways from the DOE Wind Market Report*, GREENTECH MEDIA (Aug. 11, 2015), http://www.greentechmedia.com/articles/read/5-Takeaways-from-the-DOE-Wind-Market-Report. Wind farms in the Midwest and Texas have prices lower than two cents per kilowatt hour. *See* Bentham Paulos, *Wind Power Wins Big Under the Clean Power Plan*, GREENTECH MEDIA (Aug. 25, 2015), http://www.greentechmedia.com/articles/read/wind-power-wins-big-under-the-clean-power-plan. These wind farms also have capacity factors of over 50%. *See id.* Interestingly, investment bankers think both wind and solar will grow even faster than government agencies predict, and at a lower cost. *See* Julia Pyper, *Investment Bankers Think Solar and Wind Will Grow Way Faster Than the IEA Forecast*, GREENTECH MEDIA (Aug. 24, 2015), http://www.greentechmedia.com/articles/read/investment-bankers-think-solar-and-wind-are-going-to-grow-faster-than-IEA. On the solar front, after competing against a variety of other electricity projects under an open solicitation bid from Xcel Energy Inc., a 156 Megawatt solar plant in Colorado was chosen as the generation of choice. *See* Daniel Cusick, *Massive Solar Projects in U.S., Chile Move Ahead*, CLIMATEWIRE (Aug. 21, 2015), http://www.eenews.net/climatewire/2015/08/21/stories/1060023746. It was chosen because the renewable project was at a price competitive with conventional resources. *See id*.

91 *See Renewable Electricity Production Tax Credit (PTC)*, U.S. DEP'T OF ENERGY, http://energy.gov/savings/renewable-electricity-production-tax-credit-ptc (last visited Aug. 18, 2015). Bipartisan senators have sponsored legislation to provide an investment tax credit for offshore wind energy, but this has not yet passed into law. *See* Daniel Bush, *Wind Energy: Senators Roll out Bipartisan Bill Promoting Offshore Projects*, E&E DAILY (July 10, 2015), http://www.eenews.net/eedaily/2015/07/10/stories/1060021569. The investment tax credit is set at 30%. *See PTC, ITC or Cash Grant? Which Should a Developer Use?*, WINDUSTRY, http://www.windustry.org/news/ptc-itc-or-cash-grant-which-should-developer-use (last visited Aug. 18, 2015). "The Federal Production Tax Credit . . . has been the single largest driver of wind energy

the tax credit was 2.3 cents per kilowatt-hour,[92] and is typically available for the first ten years a facility operates.[93] It will continue at that level through 2016, decreasing to 80 percent of its value in 2017, 60 percent in 2018, and finally 40 percent in 2019 before expiring at the end of that year.[94] Originally enacted in 1992, Congress has allowed the PTC to expire on six different occasions and then extended it, usually retroactively.[95] As has been noted by commentators, this "boom and bust" policy cycle can "foster a legacy of increased regulatory uncertainty and reduced investor confidence" that "wreaks havoc with the business confidence necessary for the long-term investments required to develop new and improved products."[96] This is especially true as it can take longer than two years to go through the planning and permitting phases of a new wind facility, notwithstanding actual construction.[97]

In addition to being free of harmful by-products like radioactive waste, toxic emissions, or greenhouse gas, wind power also requires very little water use.[98] In places like the Southwest where drought is expected to increase due to climate change,[99] wind's lack of water use could be important. This is especially true

development in the United States to date, despite its continual need for renewal by Congress." *Chapter 10: Tax Incentives*, WINDUSTRY, http://www.windustry.org/community_wind_toolbox_10_tax_incentives (last visited Apr. 19, 2017).

92 *See Renewable Electricity Production Tax Credit (PTC)*, *supra* note 91.

93 *See Production Tax Credit for Renewable Energy*, UNION OF CONCERNED SCIENTISTS, http://www.ucsusa.org/clean_energy/smart-energy-solutions/increase-renewables/production-tax-credit-for.html#.VcUhTPNViko (last visited Aug. 18, 2015).

94 *See* NAW Staff, *Congress Passes Omnibus Bill with Five-Year Wind PTC Extension*, NORTH AMERICAN WINDPOWER (Dec. 18, 2015), http://nawindpower.com/congress-passes-omnibus-bill-with-five-year-wind-ptc-extension.

95 These include in 2000, 2002, 2004, 2010, 2013, and 2014. *See Production Tax Credit for Renewable Energy*, *supra* note 93.

96 N.Y. STATE DEP'T OF PUB. SERV., WHITE PAPER ON RATEMAKING AND UTILITY BUSINESS MODELS 89 n.90 (2015).

97 *See Production Tax Credit for Renewable Energy*, *supra* note 93.

98 *See Wind Conserving Water*, AM. WIND ENERGY ASS'N, http://www.awea.org/wind-and-water ("The production of clean wind energy reduces the consumption of water, which is heavily relied on to cool thermal power plants.") (last visited Mar. 2, 2017).

99 *See* JOHN WALSH ET AL., U.S. GLOB. CHANGE RESEARCH PROGRAM, CLIMATE CHANGE IMPACTS IN THE UNITED STATES: THE THIRD NATIONAL CLIMATE ASSESSMENT 34–35 (J. M. Melillo et al. eds., 2014), http://s3.amazonaws.com/nca2014/low/NCA3_Full_Report_02_Our_Changing_Climate_LowRes.pdf?download=1.

as hydropower resources may not be utilized for energy production during drought; instead, those water resources could be available for environmental, agricultural, and household uses.[100] However long either the PTC or ITC extension will be implemented for (if beyond 2019), it seems unlikely it will reach anything close to the more than five decades (and counting) that nuclear has been subsidized.

B. *Solar*

The primary federal subsidy available to solar installations currently is the Investment Tax Credit (ITC).[101] The ITC is equal to 30 percent of "eligible solar energy property" including "equipment that uses solar energy to generate electricity, to heat or cool (or provide hot water for use in) a structure, or to provide solar process heat."[102] Solar power used for illuminating the interiors of buildings is also eligible. However, passive solar systems or solar systems used for pool heating are not.[103] To qualify for the ITC, the system must be in place and operational before December 31, 2019.[104] After that date, the tax credit decreases to 26 percent for systems placed in service before the end of 2020, and 22 percent for systems place in service by the end of 2021.[105] The ITC then decreases to ten percent for utility-scale,

100 In 2014, wind energy saved 2.5 billion gallons of freshwater in California and 13 billion gallons in Texas. *See Federal Production Tax Credit for Wind Energy*, AM. WIND ENERGY ASS'N, http://www.awea.org/Advocacy/Content.aspx?ItemNumber=797 (last visited Aug. 19, 2015).

101 The ITC generally creates larger tax benefits than other tax advantages for solar energy. *See* NC CLEAN ENERGY TECH. CTR., COMMERCIAL GUIDE TO THE FEDERAL INVESTMENT TAX CREDIT FOR SOLAR PV3 (2015), http://solaroutreach.org/wp-content/uploads/2015/03/CommercialITC_Factsheet_Final.pdf.

102 *Business Energy Investment Tax Credit (ITC)*, U.S. DEP'T ENERGY, (Aug. 21, 2015), http://energy.gov/savings/business-energy-investment-tax-credit-itc. While the tax credit can be carried forward if a homeowner does not owe enough taxes to use the entire credit in the installation year, it is currently unclear whether the unused tax credit may be carried forward past 2016. *Residential Renewable Energy Tax Credit*, U.S. DEP'T OF ENERGY, http://energy.gov/savings/residential-renewable-energy-tax-credit (last visited Oct. 5, 2015).

103 *See* U.S. DEP'T OF ENERGY, *supra* note 102.

104 *See id.* Interestingly, the Energy Improvement and Extension Act of 2008 (H.R. 1424) allows taxpayers to take the credit against the alternative minimum tax (AMT). *See id.*

105 *See* NUCLEAR REGULATORY COMM'N, COMBINED LICENSE VOGTLE ELECTRIC GENERATING PLANT UNIT 4 (2012), http://pbadupws.nrc.gov/docs/ML1130/ML113060412.pdf

commercial, and residential systems which are served through leases and power purchase agreements. The ITC expires completely for homeowner-owned residential systems.[106]

The ITC has been available to solar generators for even less time than the PTC has been available to wind; first created by the Energy Policy Act of 2005,[107] the ITC was originally set to expire at the end of 2007. It was then extended for one additional year, and then for the eight-year term set to expire at the end of 2016.[108] While the eight-year term has provided certainty to developers and investors,[109] this certainty is now disappearing.[110]

C. *Hydro*

While there are no plans for new large hydropower facilities to be built in the United States,[111] small hydro projects are still being proposed and built. These new facilities are eligible for the PTC, albeit at one half of the rate that wind projects receive.[112]

Existing dam and hydropower projects, however, continue to create power, often at very cheap rates. These projects are supported in multiple ways: continued operation and maintenance for the dams and lake systems owned by the federal government and operated by the Army Corps of Engineers; continued technology development, market acceleration and deployment;[113]

106 *See* Herman K. Trabish, *What Utilities Need to Know About Solar Growth After the ITC Extension*, UTILITY DIVE (Jan. 7, 2016), http://www.utilitydive.com/news/what-utilities-need-to-know-about-solar-growth-after-the-itc-extension/411139/. *See also Extend the Solar Investment Tax Credit*, SOLAR ENERGY INDUS. ASS'N, (Aug. 21, 2015), http://www.seia.org/research-resources/extend-residential-solar-investment-tax-credit.

107 *See* Energy Policy Act of 2005, 42 U.S.C. § 15801 (2012).

108 *See The Solar Investment Tax Credit (ITC)*, SOLAR ENERGY INDUS. ASS'N (Jan. 27, 2015), http://www.seia.org/sites/default/files/ITC%20101%20Fact%20Sheet%20-%201-27-15.pdf.

109 *See id*.

110 *See id*.

111 This is not true everywhere; BC Hydro, in Canada, is proposing a large new hydropower project which would flood almost 100 km of agricultural lands and boreal forests. *See Work Begins on Massive Work Camp for Site C Dam*, CBC NEWS (Sept. 14, 2015), http://www.cbc.ca/news/canada/british-columbia/work-begins-on-massive-work-camp-for-site-c-dam-1.3227002. It is opposed by both farmers and environmental groups. *See id*.

112 *See Renewable Electricity Production Tax Credit (PTC)*, *supra* note 91.

113 *Energy Department Reports Highlight Trends of Growing U.S. Wind Energy Industry*, U.S. DEP'T OF ENERGY (Aug. 10, 2015),

and federal re-licensing of facilities by the Federal Energy Regulatory Commission for those dams and lake systems owned and operated privately.[114] The most common criticism of current hydropower is the impact on fish and other endangered species.[115] For non-federal hydro projects, endangered species and other wildlife impacts are considered during the periodic relicensing process, overseen by the Federal Energy Regulatory Commission.[116] To minimize environmental and other impacts, there are proposals to retrofit dams to support hydropower.[117]

D. *Other Technologies*

A number of other renewables are eligible for the PTC, including biomass, geothermal, marine and hydrokinetic, landfill gas, and municipal solid waste.[118] Some facilities are limited to the first five years of operation rather than the standard ten, depending on when they were put into service. The change in time frame yet again points to an inconsistent policy landscape.

In addition to wind and solar, the ITC is available for geothermal, municipal solid waste, combined heat and power, fuel cells using both renewable and non-renewable fuels, tidal, and microturbines.[119] The ITC is currently scheduled to expire on

https://www.energy.gov/eere/water/hydropower-research-development. Additionally, the federal government financed Army Corps of Engineers and Bureau of Reclamation dams and include ongoing borrowing from the Treasury. *See* U.S. ENERGY INFO. ADMIN., FEDERAL FINANCIAL INTERVENTIONS AND SUBSIDIES IN ENERGY MARKETS 2007, *supra* note 7, at 6.

114 The government support of hydropower in fiscal year 2007 was estimated at $174 million. *See* U.S. ENERGY INFO. ADMIN., FEDERAL FINANCIAL INTERVENTIONS AND SUBSIDIES IN ENERGY MARKETS 2007, *supra* note 7, at xvi.

115 *See Salmon of the West*, U.S. FISH AND WILDLIFE SERVICE, http://www.fws.gov/salmonofthewest/dams.htm (last visited Jan. 11, 2017).

116 *See* FED. ENERGY REGULATORY COMM'N, GUIDANCE ON ENVIRONMENTAL MEASURES IN LICENSE APPLICATIONS, http://www.ferc.gov/industries/hydropower/gen-info/licensing/guidance.pdf (last visited Mar. 2, 2016).

117 *See* Sean O'Neill, *Should the U.S. Government Play a Role in Hydro Power?*, ENERGYBIZ (Oct. 14, 2013), http://www.energybiz.com/article/13/10/should-us-government-play-role-hydro-power.

118 Closed loop biomass and geothermal receive $0.023/kWh, like wind. *See Renewable Electricity Production Tax Credit (PTC)*, *supra* note 91. The rest receive $0.011/kWh. *See id*.

119 *See Business Energy Investment Tax Credit (ITC)*, DATABASE OF STATE INCENTIVES FOR RENEWABLES & EFFICIENCY (DSIRE), http://programs.dsireusa.org/system/program/detail/658 (last updated May 13, 2015). The incentive is 30% for solar, fuel cells, and small wind, and 10% for geothermal, microturbines, and combined heat and power, with caps for fuel cells,

December 31, 2016, for geothermal heat pumps, hybrid solar lighting, small wind, fuel cells, microturbines, and combined heat and power systems.[120] Only the incentive for equipment which produces electricity from geothermal energy will remain the same.[121]

Certain entities, basically those in the public sector and electric cooperatives, can finance renewable energy projects using clean renewable energy bonds (CREBs).[122] The technologies that qualify for CREBs are the same as those that qualify for the renewable PTC. While not a guarantee, the bondholder receives the tax credit in lieu of a portion—and only a portion—of the traditional bond interest. By only being required to pay part of the interest, borrowing costs are lowered for the public entity installing the renewable energy.[123] However, there was a cap on CREBs, and they have been fully allocated since March 2011.[124] There has been no movement to authorize further funds for the program. On the other hand, Congress did choose to authorize money for Qualified Energy Conservation Bonds (QECBs) which would work in a similar fashion. Those, however, are allocated by the states.[125]

III. EXPLORING THE DISPARITY BETWEEN NUCLEAR AND OTHER EMISSION-FREE GENERATION

Given that the disparity between the federal subsidies for the different forms of low- and no-carbon sources is so great,[126] the

microturbines, and small wind installed prior to 12/31/08. *See id*.

120 *See id*.

121 *See id.*

122 *See Clean Renewable Energy Bonds (CREBs)*, DATABASE OF STATE INCENTIVES FOR RENEWABLES & EFFICIENCY (DSIRE), http://programs.dsireusa.org/system/program/detail/2510 (last updated Apr. 16, 2015).

123 *See id.*

124 *See id.*

125 *See Qualified Energy Conservation Bonds (QECBs)*, DATABASE OF STATE INCENTIVES FOR RENEWABLES & EFFICIENCY (DSIRE), http://programs.dsireusa.org/system/program/detail/3098 (last updated Mar. 20, 2015).

126 In analyzing these subsidies, it would be helpful to have an objective measure of how much they amount to, on a per kilowatt-hour basis, for each type of electricity. The U.S. Energy Information Administration ("EIA") attempts to remove subsidies from its levelized cost of electricity calculations. *See Levelized Cost and Levelized Avoided Cost of New Generation Resources in the Annual Energy Outlook 2015*, U.S. ENERGY INFO. ADMIN., http://www.eia.gov/forecasts/aeo/electricity_generation.cfm (last visited Oct. 3, 2015). Theoretically, then, this

question becomes why the difference exists and if it should continue. Of course, a common historical argument is that nuclear power also serves defense needs—and, because it can provide energy security and independence, it should occupy a special place in policy.[127] The assumption that nuclear power is the only no- or low-carbon technology that can provide energy independence, however, is quickly becoming false. Installed wind energy is over 65 GW, with the majority of that capacity coming online after 2007, and it continues to grow.[128] Nuclear, on the other hand, provides around 99 GW.[129] It is entirely possible that wind will have more installed capacity than nuclear by 2019.[130] Solar capacity has surpassed 20 GW, and an additional 1.4 GW was installed in the second quarter of 2015 alone.[131] When other low- and no-carbon sources are factored in, other technologies can provide energy independence at the level traditionally provided by nuclear power.[132]

agency should be able to adequately and objectively determine the level of subsidies for each type of electricity. However, the EIA does not even acknowledge any ongoing subsidies for nuclear or any form of hydro. Therefore, direct comparison remains elusive.

127 *See* RAPHAEL J. HEFFRON, DECONSTRUCTING ENERGY LAW AND POLICY: THE CASE OF NUCLEAR ENERGY 6.3.3 (2015) ("[T]he 2005 Act stated that energy security (energy independence) was a key goal in US energy policy and nuclear was to assist in achieving these goals."). *See also* Jesse Lee, *Nuclear Energy and an Energy-Independent Future*, WHITE HOUSE BLOG (Feb. 16, 2010), https://obamawhitehouse.archives.gov/blog/2010/02/16/nuclear-energy-and-a-clean-energy-future. The Senate has also published a document which notes that the priority of the 2005 Energy Policy Act was "encouraging the production of energy from sources that would protect the environment, particularly nuclear power." STAFF OF S. COMM. ON ENERGY AND NAT. RES., 109TH CONG., ENERGY POLICY ACT OF 2005 ANNIVERSARY REP. (2006), http://www.energy.senate.gov/public/index.cfm/files/serve?File_id=f3ef8500-1a60-4c8b-b455-4279b8f86e6d.

128 *See* Wesoff, *supra* note 90.

129 *See Nuclear Power Plants, World-Wide*, EUROPEAN NUCLEAR SOC'Y, https://www.euronuclear.org/info/encyclopedia/n/nuclear-power-plant-world-wide.htm (last visited Aug. 20, 2015).

130 *See* Wesoff, *supra* note 90.

131 The industry expects 7.7 GW of capacity to come online in 2015. *See* Daniel Cusick, *Utility- and Home-Based Solar Power Continue to Set Records*, CLIMATEWIRE (Sept. 9, 2015), http://www.eenews.net/climatewire/2015/09/09/stories/1060024395.

132 While these numbers refer to installed (nameplate) capacity and it is true that renewables do not generate installed capacity (hence why they are deemed intermittent), capacity factors can vary widely based on location, technology, maintenance, and other factors. *See Monthly Generator Capacity Factor Data Now Available By Fuel and Technology*, U.S. ENERGY INFO. ADMIN. (Jan. 15, 2014) http://www.eia.gov/todayinenergy/detail.cfm?id=14611. Nuclear capacity

Another argument commonly made is that nuclear power provides baseload power, and that integrating higher levels of other no- and low-carbon sources onto the grid would be a recipe for chaos.[133] However, in July 2015, Germany generated the same amount of energy from solar photovoltaics as from nuclear power, and the grid performed completely adequately.[134] The argument around grid reliability is even more persuasive when one factors in the nature of many renewables as distributed generation. Nuclear—at least currently and for the far foreseeable future[135]—is

factors, too, can go below 80%, *see id*., and can lead to issues when significant generation is taken off-line in an unscheduled basis, which is happening regularly. Geothermal capacity factors are already around 70%. *See id*. Wind capacity factors continue to increase. *See Overview of U.S. Wind Market in 2015*, RENEWABLES INT'L, http://www.renewablesinternational.net/overview-of-us-wind-market-in-2015/150/435/93616/ (last visited Apr. 19, 2016); Lauren Tyler, *Georgia Mt. Community Wind Farm Exceeds Production Expectations*, N. AM. WINDPOWER (March 4, 2016), http://nawindpower.com/georgia-mt-community-wind-farm-exceeds-production-expectations), and have been engineered for over 50% at current conditions, *see* BRANDON OWENS, THE RENEWABLE ENERGY ERA 19 (2015), http://gereports.cdnist.com/wp-content/uploads/2016/02/23113118/GE_Renewables_Digital.pdf. Engineering improvements continue, which will lead to continued capacity factor improvements, especially for wind and solar.

133 Additionally, the PJM market found that retiring nuclear plants and increasing renewables to at least 20% would not threaten reliability in the near term. *See* Jeff St. John, *Mid-Atlantic Grid Can Lose Coal and Nuclear, and Remain Reliable with Natural Gas and Renewables*, GREENTECH MEDIA (Mar. 30, 2017), https://www.greentechmedia.com/articles/read/mid-atlantic-grid-can-stay-reliable-with-natural-gas-and-renewables.

134 *See* Sandra Enkhardt, *Germany: Record PV and Wind Grid Feed-In for July*, PV MAG. (Aug. 5, 2015), https://www.pv-magazine.com/2015/08/05/germany-record-pv-and-wind-grid-feed-in-for-july_100020507/. While some continue to be skeptical about how Germany has integrated renewables, the country is at an average of 30% with no reliability issues. *See* Eric Martinot, *How Is Germany Integrating and Balancing Renewable Energy Today?*, RENEWABLE ENERGY FUTURES TO 2050 (Jan. 2015), http://www.martinot.info/renewables2050/how-is-germany-integrating-and-balancing-renewable-energy-today. What has occurred is that power is more expensive; however, German households pay an average electrical bill which equates to approximately 2.5% of household income, compared to 2.7% of household income in the U.S. *See* Umair Irfan, *NATIONS: Burden of Germany's Shift to Renewable Energy Falls on Taxpayers, but Energy Rates Are Close to U.S. Range*, CLIMATEWIRE (Oct. 22, 2014), http://www.eenews.net/climatewire/2014/10/22/stories/1060007702. And in Germany, that includes an € 0.0624 per kWh renewable energy surcharge. *See id*. Germany's focus on renewables has also halved utility profits. *See* Jeevan Vasagar, *Eon Prices Halve on Germany's Green Technology*, FIN. TIMES, November 13, 2013. The potential for similar outcomes for utility revenues is likely behind at least some of the focus on any challenges Germany may have integrating high renewable penetration.

135 There have been plans to build micro reactors. *See* Ben Bradford, *Are*

part of the traditional utility system, where power is supplied from large plants which may be close to demand or which may require the power to travel significant distances.[136] The ability to provide generation where it is needed—without much transmission and distribution—will be vital to recovery efforts from larger storms and the other effects of climate change.[137] Therefore, aside from the national energy independence issues, non-nuclear no- and low-carbon sources can be distributed, enabling them to be the generation for microgrids and in other situations where parts of the grid need to be islanded, leading to increased reliability in times of crisis or natural disaster.

The argument that nuclear generation is more important for energy independence and grid stability than other no- and low-carbon sources is no longer convincing. In light of this, the question is how these federal subsidies will continue into the future. The five new nuclear reactors currently under construction are all being brought on-line by a quasi-federal agency or vertically integrated utilities.[138] This is simply due to the

Mini-Reactors the Future of Nuclear Power?, NAT'L PUB. RADIO (Feb. 4, 2013, 3:33 AM), http://www.npr.org/2013/02/04/170482802/are-mini-reactors-the-future-of-nuclear-power. However, after the federal government spent $111 million by the end of 2014, the program was shelved. *See Small Nuclear Power Reactors*, WORLD NUCLEAR ASS'N, http://www.world-nuclear.org/info/Nuclear-Fuel-Cycle/Power-Reactors/Small-Nuclear-Power-Reactors/ (last updated Aug. 2015). For micro reactor programs that are still ongoing in Russia, cost estimates have increased from $140 million to $740 million. *See* Henry Hewitt, *Nuclear Power Industry Still Has an Unclear Future*, GREENTECH MEDIA (Aug. 14, 2015), https://www.greentechmedia.com/articles/read/Nuclear-Power-Industry-Still-Has-an-Unclear-Future.

136 There is at least some acknowledgement in the utility industry that "the idea of large coal-fired or nuclear power stations to be used for baseload power is 'outdated'" and that rooftop solar and microgrids will serve most market needs. *See* Karel Beckman, *Steve Holliday, CEO National Grid: "The Idea of Large Power Stations for Baseload Is Outdated"*, ENERGYPOST (Sept. 11, 2015), http://www.energypost.eu/interview-steve-holliday-ceo-national-grid-idea-large-power-stations-baseload-power-outdated/.

137 Since the ability to use installed solar PV was not in place for Superstorm Sandy, portable solar generators were brought in while the power was still out. *See* Katherine Tweed, *Can Solar Generators Get a Toehold After Sandy?*, GREENTECH MEDIA (Dec. 5, 2012), http://www.greentechmedia.com/articles/read/can-solar-generators-get-a-toehold-post-sandy.

138 The first is Watts Bar 2, which is being constructed by the Tennessee Valley Authority. *See Watts Bar Unit 2 Complete and Commercial*, TENNESSEE VALLEY AUTHORITY, https://www.tva.com/Newsroom/Watts-Bar-2-Project. The Tennessee Valley Authority is a corporate agency of the United States. *See About TVA*, TENN. VALLEY AUTH., https://www.tva.gov/About-TVA (last visited Apr.

exorbitant cost that nuclear plants entail.[139] Due to the monopoly nature of these companies, ratepayers will be paying for them, regardless of cost, for decades to come. Cost overruns and ballooning decommissioning costs can merely be added into the asset rate base, and the utility's shareholders will receive their regulated rate of return on the assets for at least the entire useful life.[140] Adding at least $1 billion to the regulated rate base where it has the ability to earn returns of more than 10 percent for over forty years[141] is especially attractive when loan guarantees are applied, as that leads to even lower risk for shareholders, driving down the real cost of capital while increasing the asset rate base.[142]

19, 2016). The next two new reactors scheduled to come online, Vogtle 3 and 4, are being built by a consortium headed by Georgia Power. *See* GA. POWER CO., 2014 ANNUAL REPORT 4 (2015), https://www.georgiapower.com/docs/about-us/2014GPCAnnualReport.pdf. Georgia Power "operates as a vertically integrated utility providing electricity to retail customers within its traditional service area located within the State of Georgia and to wholesale customers in the Southeast." *See id*

. The final two new reactors, V.C. Summer Units 2 and 3, are being constructed by South Carolina Electric & Gas Company (SCE&G). *See Nuclear Power*, SCE&G, https://www.sceg.com/about-us/power-generation/nuclear (last visited Mar. 4, 2017). "SCE&G is a vertically integrated electric . . . and gas distribution . . . utility operating within South Carolina and servicing 663,000 electric customers and 314,000 gas customers." *Announcement: Moody's Places the Ratings of SCANA Corp. and Certain Ratings of SCE&G on Review for Downgrade and Affirms Ratings of PSNC*, MOODY'S INV'R SERV. (Aug. 1, 2011), https://www.moodys.com/research/Moodys-places-the-ratings-of-SCANA-Corp-and-certain-ratings—PR_223806.

139 *See* Kristi E. Swartz, *Georgia Power IDs Site for Possible Future Nuclear Expansion*, ENERGYWIRE (March 17, 2016), http://www.eenews.net/energywire/2016/03/17/stories/1060034175 ("I would say from an investor's standpoint, the concept of a new nuclear plant is laughable . . . It would be an equity negative even if it's a large capital expense that goes into rate base.").

140 *See id*.

141 $14 billion is an estimate of what Vogtle was expected to cost at completion; it has since increased. *See* Kristi E. Swartz, *Vogtle's Spiking Costs Cause Confusion at Georgia PSC*, ENERGYWIRE (Jan. 29, 2016), http://www.eenews.net/energywire/2016/01/29/stories/1060031372. The new Vogtle reactors have been granted licenses lasting 40 years. *See* NUCLEAR REGULATORY COMM'N, COMBINED LICENSE: VOGTLE ELECTRIC GENERATING PLANT UNIT 3, GEORGIA POWER COMPANY (2012), http://pbadupws.nrc.gov/docs/ML1129/ML112991110.pdf; NUCLEAR REGULATORY COMM'N, COMBINED LICENSE: VOGTLE ELECTRIC GENERATING PLANT UNIT 4, GEORGIA POWER COMPANY, http://pbadupws.nrc.gov/docs/ML1130/ML113060412.pdf.

142 It is possible that, in the future, nuclear plants could be financed without loan guarantees; however, this would increase risk of default, and therefore it would likely increase the price. With the price increase, a public utility commission may not think new nuclear is the most cost-effective choice. All four

This goes to the very heart of why federal subsidies need to be equitably distributed: for regulated utilities, earnings are heavily dependent on increasing investment, whether or not that is good for the customer or the planet.[143] For competitive companies—including companies that own the majority of solar and wind generating capacity[144]—long-term increases in profitability are driven by growing revenues and controlling costs. While some of the discrepancies can be dealt with at the state level[145] through regulatory reform, federal signals must be altered to drive significant change.

nuclear plants currently under construction by investor-owned utilities have loan guarantees.

143 "[U]tilities have inherent interests in growing rate base through capital expenditures." N.Y. STATE DEP'T OF PUB. SERV., *supra* note 96, at 39.

144 *See Existing Net Summer Capacity by Energy Source and Producer Type, 2005 through 2015*, U.S. ENERGY INFO. ADMIN., https://www.eia.gov/electricity/annual/html/epa_04_02_a.html (showing that independent power producers own more non-hydroelectric renewable energy capacity than regulated utilities) (last visited Apr. 19, 2017).

145 Most of the state-level reforms revolve around state Renewable Energy Portfolio Standards (REPS). While state REPS will continue to drive demand, these are expected to only "require average annual renewable energy additions of 4–5 GW/year through 2025." U.S. DEP'T OF ENERGY, 2014 WIND TECHNOLOGIES MARKET REPORT, ix (2015), http://www.energy.gov/sites/prod/files/2015/08/f25/2014-Wind-Technologies-Market-Report-8.7.pdf. Nuclear was not included in most state REPS due to the fact that it is not renewable. To supplement the price nuclear generation was receiving in wholesale markets to pay for its "environmental values," New York and Illinois both passed legislation subsidizing at-risk nuclear plants with Zero Emission Credits. Jeffrey Tomich, *Nuclear: PJM Monitor Rails Against Threat of "Contagious" Subsidies*, E&E NEWS (Mar. 13, 2017), http://www.eenews.net/energywire/2017/03/13/stories/1060051340. While these are being challenged in court, *see State Cases: New York*, STATE POWER PROJECT (last visited Mar. 23, 2017), https://statepowerproject.org/new-york/#nyces; *State Cases: Illinois*, STATE POWER PROJECT (last visited Mar. 23, 2017), https://statepowerproject.org/illinois/, Connecticut is considering reclassifying its sole nuclear plant as renewable to enable the state to protect the generation asset by giving it a five year power purchase agreement, rather than having the plant paid for at the wholesale rate. *See* Peter Maloney, *Connecticut Bill Would Protect Millstone Nuke by Classifying it as a Renewable Resource*, UTILITY DIVE (Mar. 16, 2017), http://www.utilitydive.com/news/connecticut-bill-would-protect-millstone-nuke-by-classifying-it-as-a-renewa/438205/. Ohio is also considering subsidizing existing nuclear plants. *See* Peter Maloney, *Ohio Lawmakers Introduce Bill to Support FirstEnergy's Nuclear Plants*, UTILITY DIVE (Apr. 6, 2017), http://www.utilitydive.com/news/ohio-lawmakers-introduce-bill-to-support-firstenergys-nuclear-plants/439950/. New Jersey is, as well. *See Does N.J.'s Nuclear Power Industry Need a Bailout?*, ASSOCIATED PRESS (Apr. 9, 2017), http://www.nj.com/news/index.ssf/2017/04/is_njs_nuclear_power_industry_in_need_of_bailout.html.

Additionally, a glimpse at the recent historical DOE Research and Development budget shows that this ingrained inequality is continuing. Between 1997 and 2014, the DOE spent more than $21 billion on research and development for fusion, nuclear physics, and nuclear energy combined, not including money spent on defense. The amount for nuclear energy increased the most on a percentage basis. All energy efficiency and renewable energy research and development combined received less than $16 billion over the same time period.[146] These analyses bring into stark relief the discrepancies in how different no- and low-carbon sources of electricity are treated. The nuclear industry has had price stability—in the form of subsidized fuel and waste disposal, a higher percentage of federal research and development funds, and liability caps—in place continuously for decades.

Notwithstanding this disparate treatment, prices for renewable generation like wind and solar continue to decline.[147] The wind energy industry has seen growth for both utility-scale and smaller-scale distributed wind energy, and wind energy prices are "competitive with wholesale power prices and traditional power sources across many areas of the United States."[148] Since 2010, enough wind power has been added annually to generate the power

146 *See Historical Trends in Federal R&D*, AM. ASS'N FOR THE ADVANCEMENT OF SCI., http://www.aaas.org/page/historical-trends-federal-rd (last updated Aug. 14, 2015); *Trends in DOE R&D, FY 1997-2016*, AM. ASS'N FOR THE ADVANCEMENT OF SCI., http://www.aaas.org/sites/default/files/DOE_1.jpg (last updated May 2015); *see also* the excel spreadsheet of the same data. AM. ASS'N FOR THE ADVANCEMENT OF SCI., http://www.aaas.org/sites/default/files/DOE_1.xlsx. Programs for "alternative" renewables are even more poorly funded. *See* Camille von Kaenel, *Renewable Energy: Infant U.S. Wave-To-Energy Industry Looks to Build More Testing Facilities*, CLIMATEWIRE (Aug. 7, 2015), http://www.eenews.net/climatewire/2015/08/07/stories/1060023142. Wave and marine energy technologies, which could power 100 million homes, have no appropriate testing station due to lack of funds; sufficient federal support could enable one to be online by 2017. *See id*. Additionally, DOE wind research was specifically cut from the latest Senate appropriations bill. *See* Geof Koss, *Governors Balk over DOE Wind Research Cuts*, GREENWIRE (Sept. 15, 2015), http://www.eenews.net/greenwire/2015/09/15/stories/1060024713.

147 *See* Tara Patel, *Fossil Fuel Losing Cost Advantage over Solar, Wind, IEA Says*, BLOOMBERG (Aug. 31, 2015), http://www.bloomberg.com/news/articles/2015-08-31/solar-wind-power-costs-drop-as-fossil-fuels-increase-iea-says.

148 U.S. DEP'T OF ENERGY, *supra* note 145, at viii. As noted in the report, "[a]vailability of federal incentives for wind projects built in the near term is leading to a resurgent domestic market, but a possible policy cliff awaits." *Id*. at ix.

equal to three new nuclear reactors.[149] Clean energy could be an even greater success with the certainty that would come with stable long-term policies.[150]

Additionally, the economics of new nuclear construction continue to seem like throwing good money after bad. The first two Vogtle reactors went 800 percent over budget, with the vast majority of that overrun covered by Georgia Power's ratepayers.[151] Reactors three and four are currently at least 39 months behind schedule and at least $2 billion over the original $14 billion budget.[152]

While there are calls for the federal government to end both the PTC and ITC for renewable sources,[153] calls to require nuclear generators to fully cover the cost of their liability, environmental impact, and waste disposal, or to otherwise eliminate direct and implicit subsidies have been muted.

149 *See* Peter Behr, *A Mighty Optimistic Wind Estimate Fuels EPA Rule*, ENERGYWIRE (Aug. 7, 2015), http://www.eenews.net/energywire/2015/08/07/stories/1060023138.

150 "Unambiguous messages are certainly what the energy sector wants . . . Business needs messages that have the long-term clarity needed to secure investment, loud enough to be heard across a wide variety of boardrooms and legally underpinned to create the new framework for delivery that will be needed." Roger Milne, *Hopes and Fears for Copenhagen Climate Change Talks*, UTILITY WEEK (Dec. 4, 2009), http://www.utilityweek.co.uk/features/europe/hopes-and-fears-for-copenhagen.php (quoting David Porter and David Green); *Energy Department Reports Highlight Trends of Growing U.S. Wind Energy Industry*, U.S. DEP'T OF ENERGY (Aug. 10, 2015), http://www.energy.gov/articles/energy-department-reports-highlight-trends-growing-us-wind-energy-industry.

151 *See* Michael Mariotte, *Vogtle: At $65 Billion and Counting, It's a Case Study of Nuclear Power's Staggeringly Awful Economics*, GREENWORLD (Aug. 2, 2015), http://safeenergy.org/2015/08/03/vogtle-at-65-billion-and-counting/.

152 The cost overruns lead to another subsidy: as state public utility commissions regularly allow cost overruns to, regardless of amount, be added to the asset base, the utility is rewarded for the overrun rather than penalized for it. South Carolina regulators approved another rate increase to pay for the two new reactors being built in that state; the project is now more than $1.1 billion over budget. *See* Kristi E. Swartz, *Reactor Delays Lead to Another Rate Increase in S.C.*, ENERGYWIRE (Sept. 24, 2015), http://www.eenews.net/energywire/2015/09/24/stories/1060025203.

153 *See* Zack Colman, *Conservative Groups Push for End to Wind Energy Tax Credit*, THE HILL (Sept. 6, 2012), http://thehill.com/policy/energy-environment/247949-koch-backed-americans-for-prosperity-conservative-groups-push-congress-to-end-wind-credit. *See also* Daniel Cusick, *U.S. Wind Energy Prices Hit Record Low as Industry Continues Rapid Growth*, CLIMATEWIRE (Aug. 11, 2015), http://www.eenews.net/climatewire/2015/08/11/stories/1060023261.

As recently noted in an article on energy market design, "[i]f nuclear plants are to succeed, they will need to be sheltered from market forces."[154] This is happening currently: "[t]he only plants being built now are in competition-free zones, and require heroic measures such as loan guarantees, production tax credits, and most important of all, a captive customer base that is financing the plants through Construction Work in Progress (CWIP) charges."[155]

Given the historic sums that have been spent on the failed waste storage facility at Yucca Mountain and nuclear research and development, it seems impossible that federal support for other clean energy sources could ever catch up. Even with the expenditures for nuclear waste disposal facilities, existing spent fuel and other nuclear wastes remain a public problem to solve. However, eliminating all liability caps might be a good place to start reducing federal nuclear subsidies. The risks of nuclear generation are socialized in a way that does not exist for any other low- or no-carbon energy source.[156] As shown above, the level of individual insurance is paltry for the type of destruction that could occur. Internalizing the risks of nuclear accidents to the industry by removing low caps on individual liability, and requiring utilities to fully insure, would let the market determine value the risk rather than having that risk borne by taxpayers.

IV. THE INTERESTING CASE OF FEDERAL LOAN GUARANTEES

Federal loan guarantees are available for a variety of technologies.[157] First introduced in the Energy Policy Act of 2005 and described as the Section 1703 Loan Program, the Department of Energy is authorized to issue loan guarantees for projects with high technology risk that "avoid, reduce or sequester air pollutants or anthropogenic emissions of greenhouse gases; and employ new or significantly improved technologies as compared to commercial

154 Bentham Paulos, *How Wind and Solar Will Blow Up Power Markets*, GREENTECH GRID (Aug. 11, 2015), http://www.greentechmedia.com/articles/read/how-wind-and-solar-will-blow-up-power-markets.

155 *Id*.

156 *See* Hewitt, *supra* note 135.

157 Under a loan guarantee, "DOE guarantees the debt of privately-held energy generation and manufacturing projects, guaranteeing to a private lender that if the company defaults on a loan related to the project, the government will step in to repay the outstanding balance." SOLAR ENERGY INDUS. ASS'N, LOAN GUARANTEE PROGRAM, http://www.seia.org/policy/finance-tax/loan-guarantee-program (last visited Mar. 21, 2016).

technologies in service in the United States at the time the guarantee is issued."[158] Loan guarantees are intended to support private financing for emerging technologies, not to serve as an alternative to private capital markets in perpetuity. The Department of Energy's Loan Programs Office states the problem succinctly:

> Commercial banks and bondholders are often unwilling to finance the first few commercial-scale projects that use a new technology since there is not yet a history of credit performance or operation. As a result, the initial commercial deployment of new energy technology is often limited by a project developer's inability to secure sufficient long-term debt financing to build the project.[159]

Nuclear power is a very mature technology. Although over 100 nuclear reactors are in commercial operation in the United States,[160] the nuclear industry feels strongly—and the DOE agrees—that the design improvements in current reactor design is different enough for them to be classified as a project with a high technology risk that is not in commercial operation.[161] Reactor financing is, therefore, subsidized through loan guarantees.[162] According to the CEO of Exelon, speaking for the entire industry,

158 42 U.S.C. § 16513(a) (2012). A list of project categories eligible for loan guarantees include renewable systems, advanced fossil energy technology, hydrogen fuel cells, nuclear, carbon capture and sequestration, efficiency, electric vehicles, pollution control equipment, refineries, and coal gasification. *See id.* at § 16513(b).

159 U.S. DEP'T OF ENERGY, LOAN PROGRAMS OFFICE, LPO FINANCIAL PERFORMANCE 2 (2014), https://www.energy.gov/sites/prod/files/2014/11/f19/DOE-LPO-Financial%20Performance%20November%202014.pdf.

160 For a high-level history of reactor design and why we are where we are, see Umair Irfan, *Can the Next Generation of Reactors Spur a Nuclear Renaissance?*, CLIMATEWIRE (July 1, 2015), http://www.eenews.net/climatewire/2015/07/01/stories/1060021132.

161 This is the definition of what is required to obtain a federal loan guarantee. Since the Vogtle reactors obtained a loan guarantee, one can infer that DOE felt they met the definition. *See Energy Department Reports Highlight Trends of Growing U.S. Wind Energy Industry*, U.S. DEP'T OF ENERGY (Aug. 10, 2015), https://www.energy.gov/articles/energy-department-reports-highlight-trends-growing-us-wind-energy-industry.

162 *See* CONG. BUDGET OFFICE, FEDERAL LOAN GUARANTEES FOR THE CONSTRUCTION OF NUCLEAR POWER PLANTS 2 (2011) ("For nuclear construction loans, borrowers will tend to turn down a guarantee if they believe the fee set by DOE is too high but go forward if they consider it fair or underpriced, which increases the likelihood that DOE's portfolio will include more projects for which the subsidy fee has been underestimated than overestimated.").

the loan guarantee program is "the single most important instrument . . . to support financing of new nuclear generating capacity."[163] The Congressional Research Service found that "loan guarantees can turn nuclear power from a high-cost technology to a relatively low-cost option."[164] Exelon values the loan guarantee at 2.5 cents per kilowatt-hour.[165] In June 2015, the Department of Energy finalized the last remaining portion of an $8 billion loan guarantee for Plant Vogtle in Georgia.[166] In states with regulated utilities, like Georgia Power, state public utility commissions also have the ability to allow for the utility to be paid back for construction costs before the plant is operational. This construction-work-in-progress (CWIP) fee ensures the utility will be paid during the long construction time, further decreasing financing costs and making nuclear power more affordable.[167] The DOE also provided a $2 billion loan to support a uranium enrichment facility in Idaho.[168]

Certainly loan guarantees were also provided to renewable technologies. For non-nuclear low- and no-carbon sources, the legislative provision which provided funding for the majority of renewable loan guarantees was the American Recovery and

163 *Testimony for the Record Before the Subcomm. on Energy & Air Quality of the H. Comm. on Energy & Commerce*, 110th Cong. (2007) (statement of Christopher Crane, Senior Vice President, Exelon Corp., President and Chief Nuclear Officer, Exelon Nuclear).

164 STAN KAPLAN, CONG. RESEARCH SERV., POWER PLANTS: CHARACTERISTICS AND COSTS 1 (2008).

165 *See* KOPLOW, *supra* note 15, at 33.

166 *See* Hannah Northey, *DOE Grants Remainder of $8B Vogtle Loan Guarantee*, GREENWIRE (June 24, 2015), http://www.eenews.net/greenwire/2015/06/24/stories/1060020811.

167 Georgia Power lists specific advantages CWIP provides Vogtle units 3 and 4, including: "[c]ut financing costs $300 million during the construction period, directly benefiting customers" and "[h]elp preserve the company's credit ratings, which will reduce borrowing costs, saving customers as much as $100 million annually for all company projects." *Construction Financials*, GA. POWER CO., https://www.georgiapower.com/about-energy/energy-sources/nuclear/construction-financials.cshtml (last visited Jan. 11, 2017).

168 *See Section 1703 Loan Program*, U.S. DEP'T OF ENERGY, http://energy.gov/lpo/services/section-1703-loan-program (last visited Oct. 5, 2015). The DOE was looking to provide a centrifuge uranium enrichment project in Ohio with another $2 billion loan guarantee, but has pulled back from the project. The company had "generous federal support before it filed for bankruptcy last year." Hannah Northey, *Obama Admin Abandons Contentious Enrichment Project*, GREENWIRE (Sept. 14, 2015), http://www.eenews.net/greenwire/2015/09/14/stories/1060024626.

Reinvestment Act (ARRA) of 2009,[169] and all authorizations under that program—known as the Section 1705 loan program—expired on September 30, 2011.[170] The good news for taxpayers is that, even with Solyndra[171] and two other defaults, the Department of Energy's Loan Programs Office has lost less than $780 million, or approximately 2 percent of the program's loans, and has already earned at least $810 million in interest.[172] In the combined portfolio of Section 1703 and Section 1705 programs, nuclear accounts for $8 billion for two reactors, while the first five solar projects larger than 100 Megawatts (MW) received a combined $4.5 billion.[173]

Although more changes may come,[174] the DOE intends to use

169 *See U.S. Dep't of Energy – Loan Guarantee Program*, DATABASE OF STATE INCENTIVES FOR RENEWABLES & EFFICIENCY (DSIRE), http://programs.dsireusa.org/system/program/detail/3071 (last updated Nov. 20, 2014).

170 *See Section 1705 Loan Program*, U.S. DEP'T OF ENERGY, http://energy.gov/lpo/services/section-1705-loan-program (last visited Oct. 5, 2015).

171 Solyndra, a solar panel manufacturing start-up company, was granted a loan guarantee on September 3, 2009, after raising more than $1 billion in private capital. The company then declared bankruptcy on September 1, 2011. *See Key Facts: Solyndra Solar*, U.S. DEP'T OF ENERGY, http://www.energy.gov/key-facts-solyndra-solar (last visited Mar. 4, 2017).

172 *See* U.S. DEP'T OF ENERGY, LOAN PROGRAMS OFFICE, *supra* note 159, at 4.

173 *See* U.S. DEP'T OF ENERGY, LOAN PROGRAMS OFFICE, INVESTING IN AMERICAN ENERGY (2015), http://www.energy.gov/sites/prod/files/2015/03/f20/LPO-Brochure-CSP.pdf. *See also Portfolio Projects*, U.S. DEP'T OF ENERGY, http://energy.gov/lpo/portfolio-projects (last visited Oct. 5, 2015). The two Vogtle reactors combined will have 2,200 MW of capacity ($3,636/MW). *See Vogtle*, U.S. DEP'T OF ENERGY, http://energy.gov/lpo/vogtle (last visited Mar. 4, 2017). The five solar projects combined will have over 1,500 MW of capacity ($3,000/MW). *See Agua Caliente*, U.S. DEP'T OF ENERGY, http://energy.gov/lpo/agua-caliente (last visited Mar. 4, 2017) (290 MW); *Antelope Valley Solar Ranch*, U.S. DEP'T OF ENERGY, http://energy.gov/lpo/antelope-valley-solar-ranch (last visited Mar. 4, 2017) (242 MW); *California Valley Solar Ranch*, U.S. DEP'T OF ENERGY, http://energy.gov/lpo/california-valley-solar-ranch (last visited Mar. 4, 2017) (250 MW); *Desert Sunlight*, U.S. DEP'T OF ENERGY, http://energy.gov/lpo/desert-sunlight (last visited Mar. 4, 2017) (550 MW); *Mesquite*, U.S. DEP'T OF ENERGY, http://energy.gov/lpo/mesquite (last visited Mar. 4, 2017) (170 MW).

174 *See* Hannah Northey, *Key Senators Eye Loan Guarantee Reforms as Bill Advances*, GREENWIRE (Aug. 21, 2015), http://www.eenews.net/greenwire/2015/08/21/stories/1060023776; Hannah Northey, *Obama Pushes Clean Energy Ahead of Vegas Speech*, GREENWIRE (Aug. 24, 2015), http://www.eenews.net/greenwire/2015/08/24/stories/1060023846. This additional funding is potentially earmarked for distributed energy projects. *See* Geof Koss, *DOE 'Open for Business' on Distributed Generation*, GREENWIRE (Aug. 25, 2015),

existing authority under Section 1703 to provide more non-nuclear loan guarantees. An almost $4 billion solicitation was issued for Renewable Energy Project and Energy Efficiency Projects in 2014, with applications due by December 2015.[175]

Some states have also decided that solar should no longer qualify for loan guarantees at the state level, as "there is now a mature private market to provide loans for residential solar."[176] At a minimum, all other forms of low- and no-carbon sources should have access to the same loan guarantees, even for mature technology, as nuclear. Otherwise, loan guarantees should be only for truly emerging technologies, such as marine kinetic generation.

V. TREATMENT OF NUCLEAR POWER AND OTHER ENERGY TECHNOLOGIES UNDER THE EPA'S CLEAN POWER PLAN

On August 3, 2015, the EPA issued the final Clean Power Plan, regulating greenhouse gas emissions from existing power plants under Section 111(d) of the Clean Air Act. In the proposed rule, nuclear power plants already under construction—namely Watts Bar 2 at TVA, Vogtle Units 3 and 4, and Sumner Units 2 and 3 in South Carolina—did not count as new low- or no-carbon sources for compliance purposes. Commenting on the proposed rule, the nuclear industry argued that all renewals of existing nuclear plant licenses should count as new zero carbon generation.[177] In the final rule, EPA decided to allow the five new reactors to count toward compliance, as well as generation increases at existing plants.[178] However, simply relicensing a plant

http://www.eenews.net/greenwire/2015/08/25/stories/1060023883.

175 *See U.S. Dep't of Energy – Loan Guarantee Program*, *supra* note 169.

176 *See* Katherine Tweed, *Why Are Taxpayer Dollars Still Being Used to Back Solar Loans?*, GREENTECH MEDIA (Aug. 11, 2015), http://www.greentechmedia.com/articles/read/Why-Are-Taxpayer-Dollars-Still-Providing-Solar-Loans.

177 "NEI had also suggested in its comments that new nuclear capacity should include nuclear plants relicensed to operate beyond 60 years, and any nuclear plants that had not received license extensions to operate beyond their original 40-year license term as of the beginning of the 2012 baseline year. The final rule appears to give no credit for license extensions." *NEI Comments on EPA's Clean Power Plan*, NUCLEAR ENERGY INSTITUTE (Aug. 3, 2015), http://www.nei.org/News-Media/Media-Room/News-Releases/NEI-Comments-on-EPA-s-Clean-Power-Plan.

178 *See NEI's Fertel Talks Industry Growth Following Power Plan Changes*, E&ETV (Aug. 11, 2015), http://www.eenews.net/tv/videos/2023/transcript.

will not count as additional "clean" generation in the final rule, but will be treated the same as all other existing generation units.[179]

Additionally, the proposed rule had tacitly acknowledged the economic pressures on some nuclear plants, and had assumed that nuclear capacity would decrease at a rate of 5.8% across all states because of the risk of nuclear plant closures. The purpose of this "at risk" calculation was to encourage states to find a way to maintain their current nuclear generation.[180] The final rule removed this "at risk" calculation; instead, the EPA adopted the premise—including for nuclear—that existing low- and no-carbon generation would be preserved.[181] The nuclear industry concluded that the final rule responded to some "key concerns" in the proposed rule and that the goals will be "less onerous for the U.S. power sector" than the proposed rule would have indicated. Even the president of the Nuclear Energy Institute feels that the final Clean Power Plan is a win overall for the industry.[182] However, the EPA's decision to not count re-licensed nuclear power plants as

179 *See id.* Commentators are also recognizing that new nuclear is a winner under the rule. *Bipartisan Policy's Grumet Says McConnell Strategy on EPA's Plan 'Disappointing'*, E&ETV (Aug. 25, 2015), http://www.eenews.net/tv/videos/2024/transcript.

180 *See* U.S. ENVTL. PROT. AGENCY, DOCKET ID NO. EPA-HP-OAR- 2013-0602, TECHNICAL SUPPORT DOCUMENT (TSD) FOR CARBON POLLUTION GUIDELINES FOR EXISTING POWER PLANTS, at 4-33 (2014), https://www.epa.gov/sites/production/files/2014-06/documents/20140602tsd-ghg-abatement-measures.pdf ("Another way to increase the amount of available nuclear capacity is to preserve existing nuclear EGUs that would otherwise be retired. While each retirement decision is based on the unique circumstances of that individual unit, the EPA recognizes that a host of factors – increasing fixed operation and maintenance costs, relatively low wholesale electricity prices, and additional capital investment associated with ensuring plant security and emergency preparedness – have altered the outlook for the U.S. nuclear fleet in recent years. Reflecting similar concern for these challenges, EIA in its most recent Annual Energy Outlook has projected an additional 5.7GW of capacity reductions to the nuclear fleet. EIA describes the projected capacity reductions – which are not tied to the retirement of any specific unit – as necessary to recognize the 'continued economic challenges' faced by the higher-cost nuclear units. Likewise, without making any judgment about the likelihood that any individual EGU will retire, we view this 5.7GW, which comprises approximately six percent of nuclear capacity, as a reasonable proxy for the amount of nuclear capacity at risk of retirement.").

181 *See* JONATHAN L. RAMSEUR & JAMES E. MCCARTHY, CONG. RESEARCH SERV., EPA'S CLEAN POWER PLAN: HIGHLIGHTS OF THE FINAL RULE 8 (2015), http://www.fas.org/sgp/crs/misc/R44145.pdf.

182 *NEI's Fertel Talks Industry Growth Following Power Plan Changes*, *supra* note 178.

"clean" generation arguably signals a shift in federal energy policy, towards relying more on renewable energy sources and less on nuclear energy.

The clean power plan is also favorable to other low- and no-cost generation. The EPA expects a significant increase in renewable generation by 2030.[183] Some commentators have noted that wind power will especially benefit, in part because it is cost-competitive in geographic locations that emit large amounts of carbon.[184] Both the Environmental Protection Agency and the Energy Information Administration have models showing wind as the "least-cost bulk compliance option."[185]

Perhaps the biggest boost from the Clean Power Plan could come from the Clean Energy Incentive Program embedded in the final rule. The program gives extra credits for wind and solar generation for projects which start after a state's compliance plan is finished in 2018 and which become operational in 2020 and 2021 (before compliance with the Plan starts in 2022).[186]

CONCLUSION

In order to continue to expand electricity generation supplied by no- and low-carbon sources of electricity, either all energy should be market-based, or the subsidies should be more equitably distributed among power sources. More than fifty years after commercial-scale implementation, nuclear power should internalize the costs of liability and the liability caps should be removed. Rather than continuing to invest so heavily in a technology which is still not profitable on the open market even with its subsidies, the federal government should first offer research and development budgets and loan guarantees to truly emerging technologies. While the CPP provides hope that regulatory policy, at least, may be changing, there is little indication that legislative policy at the federal level is. However, legislative change is especially important as attitudes and

183 *See* JONATHAN L. RAMSEUR & JAMES E. MCCARTHY, *supra* note 181, at 7.

184 These states include those in the MISO and the SPP. *See* Bentham Paulos, *Wind Power Wins Big Under the Clean Power Plan*, GREENTECH MEDIA (Aug. 25, 2015), http://www.greentechmedia.com/articles/read/wind-power-wins-big-under-the-clean-power-plan.

185 *Id.*

186 *See id.*

economics are changing. Fifty-six percent of Americans younger than thirty oppose nuclear power.[187] For the first time since Gallop starting asking, a majority of all Americans oppose nuclear energy. With legislative changes, we have the ability to implement a no- and low-carbon future based on market realities.[188]

187 *See Pew Survey: Most Young Americans Oppose Offshore Drilling, Nuclear Power*, FUELFIX.COM (July 1, 2015), http://fuelfix.com/blog/2015/07/01/pew-survey-most-young-americans-oppose-offshore-drilling-nuclear-power/#33023101=0.

188 *See* Rebecca Rifkin, *For First Time, Majority in U.S. Oppose Nuclear Energy*, GALLUP (March 18, 2016), http://www.gallup.com/poll/190064/first-time-majority-oppose-nuclear-energy.aspx.