NOTES

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The Race to Renewables: A Comparative Study of the Energy Market in Germany and the United States

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INTRODUCTION

The United States has been slow to invest in renewable energy generation. In 2015, thirteen percent of the energy generated in the United States was generated using renewable energy sources,[1] of which forty-six percent was generated using hydroelectric stations built in the 1970s.[2] However, Americans in general support renewable development. Seventy-three percent of Americans agree that the United States needs to emphasize the use of alternative energy to solve the nation's energy problems.[3] In particular, seventy percent of Americans support an emphasis on wind generated power and seventy-nine percent support an emphasis on solar power.[4]

Meanwhile, Germany has taken aggressive measures to increase their renewable generation. In 2015, thirty-one percent of the country's energy was generated by renewable sources.[5] On May 15, 2016, renewable energy supplied 45.5 gigawatts of the 45.8 gigawatt demand for the day.[6] Germany's renewable energy generation tripled over the last ten years.[7]

This paper will analyze the German and the U.S. energy markets in an effort to understand the discrepancy in renewable energy development and the efficacy of each country's chosen path. First, this paper will compare the demographics of the two countries to understand their respective energy requirements. Second, this paper will examine the energy generation policies that led to the explosion of

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1 *How Much U.S. Electricity is Generated from Renewable Energy?*, U.S. ENERGY INFO. ADMIN., https://web.archive.org/web/20160614183723/https://www.eia.gov/energy_in_brief/article/renewable_electricity.cfm#close (last updated May 5, 2016). Energy generation is the process of generating electric power from energy sources. Energy generation is also referred to as energy production. This paper will use the term energy generation.

2 *Id.*

3 *Energy*, GALLUP, www.gallup.com/poll/2167/energy.aspx (last visited Nov. 26, 2016).

4 *Id.*

5 Sara Hoff, *Germany's Renewables Electricity Generation Grows in 2015, but Coal Still Dominant*, U.S. ENERGY INFO. ADMIN.: TODAY IN ENERGY (May 24, 2016), http://www.eia.gov/todayinenergy/detail.php?id=26372.

6 Jessica Shankleman, *Germany Just Got Almost All of Its Power From Renewable Energy*, BLOOMBERG (May 16, 2016, 10:12 PM), http://www.bloomberg.com/news/articles/2016-05-16/germany-just-got-almost-all-of-its-power-from-renewable-energy.

7 *Id.*

renewables in the German market in comparison to the United States. Finally, this paper will analyze the efficacy of each country's renewable energy path and the overall impact of each approach on the country's carbon emissions.

For simplicity, this paper will focus on the electric sector—energy generated for consumption by an end user—and not the transportation sector. While oil is a huge emitter of carbon dioxide that factors into each country's carbon footprint, the scope of this paper will focus on energy generated for electric market consumption.

I
OVERVIEW OF ENERGY GENERATION

Energy generation sources are split into two categories: non-renewables and renewables.[8] Non-renewables are sources that require finite resources to generate energy, such as coal, gas, and uranium (nuclear power).[9] Renewables are sources that do not require finite resources for generation, such as solar, wind, biomass, hydro, and geothermal.[10] A country's energy generation portfolio is comprised of four main generation sources: coal, nuclear, natural gas, and renewables.

Coal is ranked using four classifications based on its heating value and carbon content.[11] The lightest of these classifications is lignite, or "brown coal."[12] Lignite is a soft brown coal that gives off less heat when burned and also emits less carbon.[13] Historically, lignite has been mined less than black coal because of its lower heat profile.[14]

Natural gas consists primarily of methane.[15] When burned, natural gas emits minimal air pollutants and burns away almost completely.[16] Natural gas can be mined from natural gas wells in the ground, or produced in tandem with coal and oil extraction.[17] After it is mined,

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8 LINCOLN L. DAVIES ET AL., ENERGY LAW AND POLICY 99 (2015).

9 *Id.*

10 *Id.*

11 *Id.* at 107.

12 Otto C. Kopp, *Lignite: Coal*, ENCYCLOPEDIA BRITANNICA, https://www.britannica.com/science/lignite (last visited Sept. 9, 2017).

13 DAVIES ET AL., *supra* note 8, at 107.

14 Kopp, *supra* note 12.

15 DAVIES ET AL., *supra* note 8, at 122.

16 *Id.*

17 *Id.* at 123.

natural gas is liquefied and transported from the well to either a refinery plant for local consumption, or to ships for exportation to other countries.[18] Pipelines are used to transport natural gas in both liquefied and gas form.[19] Liquefied natural gas is commonly referred to as LNG.

Nuclear energy is created using uranium.[20] To create nuclear energy from uranium, the uranium ore is mined, then the uranium is leached from the ore and turned into uranium oxide.[21] Two thousand tons of uranium oxide is needed to power a 1,000 MW nuclear reactor per year.[22] Energy is produced by splitting the atoms within the reactor core.[23] Nuclear energy is considered a clean energy source because it does not emit any carbon dioxide during the generation process.[24] However, nuclear reactors proved to be a dangerous source of energy and the failure of a plant can be devastating, as witnessed in Chernobyl and Fukushima.[25] The Fukushima disaster will be further explained later in this paper.

Renewable energy is defined by the unlimited supply of the generation resource.[26] The most utilized renewable sources are solar, wind, and hydro because of the significant quantity of energy produced from these sources.[27] The Achilles' heel of renewable generation is the variability of the resource and the lack of reliable, affordable storage

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18 *Liquefied Natural Gas*, OFFICE OF FOSSIL ENERGY, https://energy.gov/fe/science-innovation/oil-gas/liquefied-natural-gas (last visited Sept. 9, 2017).

19 *Id.*

20 DAVIES ET AL., *supra* note 8, at 134.

21 *Id.*

22 *Id.*

23 *Id.* at 130.

24 *Nuclear Plants: Protecting Air, Water, Soil, and Wildlife*, NUCLEAR ENERGY INST., (July 2015), https://www.nei.org/resources/fact-sheets/nuclear-protects-air-water-soil-wildlife (explaining how nuclear energy helps the electric sector comply with the Clean Air Act standards).

25 Rebecca Gillaspy, *Risks of Nuclear Power Plants and Radioactive Waste: Safety and Health Concerns*, STUDY.COM, http://study.com/academy/lesson/risks-of-nuclear-power-plants-and-radioactive-waste-safety-and-health-concerns.html (last visited Oct. 8, 2017); *Fukushima Accident*, WORLD NUCLEAR ASS'N, http://www.world-nuclear.org/information-library/safety-and-security/safety-of-plants/fukushima-accident.aspx (last updated Oct. 2017); *Chernobyl Accident 1986*, WORLD NUCLEAR ASS'N, http://www.world-nuclear.org/information-library/safety-and-security/safety-of-plants/chernobyl-accident.aspx (last updated Nov. 2016).

26 DAVIES ET AL., *supra* note 8, at 139.

27 *Id.*

technology.[28] The availability of renewable generation varies based upon the availability of the resource.[29] Additionally, we currently do not have technology to store bulk energy; energy must be consumed as it is generated.[30] Renewable generation must be paired with a non-variable generation source, usually natural gas, that can generate energy when the renewable resource is unavailable or unable to meet demand.[31]

II
DEMOGRAPHICS

Understanding the demographics of Germany and the United States is helpful to understand the energy policies developed by each country.

A. Germany

Germany is the largest economy in the European Union and the fourth largest economy in the world.[32] Germany is one of the world's most technologically advanced producers of iron, machinery, electronics, and automobiles.[33] The industry sector comprises 30.3% of the country's gross domestic product (GDP) while the service sector comprises 69.1%.[34] The country is 357,022 sq. km., making it smaller than the state of Montana.[35] However, Germany's population is 80,594,017, which is roughly twice the population of California.[36] Consequently, Germany is densely populated with 75.7% of the population living in urban areas.[37] The country is comprised of mostly middle class society with a GDP per capita of $47,900 in 2015.[38]

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28 *See* Jackie Jones, *Balancing Act: How Can We Deal with Variability?*, RENEWABLE ENERGY WORLD (Nov. 10, 2011), http://www.renewableenergyworld.com/articles/print/volume-14/issue-6/solar-energy/balancing-act.html.

29 *Id.*

30 *Id.*

31 *Id.*

32 WORLD DEVELOPMENT INDICATORS DATABASE (2017), http://databank.worldbank.org/data/download/GDP.pdf.

33 *The World Factbook: Europe:: Germany*, CENTRAL INTELLIGENCE AGENCY, https://www.cia.gov/library/publications/the-world-factbook/geos/gm.html (last updated Feb. 23, 2018).

34 *Id.*

35 *Id.*

36 *Id.*

37 *Id.*

38 *Id.*

Germany's domestic energy production portfolio in 2016 comprised of 29% from renewables, 40.3% from coal (23.1% lignite and 17.2% hard coal), 13.1% nuclear power, and 12.4% natural gas.[39]

Germany is an exporter of energy with fifty-two terawatt hour (TWh) of power available for export in 2015.[40] However, Germany lacks the natural resources needed for energy generation. Germany's most abundant natural energy resource is coal, and coal comprises the largest market share of energy generation.[41] While Germany is one of the largest petroleum refiners in the world, the crude oil used in refinement is imported from other countries in the European Union.[42] Germany also imports ninety percent of its natural gas supply from Russia, Norway, and the Netherlands.[43]

B. The United States

The United States is the largest economy in the world.[44] It is the world's leader in high technology innovation and has the second-largest industrial output in the world, including petroleum, steel, electronics, and automobiles.[45] The industry sector comprises 18.9% of the country's GDP while the service sector comprises 80.2%.[46] In addition, the agriculture sector accounts for 0.9% of GDP.[47] The United States covers 9,833,517 sq. km. and has a population of 326,625,791.[48] Thus, the country is sparsely populated with 44.5% of land used for agriculture and 82% of the population living in urban areas.[49] The United States has a "two-tier" labor market: (1) uneducated lower workers and (2) technically skilled management.[50]

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39 Kerstine Appunn et al., *Germany's Energy Consumption and Power Mix in Charts: Power Production*, CLEAN ENERGY WIRE: FACTSHEET, (Mar. 23, 2017), https://www.cleanenergywire.org/factsheets/germanys-energy-consumption-and-power-mix-charts.

40 *Id.*

41 *Germany: Analysis*, U.S. ENERGY INFO. ADMIN., http://www.eia.gov/beta/international/analysis.cfm?iso=DEU (last updated Aug. 2016).

42 *Id.*

43 *Id.*

44 *The World Factbook: North America:: United States*, CENTRAL INTELLIGENCE AGENCY, https://www.cia.gov/library/publications/the-world-factbook/geos/us.html (last updated Feb. 23, 2018).

45 *Id.*

46 *Id.*

47 *Id.*

48 *Id.*

49 *Id.*

50 *Id.*

The United States' domestic energy production portfolio in 2016 was compromised of thirty-four percent natural gas, thirty percent coal, fifteen percent renewables, and twenty percent nuclear power.[51] Domestic production is dominated by the country's natural resources: natural gas and coal. The United States is able to meet its electric demand by using the natural resources available within its borders. The United States' energy import is predominantly petroleum, which is required for the country's large transportation sector.[52] However, the United States is projected to become completely energy independent between 2020 and 2030.[53]

C. Comparison

The United States and Germany are similarly situated economically. The United States covers a landmass twenty-seven times the size of Germany, yet the population of the United States is only four times that of Germany. Germany has a dense population within its limited landmass, while the United States has a sprawling population with a higher concentration in urban areas due to the expansive amount of land used in the agriculture industry.

In addition, the United States has an abundance of natural generation resources, allowing the country to continue with traditional energy generation and remain fairly energy independent. In contrast, Germany's small size yields significantly less generation resources. Outside of coal, Germany is dependent on natural gas imports from Russia and other European countries. Germany is not able to gain energy independence using traditional generation and thus is required to rely on a comprehensive generation portfolio. Next, this paper will explore the development of energy generation policies in both Germany and the United States.

III
GERMAN GENERATION POLICY

Germany and the United States took two very different approaches to the integration of the renewable energy market. While the United

51 *Electricity Explained: Electricity in the United States*, U.S. ENERGY INFO. ADMIN., https://www.eia.gov/energyexplained/index.cfm?page=electricity_in_the_united_states (last updated May 10, 2017).

52 ENERGY IMPORTS−STATISTICS & FACTS, STATISTA, https://www.statista.com/topics/3027/us-energy-imports (last visited Oct. 22, 2017).

53 *Id.*

States promoted a laissez-faire federal approach to renewable development, Germany took a heavy-handed approach and created a national policy, Energiewende, to push renewable integration into its energy market while simultaneously suspending its nuclear energy program.

A. The Atom-Moratorium

Germany's drastic increase in its renewable portfolio did not occur gradually, but in response to the Fukushima Disaster in Japan. On March 11, 2011, a 9.0 magnitude earthquake and subsequent tsunami caused three of Japan's nuclear plants to black out.[54] Without power, the plants were unable to maintain their cooling measures.[55] Consequently, all three cores largely melted in the first three days after the earthquake and released radiation into the environment.[56] The Japanese government evacuated those living within a 20 km radius and, by the end of 2011, over 19,000 people had been examined for radiation exposure.[57] Four years later, in September 2015, the first town within the evacuation zone was deemed safe for citizens to return.[58] No other communities within the evacuation zone have been reopened.[59] The clean-up of the radioactive molten fuel is expected to take thirty to forty years and cost Japan $189 billion (USD).[60]

The dense population of Germany does not provide the country with enough open space to store radioactive materials nor build nuclear reactors away from populated areas.[61] In a projected catastrophe simulation of the Philippsburg 2 nuclear plant in southwest Germany, experts in the Interior Ministry found that five large cities, with a combined population of 1,070,321 people would be effected by

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54 *Fukushima Accident*, *supra* note 25.

55 Eri Osaka, *Corporate Liability, Government Liability, and the Fukushima Nuclear Disaster*, 21 PAC. RIM L. & POL'Y J. 433, 433 (2012).

56 *Fukushima Accident*, *supra* note 25.

57 *Id*.

58 Justin McCurry, *Safe at last? View from Naraha- the first Fukushima community declared fit for humans*, THE GUARDIAN (Oct. 11, 2015, 9:00 PM), https://www.theguardian.com/environment/2015/oct/12/safe-at-last-view-from-naraha-the-first-fukushima-community-declared-fit-for-humans.

59 *Id.*

60 Justin McCurry, *Dying robots and failing hope: Fukushima clean-up falters six years after tsunami*, THE GUARDIAN (Mar. 8, 2017, 10:23 PM), https://www.theguardian.com/world/2017/mar/09/fukushima-nuclear-cleanup-falters-six-years-after-tsunami.

61 Richard J. Schell, *A Case Study on the Politics Behind Sustainable Energy Policy, Germany's "Atom-Moratorium" and "Energiewende,"* 1 U. PUERTO RICO BUS. L.J. 55, 57 (2016).

radiation, people living within 100 kilometers of the plant would have to stay inside their homes, and in the worst case scenario, one million people would need to be quickly evacuated.[62] As a result of Fukushima, Chancellor Angela Merkel ordered the closure and inspection of Germany's seventeen nuclear plants.[63] The inspections led to the government passing an Atom-Moratorium, which closed the seven oldest nuclear plants and set a goal to phase out all nuclear plants by 2022.[64] At this writing, two additional plants have been closed, leaving only eight of Germany's seventeen plants in operation.[65] In 2010, twenty-five percent of Germany's energy generation was derived from nuclear energy.[66] Today, only sixteen percent of Germany's energy generation is derived from nuclear energy.[67]

The German government also established an ethics commission to advise the government on the future of the energy industry now that nuclear generation has been removed from the country's generation portfolio.[68] The commission's advisory report points to renewables, particularly wind and hydroelectricity, as the most desirable source moving forward.[69] The report recommended moving away from fossil fuels, particularly coal, as fossil fuels are an inefficient and unsustainable alternative to nuclear.[70]

B. Energiewende

Two important factors that led to Germany replacing nuclear generation with renewable sources are: (1) massive public opposition

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62 Michael Frohlingsdorf, Cordula Meyer & Holger Stark, *Germany Unprepared for Major Nuclear Disaster*, SPIEGEL ONLINE: INTERNATIONAL (Mar. 22, 2012, 3:56 PM), http://www.spiegel.de/international/germany/germany-unprepared-for-nuclear-disaster-like-fukushima-a-823126.html; *Population of Cities in German (2018)*, WORLD POPULATION REVIEW, http://worldpopulationreview.com/countries/germany-population/cities/ (last visited Feb. 11, 2018) (illustrating the population of the Karlsruhe, Heidelberg, Mannheim, Ludwigshafen, and Darmstadt, the five cities that would be effected by the simulated meltdown).

63 Schell, *supra* note 61, at 60.

64 *Id*.

65 *Nuclear Power in Germany*, WORLD NUCLEAR ASSOCIATION, http://www.world-nuclear.org/information-library/country-profiles/countries-g-n/germany.aspx (last updated Aug. 2017).

66 *Id.*

67 *Id.*

68 Schell, *supra* note 61, at 60.

69 *Id*.

70 *Id*.

to nuclear, and (2) a lack of natural resources.[71] Before Fukushima, public opinion was already shifting away from nuclear energy.[72] In 1988, public opinion polls illustrated that seventy percent of the country opposed nuclear development.[73] Fukushima simply forced the government's hand in the face of loud opposition.[74]

There was also growing public concern for the country's dependency on foreign resources at the time. Energy independence became a hot topic after the two oil crises in the 1970s and again in 2008 when oil prices peaked at $140 per barrel.[75] The Russian gas dispute with Ukraine exposed the vulnerability of Germany's reliance on Russian natural gas.[76] The German energy market had few avenues available to fill the demand gap created by shutting down its nuclear plants.

Most importantly, Germany already passed three renewable-friendly acts that created the basis for the German energy policy commonly referred to as Energiewende.[77] Energiewende was coined in the late 1980s in a study published by the Institute of Applied Ecology that called for the phasing out of coal and nuclear and emphasized an energy policy based on pillars of sustainability, decentralized supply, and resource conservation.[78]

The first act, Energiewirtscaftsgesetz (EnWG), unbundled the German electric grid from vertically integrated utilities.[79] The Act provides that grid operators may not be directly involved in electricity production or in the sale of a vertically integrated utility.[80] Vertically integrated utilities are utilities that generate, transmit, and distribute

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71 Ann M. Jurca, *The Energiewende: Germany's Transition to an Economy Fueled by Renewables*, 20 GEO. INT'L ENVTL. L. REV. 141, 144 (2014).

72 *Id.* at 146.

73 *Id.* at 147 (explaining that the movement away from nuclear energy started after Chernobyl the Chernobyl disaster).

74 *Id.* at 145.

75 *Id.*

76 *Id.*

77 *Id.* at 147.

78 *Id.*

79 Energiewirtschaftsgesetz [EnWG] [Energy Industry Act], July 7, 2005, BUNDESGESETZBLATT, Teil I [BGBL .1 S] at 3621, § 6 (Ger.); *see* Dirk Uwer & Daniel J Zimmer, *Electricity Regulation in Germany: Overview*, PRACTICAL LAW (Sept. 1, 2014), https://content.next.westlaw.com/Document/Ieb49d7b71cb511e38578f7ccc38dcbee/View/FullText.html?contextData=(sc.Default)&transitionType=Default&firstPage=true&bhcp=1.

80 Energiewirtschaftsgesetz [EnWG] [Energy Industry Act], July 7, 2005, BUNDESGESETZBLATT, Teil I [BGBL 1 S] at 3621, § 7 (Ger.).

power to the end customer.[81] Those responsible for grid operations must be able to make independent decisions within the electric organizational structure.[82] Thus, the Act removed grid operations from the power of the utility. As a result, three of the four largest utilities in Germany sold their majority stake in their transmission system operators (TSO).[83] EnBW is the only vertically integrated utility that still holds sole ownership over its TSO, TransnetBW.[84]

The second act, the Electricity Feed In Law, Stromeinspeisungsgetz, was passed in 1990 as a compromise between the highly subsidized coal industry and political pressure to create a market for renewable energy.[85] The law introduced both financial incentives to operate small wind and hydrogenation, and the feed-in tariff system (FITS).[86] FITS guaranteed that any generator could sell its electricity to the utility for a minimum of ninety percent of what the utility charges the customer.[87] The FITS system, along with independent grid operations, allowed small generators access to the end customer. As a result, smaller and highly efficient generators could compete with large utility generators.

The third act, the Renewable Energy Law, Erneuerbare-Energien-Gesetz (EEG), passed in 2000 and set compensation for renewable generators low enough to make the operation of renewable generation profitable if the generator took advantage of geographical locations and efficient technology.[88] Most significantly, EEG decoupled the feed-in rates for renewables from retail rates.[89] Under the Electricity Feed In Law, FITS were assessed at ninety percent of retail electric rates.[90] After the implementation of EEG, FITS are calculated based on the generation costs of the eligible renewable technologies.[91] The FITS rate has a built-in technology depreciation rate that reduces the tariff each year to account for changes in technology and the continued lowered

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81 DAVIES ET AL., *supra* note 8, at 293.

82 Energiewirtschaftsgesetz [EnWG] [Energy Industry Act], July 7, 2005, BUNDESGESETZBLATT, Teil I [BGBL 1 S] at 3621, § 7a (Ger.).

83 Uwer & Zimmer, *supra* note 79, at 2.

84 *Id*.

85 Jurca, *supra* note 71, at 154.

86 *Id*. at 155.

87 *Id*.

88 *Id*.

89 Felix Mormann et al., *A Tale of Three Markets: Comparing the Renewable Energy Experiences of California, Texas, and Germany*, 35 STAN. ENVTL. L.J. 55, 81 (2016).

90 *Id.*

91 *Id.*

cost of development.[92] The German Parliament intervened and lowered the FITS rate beyond the standard depreciation rate after the price of solar hardware dramatically dropped.[93]

In 2016, the German Parliament voted to change the current FITS, which was implemented in January 2017 (EEG 2017).[94] EEG 2017 specifies how much renewable capacity can be built each year.[95] Payment for renewable installation is now paid via auction rather than the current FITS.[96] The auction system was piloted in 2015 for ground mounted solar installations.[97] It will consist of three to four rounds of auctions each year.[98] The lowest bid is first accepted and then the next lowest until allocated capacity is reached.[99] This reform was passed in an effort to control the expansion of renewable generation and allow for necessary grid development to serve the new evolving market, as well as to provide a market-based rate for renewable pricing.[100]

Under EEG 2017, small renewable generation will remain on the FITS and installations under 750 kWh capacity will not be subject to the auction system.[101] Individual installations and community renewable generation will retain the current financial incentives to participate in the renewable network.[102]

C. Effects of Energiewende and the Atom-Moratorium

Germany's immediate shift to renewable power has had two major consequences: changes in the energy market structure and significant price increase to customers.

The first, and most apparent, is the change in the energy market. Between 2007 and 2014, Germany's largest eight utilities lost a combined 300 billion euros.[103] This loss was caused, in large part, by

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92 *Id.* at 82.

93 *Id.*

94 Kerstine Appunn, *EEG reform 2016 – switching to auctions for renewables*, CLEAN ENERGY WIRE (July 8, 2016), https://www.cleanenergywire.org/factsheets/eeg-reform-2016-switching-auctions-renewables.

95 *Id.*

96 *Id.*

97 *Id.*

98 *Id.*

99 *Id.*

100 *Id.*

101 *Id.*

102 *Id.*

103 John Pang, Chris Vlaholus, John Sterling & Bob Gibson, *Germany's Energiewende*, PUB. UTIL. FORT., 14 (Nov. 2014).

their holdings in fossil-fire and nuclear generation, the falling cost of solar generation, and Germany's FITS.[104] By 2014, there was nearly four times as much interconnected solar in Germany than in the United States, even though Germany received the same solar radiation as the Pacific Northwest.[105] In addition, the German market supports a merit-based system.[106] Power is bought in a day-ahead auction.[107] Power producers enter bids for their electricity at short-term marginal costs.[108] The marginal costs consist of fuel and carbon offsets.[109] The offers are then lined up from lowest to highest and accepted based on need per hour.[110] Renewables have close to zero marginal costs,[111] so on sunny and windy days, renewables dominate dispatch orders and can force the wholesale price of energy into the negative.[112] Negative wholesale prices are a result of energy generation surpassing energy demand at any given time. Because energy cannot be stored, an energy surplus scenario means the generator cannot recover the cost of the energy generated, and will actually pay customers to buy the surplus energy.[113]

Germany's energy market is dominated by four vertically integrated utilities: E.ON, EnWB, RWE, and Vattenfall (the Big Four).[114] The Big Four still own eighty percent of the power plants in Germany.[115] They each also own the nuclear plants currently being phased out. After the Atom-Moratorium was announced, the stock prices for the Big Four fell significantly. RWE's shares fell by seventy-seven percent while E.ON's dropped by sixty-three percent.[116] E.ON filed suit in state court

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104 *Id.* at 14−15.

105 *Id.* at 14.

106 *Id.*

107 Johanna Cludius, Hauke Hermann, Felix Matthews, & Verena Graichen, *The Merit Order Effect of Wind and Photovoltaic Electricity Generation in Germany 2008-2012*, 44 ENERGY ECON. 302, 307 (2014).

108 *Id.*

109 *Id.*

110 *Id.*

111 *Id.*

112 Pang et al., *supra* note 103.

113 Kerstine Appunn & Sören Amelang, *Why Power Prices Turn Negative*, CLEAN ENERGY WIRE (Aug 5, 2016), https://www.cleanenergywire.org/factsheets/why-power-prices-turn-negative.

114 Jurca, *supra* note 71, at 151.

115 *Id*.

116 Allison Williams, *Court Weighs Nuclear Shutdown Costs*, HANDELSBLATT GLOBAL (Mar. 15, 2016, 11:57 AM), https://global.handelsblatt.com/companies-markets/court-weighs-nuclear-shutdown-costs-471122.

claiming 382 million euros in damages from the alleged illegal closure of its nuclear plant.[117] The court dismissed the case, stating that the company should have filed to appeal the closure instead of filing civil suit after the fact.[118] E.ON claimed an appeal would have been futile and the plants would have closed anyway.[119] EnWB filed the same suit in state court.[120] The state court dismissed the EnWB case in early 2016, stating the same reasoning as cited in the E.ON case.[121] RWE, however, filed suit in 2011 immediately after the nuclear plants' closures.[122] The court held that RWE was entitled to damages, stating the government's shutdown was illegal because the government had not properly consulted RWE before the closure.[123] Germany's federal administrative court upheld the ruling.[124]

RWE, E.ON, and Vattenfall also jointly filed a takings claim in federal court on the basis that German Atomic Law only allows the government to close a power plant for an illegal act or in the face of a pressing state interest.[125] The government argued that the Atomic-Moratorium was not a diminution of value under takings law, but a reduction of volume in electricity generation.[126] RWE claimed 6 billion euros in damages, E.ON claimed 8 billion euros, and Vattenfall claimed 4.7 billion euros in damages.[127] The court rejected the utilities' claim, but did hold that the operators were entitled to appropriate compensation because (1) the government did not consider repayment for planned investments, and (2) the government did not consider the utilities' ability to generate the required quantities of electricity before the decommission of the nuclear plants.[128] The court did not specify an

117 Hilke Fischer, *Eon Loses Court Battle for Nuclear Phase-out Damages*, DEUTSCHE WELLE (July 1, 2016), http://p.dw.com/p/1JHkS.

118 *Id.*

119 *Id.*

120 *Id.*

121 *Id.*

122 *Id.*

123 *Id.*

124 *Id.*

125 *Id.*; Schell, *supra* note 61, at 61.

126 Fischer, *supra* note 117.

127 *Id.*

128 The Associated Press, *German Court Paves Way for Nuclear Compensation Claims*, BUSINESS INSIDER (Dec. 6, 2016, 4:35 AM), http://www.businessinsider.com/ap-german-court-paves-way-for-nuclear-compensation-claims-2016-12.

amount for the compensation, but gave the government until 2018 to comply with the ruling.[129]

The second major consequence of Germany's shift to renewables has been a significant price increase to residential customers.[130] Germany has one of the lowest wholesale prices for electricity in the EU, but the most expensive end-user price due to a renewable surcharge.[131] The 2000 amendment to EEG set a fixed price for renewables to protect investors and producers from market changes and incentivize renewable generation.[132] The generators receive the fixed price from the grid operator who then markets the electricity on the electricity exchange.[133] The difference between the price paid and the price received by the operator is passed on to the end customer as the EEG surcharge.[134]

The consequence of the surcharge is that renewables are subsidized regardless of the market. Thus, renewables continue to receive a premium price even when demand is low and the price of operation has stabilized.[135] As a result of the grid's merit-based system for accepting generation, premium price is paid for energy, regardless of market demand.[136] As a direct result of the merit-based system and the renewable subsidy, the end price to residential customers dramatically increased.[137]

This price increase is disproportionately distributed to residential customers. Energy customers are split into two categories: privileged and non-privileged.[138] Privileged customers are energy intensive companies and pay .05 cents per kilowatt hour (ct/kWh) for the energy surcharge.[139] Non-privileged customers consist mainly of households and pay 5.23 ct/kWh.[140] The privilege status allows companies to

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129 *Id.*

130 *See* Jurca, *supra* note 71, at 156.

131 *See also id.*

132 *Id.*

133 *Id.*

134 *Id.*

135 *Id.* at 157.

136 *Id.*

137 *Id.*

138 Cludius et al., *supra* note 107, at 5.

139 *Id.* (stating surcharge rates in 2013).

140 *Id.*

decrease their proportion of the shared burden of the EEG surcharge.[141] In 2013, 1,716 companies held privileged status.[142]

However, the higher energy price increased demand response for German retail customers.[143] Demand response is the customer's change in behavior based on market prices.[144] The surcharge price is a direct signal to customers to decrease consumption, and it is working.[145] German residents use roughly one-fourth the energy of the average American customer, consuming on average 300 kWh per month.[146] In addition, energy costs have remained at a constant two percent of household spending since 1990.[147] Thus, even though the price of energy has greatly increased, Germans are still spending the same percentage of income on energy, illustrating that they are lowering consumption as a result of the price increase.[148] Lastly, there is strong public support for Energiewende regardless of the increase in price as sixty-six percent of Germans supported the decisions carried out under Energiewende.[149]

IV
UNITED STATES' ENERGY POLICY

The United States, in contrast to Germany's headfirst rush into renewable energy generation, has taken a slow and steady approach.

A. Lack of Social Momentum

The Atom-Moratorium and Germany's lack of natural resources forced Germany's transition to renewable generation. These two motivating factors are not relevant to the United States. The United States has been insulated from the dramatic shift in energy policy that led Germany along its path to a renewable revolution.

After the Fukushima disaster, the United States' response was starkly different from the Atom-Moratorium passed in Germany. Why? Because the threat of a nuclear meltdown is not as prevalent in the

141 Jurca, *supra* note 71, at 160.
142 *Id*.
143 Pang et al., *supra* note 103, at 16.
144 DAVIES ET AL., *supra* note 8.
145 Pang et al., *supra* note 103, at 16.
146 *Id*.
147 *Id*.
148 *Id*.
149 *Id*. at 17.

United States' society. Germany is a densely populated country and a singular nuclear meltdown would be catastrophic to the entire country. Germany has one-fourth the population of the United States and occupies a landmass twice the size of Pennsylvania.[150] In contrast, 77.8% of the land mass in the United States is sparsely populated.[151]A singular nuclear meltdown would not have the devastating effect in the United States that it would in Germany. Because of this, there was no cry in the United States to end the nuclear generation as there was in Germany.

Additionally, the United States has an abundance of natural resources. Germany only has a singular natural resource for energy generation: coal. German generation cannot support a diverse generation portfolio and promote energy independence. Germany was forced to turn to renewable energy generation to ensure energy security within its borders. This is not the case in the United States. Not only does the United States still use nuclear to generate twenty percent of its energy, the United States has an abundance of coal and natural gas.[152] The U.S. Energy Information Administration (EIA) reported that the United States has 18.3 billion short tons of recoverable coal reserves left in producing mines, meaning that the United States has the second most recoverable coal reserves in the world, behind China.[153] The EIA estimates there is enough natural gas in the United States to last the next ninety-three years.[154] With only 10.6% of oil originating through

150 *The World Factbook: Europe:: Germany*, *supra* note 33 (explaining Germany's land mass size); *United States Population*, TRADING ECONOMICS, http://www.tradingeconomics.com/united-states/population (last visited May 1, 2017) (stating the United States' population in 2016); *Germany Population*, TRADITION ECONOMICS, http://www.tradingeconomics.com/germany/population (last visited May 1, 2017) (stating Germany's population).

151 *The World Factbook: North America:: United States*, *supra* note 44 (illustrating that 44.6% of landmass is used for agriculture and 33.3% is forest).

152 *How Much Natural Gas Does the United States Have, and How Long Will it Last?*, U.S. ENERGY INFO. ADMIN., https://www.eia.gov/tools/faqs/faq.php?id=58&t=8 (last updated July 25, 2017); *Coal Explained*, U.S. ENERGY INFO. ADMIN., https://www.eia.gov/energyexplained/index.cfm?page=coal_reserves (last visited Sept. 13, 2017).

153 *Coal Explained*, *supra* note 152.

154 *How Much Natural Gas Does the United State Have, and How Long Will it Last?*, *supra* note 152.

imports, the United States enjoys energy stability free of external instabilities.[155]

The United States also lacks both cohesive support on global warming and the need to move away from fossil fuels. In a study from March 2016 by Gallup, sixty-four percent of Americans surveyed stated that they are worried about global warming a "great deal" or a "fair amount," while thirty-six percent stated that they were not worried at all.[156] In contrast, a Gallup poll from 2015 showed fifty-five percent of Americans stated they were "concerned a great deal" and forty-five percent stated they were "concerned very little."[157] While awareness of global warming is gaining traction in the United States, there is still a long way to go before there is enough public support to prompt national political change.

B. PURPA and FERC

Federal support for renewable development in the United States has been more limited than in Germany. The United States has one act, the Public Utility Regulatory Policies Act (PURPA), and two Federal Energy Regulation Commission (FERC) orders that make up the foundation for renewable access to the grid.

PURPA allows utilities to buy energy generated by qualified facilities at an avoided-cost rate.[158] An avoided-cost rate is the price the utility would have had to spend to generate the same energy.[159] Unlike Germany's Electric Feed in Law, the price paid to the generators is not coupled with the retail price. In addition, PURPA pricing does not allow for technology recovery cost.[160] This puts renewable generators at a significant disadvantage. Traditional generators can recover capital investments through a premium added to the rate charged to the end customer.[161] Under PURPA, new renewable generators are unable to

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155 *How Much Petroleum Does the United States Import and Export?*, U.S. ENERGY INFO. ADMIN., https://www.eia.gov/tools/faqs/faq.php?id=727&t=6 (last updated Apr. 4, 2017).

156 Lydia Saad & Jeffrey M. Jones, *U.S. Concern About Global Warming at Eight-Year High*, GALLUP (Mar. 16, 2016), http://www.gallup.com/poll/190010/concern-global-warming-eight-year-high.aspx.

157 *Id.*

158 Hon. Richard D. Cudahy, *PURPA: The Intersection of Competition and Regulatory Policy*, 16 ENERGY L.J. 419, 422 (1995).

159 *Id.*

160 *Id.* at 434–36.

161 DAVIES ET AL., *supra* note 8, at 327.

recover the investment cost of creating new generation technology in the ratemaking formula.

FERC Order 888 requires transmission-owning utilities to provide transmission access to all facilities at the same rate.[162] This means that the cost for a utility to transmit its own generated electricity must also be the same price charged to another generator. FERC Order 888 allows renewable generators equal access to the electric grid.

FERC Order 2000 attempted to end vertically integrated utilities by requiring transmission-owning utilities to either join the Regional Transmission Organizations (RTO) or state why they refuse to do so.[163] RTOs are then required to be independent and hold the authority to propose rate changes for transmission costs.[164] FERC Order 2000 mirrors Germany's Energy Industry Act, which allows the grid to be overseen by independent operators rather than the traditional, vertically integrated utility.

PURPA also requires utilities to make net-metering services available, on request, to the customers that the utility serves.[165] Net metering allows a customer to offset electric costs by selling energy the customer generates, but does not consume, back to the grid.[166] Net-metering works like a credit system to offset a customer's bill when their solar panel or wind turbine creates more power than the customer consumes and that power is then transported to the grid. Unlike a feed-in tariff, net-metering does not provide a set price for the energy used, nor does it provide the customer with a payment at the end of the billing cycle. While net-metering is required, it is not applied uniformly across all states. In fact, six states have yet to implement any net-metering policy.[167] Some states provide exemptions to a utility's net-metering requirement.[168] Others implement caps on the size of consumption offset by net-metering, typically between 10–80 kW.[169] Without uniformity, the unpredictable compensation for renewable production

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162 Jay Reidy, Note, *How Crude?: Determining Transmission "Beneficiaries" and Related Steps Toward Workable Renewable Transmission Cost Allocation*, 41 ECOLOGY L.Q. 492, 502 (2014).

163 *Id.* at 504.

164 *Id.*

165 Heather Payne, *A Tale of Two Solar Installations: How Electricity Regulations Impact Distributed Generation*, 38 U. HAW. L. REV. 135, 143 (2015).

166 *Id.*

167 *Id.* at 144.

168 *Id.* at 145.

169 *Id.* at 149.

has not produced the same results as Germany's strict, favorable price point.

These three acts lay the foundation for renewable generation in the United States. PURPA requires utilities to buy renewable energy from the generator, FERC Order 888 requires the utility to give all generators access to the grid, and FERC Order 2000 removes utility oversight of the electric grid. However, these acts lack a financial incentive for investors to join the renewable market.

The United States does provide a Production Tax Credit (PTC) that gives a tax credit to qualified energy generators per kilowatt generated.[170] The PTC is available to a qualified facility for ten years after the facility has been placed into service.[171] However, a tax credit is only beneficial when a generator has additional income that would be offset by the tax credit. Without an income that would create tax liability, a tax credit is useless. Thus, during the first few years of a generator's business, when a return on investment is the most crucial, the generator is unable to take advantage of this resource. This tax regime encourages small generators to team with larger corporations that have a tax liability which can be offset by the credit.[172] The net effect shows that individual growth in the market is stifled. In addition, the PTC cannot be applied against the Alternative Minimum Tax (AMT).[173] If the generator or generator's corporate partner is subject to the AMT, the tax credit would be useless. The PTC is set to phase out over the next five years, and 2016 was the last year new generators could qualify for 100% of the PTC.[174]

Germany's legal framework laid the foundation for a new generation to recuperate initial costs and guaranteed a fixed premium rate for the energy it generated. As a result, net installed renewable capacity increased by 82.5% in 2016.[175] In contrast, the United States allows renewable energy access to the power grid at a guaranteed, avoided-cost rate, and offers a tax credit to help offset the initial costs. As a result, the net renewable generation rose only 42% from 2010 to

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170 Molly F. Sherlock, THE RENEWABLE ELECTRICITY PRODUCTION TAX CREDIT: IN BRIEF, 1 (2015).

171 *Id.*

172 *Id.*

173 *Id.*

174 *Id.*

175 Appunn et al., *supra* note 39 (illustrating that in 2010, renewable generation capacity was 55.9GW and in 2016, renewable generation capacity was 102GW).

2016.[176] This vast difference in the two nations' renewable increase rate suggests that Germany's financial incentives were more effective at initiating new renewable builds than the United States' laissez-faire approach.

V
EFFICACY

The big question remains, were these programs actually successful? Germany increased its renewable market, but did it actually reduce the country's carbon footprint? The efficacy of each program on the overall carbon emissions of the country is examined in this Part.

A. Germany

After the Atom-Moratorium, Germany's generation options were limited to coal, renewables, and natural gas. Prior to the Atom-Moratorium, twenty percent of Germany's energy came from nuclear generation and Germany immediately had a large void to fill and natural gas had proven not to be a viable option for the country.[177]

Natural gas has been the cause of the "Energiewende paradox."[178] Because Energiewende created a market platform for new renewable generation to come on the market at a guaranteed premium price, the growing supply of energy drove the wholesale energy prices down to marginal costs.[179] Renewable generation operates with very little overhead once the generation is in operation.[180] Renewables require very little manpower to operate and have no fuel costs.[181] In comparison, natural gas plants are an expensive investment. Germany does not have adequate natural gas within its borders and must import

176 *Table 1.1A Net Generation from Renewable Sources: Total (All Sectors), 2007-Febrary 2017*, U.S. ENERGY INFO. ADMIN. (Apr. 25, 2017), https://www.eia.gov/electricity/monthly/epm_table_grapher.cfm?t=epmt_1_01_a (illustrating that renewable generation from 2010 was 427,376 thousand megawatt hours and renewable generation in 2016 was 609,445 thousand megawatt hours).

177 Sören Amelang, *When Will Germany Finally Ditch Coal?*, CLEAN ENERGY WIRE (Dec. 16 2016), https://www.cleanenergywire.org/factsheets/when-will-germany-finally-ditch-coal.

178 *Id.*

179 *Id.*

180 Kerstine Appunn, *Setting the Power Price: The Merit Order Effect*, CLEAN ENERGY WIRE (Jan. 23, 2015), https://www.cleanenergywire.org/factsheets/setting-power-price-merit-order-effect.

181 Jurca, *supra* note 71, at 145.

natural gas from bordering countries, primarily Russia.[182] Natural gas plants have the highest overall cost of operations than any other energy generation.[183] Additionally, Energiewende does not provide natural gas with the same premium cost recovery mechanisms that is provided to renewable energy. Thus, natural gas plants have become an expensive generation source that is being pushed further out of Germany's energy market.

In addition to the rise of renewable installations discussed previously, Germany is seeing a resurgence of coal. Germany opened 10.7GW of new coal power plants between 2011 and 2015,[184] which is more coal installations in four years than had been installed over the previous twenty years.[185] In 2012, Germany's Environmental Minister defended the new coal installations by saying, "if one builds a new state-of-the-art lignite power plant to replace several older and much less efficient plants, then I feel this should be acknowledged as a contribution to our climate protection efforts."[186] However, in 2012, 2,743 MW of new coal generation came online while only 1,321 MW of old coal generation was retired.[187] In 2013, coal energy generation hit its highest levels of production since the reunification of Germany in 1990.[188] Overall, brown coal production rose by 6.5% and accounts for 25% of overall generation[189] and hard coal production also increased by 6% and accounts for 15.2% of overall generation.[190]

As a result, in 2016, Germany's energy generation came from 29% renewables, 13.1% nuclear, 12.4% natural gas, and 40.3% coal.[191] 2016 marked the second year in a row during which Germany's CO_2

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182 *Id*.

183 Appunn, *supra* note 180.

184 Robert Wilson, *Why Germany's Nuclear Phase Out is Leading to More Coal Burning*, THE ENERGY COLLECTIVE (Jan. 20, 2014), http://www.theenergycollective.com /robertwilson190/328841/why-germanys-nuclear-phase-out-leading-more-coal-burning.

185 *Id.*

186 *Id.*

187 *German Brown Coal Power Output Hits New High*, SPIEGEL ONLINE (Jan. 7, 2014, 1:52 PM), http://www.spiegel.de/international/germany/researchers-alarmed-at-rise-in-ger man-brown-coal-power-output-a-942216.html.

188 *Id.*

189 *Germany's Clean Energy Drive Fails to Curb 'Dirty' Coal Power*, DEUTSCHE WELLE (July 1, 2014), http://www.dw.com/en/germanys-clean-energy-drive-fails-to-curb -dirty-coal-power/a-17345796.

190 *Id.* (explaining that total production increased by eight billion kilowatt hours to 124 kilowatt hours, which is a 6% increase).

191 Appunn et al., *supra* note 39 (pie chart of Germany's share of energy sources in gross German power production in 2016).

emissions increased.[192] In 2013, Germany emitted 9.4 metric tons per capita,[193] and in 2016, Germany emitted 11 metric tons per capita.[194]

Germany is facing serious legal repercussions from their heavy-handed regulations of their energy market. The Big Four filed a takings lawsuit after the nuclear moratorium was successful.[195] The German court held that the government failed to consider both the utilities' repayment for planned investment and whether the utilities were equipped to produce similar quantities of electricity without nuclear plants.[196] The Court will not rule on an actual compensation amount for a few more years, but the Court did require the government to provide new legislation to address these issues by June 2018.[197]

The German government is also receiving a large bill to dispose of the decommissioned nuclear plants. The Nuclear Commission came to a settlement with the Big Four in which the Big Four will pay 23.5 billion euros into a fund that will be used to manage the storage and disposal of the nuclear waste.[198] The government will assume all future liabilities for the maintenance of the waste.[199] Economists estimated that the government's additional cost will be in excess of 23.3 billion euros.[200]

Energiewende also greatly increased the price of electricity to the residential customer. The fixed price for renewables required under the Renewable Energy Source Act of 2000 is charged to the end customer

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192 Richard Martin, *Germany Runs Up Against the Limits of Renewables*, MIT TECHNOLOGY REV. (May 24, 2016), https://www.technologyreview.com/s/601514/germany-runs-up-against-the-limits-of-renewables/ (stating that emissions rose from 2014 to 2015); Peter Teffer, *German CO2 Emissions Up Despite 'Energy Transition'*, EUOBSERVER (Mar. 20, 2017, 6:31 PM), https://euobserver.com/environment/137298 (stating that emissions rose again in 2016).

193 *See CO2 Emissions (Metric Tons Per Capita)*, THE WORLD BANK, http://data.worldbank.org/indicator/EN.ATM.CO2E.PC?locations=DE&view=chart (last visited May 1, 2016).

194 Teffer, *supra* note 192 (stating that Germany emitted 906 million metric tons in 2016); *Germany Population*, *supra* note 50 (stating that Germany's population for 2016 is 82.18 million people).

195 Fischer, *supra* note 117.

196 The Associated Press, *supra* note 128.

197 Christoph Steitz & Vera Eckert, *German Utilities Set for Compensation After Court Win on Nuclear,* REUTERS (Dec. 6, 2016, 1:30 AM), https://www.reuters.com/article/us-germany-nuclear/german-utilities-set-for-compensation-after-court-win-on-nuclear-idUSKBN 13V0WY?il=0.

198 Fischer, *supra* note 117.

199 *See id.*

200 *See id.*

as a surcharge.[201] As explained above, residential customers are categorized as non-privilege customers.[202] Non-privileged customers pay a surcharge one thousand percent higher than energy-intensive privileged customers.[203] Non-privileged customers are paying a higher surcharge to consume less energy than their privileged counterparts.[204] As a result, Germany has the lowest wholesale price for energy in the EU but has the most expensive consumer end-price.[205]

While Germany's federal support for renewables looks good on paper, the practical effects of their actions tell a different story. The sharp federal subsidies of the renewable market have pushed less carbon-intensive natural gas out of the market and have led to large bills rendered to German taxpayers via settlements with the utilities and an increase in electricity prices. The decrease of variety in Germany's generation allows clean, renewable generation to rise hand-in-hand with carbon intensive coal emissions and undermines the foundational goal of the clean energy movement.

B. The United States

The United States has an abundance of natural resources that allow for compressive energy generation without a dependency on foreign resources. Unlike in Germany, the addition of renewable generation has occurred in parallel with a decline in the United States' coal generation. In 2011, coal comprised 42.3% of energy generation.[206] In 2016, the market share fell to 30.4%.[207] This is a direct result of older coal plants retiring and investors turning to natural gas and renewables.[208] Coal production in the United States decreased by 42 million tons per year from 2006 to 2015.[209] In 2016, production fell by 150 million tons, making 2016 the highest single year drop in coal production in the last

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201 Jurca, *supra* note 71, at 160.

202 *Id.*

203 Cludius et al., *supra* note 107.

204 *Id.*

205 *Id.*

206 Joy Liu, *Electricity Monthly Update*, U.S. ENERGY INFO. ADMIN., https://www.eia.gov/electricity/monthly/update/archive/april2017/ (last updated May 24, 2017).

207 *Id.*

208 *Id.*

209 Joshua S. Hill, *US Coal Industry Will Continue Historic Decline Through 2017, Predicts IEEFA*, CLEAN TECHNICA (Jan. 27, 2017), https://cleantechnica.com/2017/01/27/us-coal-industry-will-continue-historic-decline-2017-ieefa/.

ten years.[210] The Institute of Energy of Economics and Finical Analysis (IEEFA) predicts that coal production in 2017 will drop by 40 million tons.[211] As a result, 26 coal companies have declared bankruptcy and 264 mines have closed.[212]

At the same time, natural gas, which comprised 24.7% of the generation market in 2011, became the leading source of energy generation in 2016 accounting for 33.8% of generation.[213] There are currently 1,793 natural gas plants in operation.[214] These plants provide over fifty percent of electricity to nine states.[215] Why? Natural gas works hand-in-hand with renewable energy to balance the grid. Natural gas plants can be turned on and off whenever they are needed without a significant loss of power. As stated previously, there is not yet a reliable method for storing energy. This means that energy must be consumed as it is generated: when the wind is blowing or the sun is shining. The grid will first meet its energy demands with generation from qualified facilities. Energy generated by other sources is not utilized when demand can be met by qualified facilities, so a natural gas plant can be turned off. Conversely, when the wind is not blowing and the grid needs generation from other sources besides qualified facilities, the natural gas plant can be turned back on. While renewables provide variable generation, natural gas creates readily available and reliable generation to keep power flowing through the electric grid, regardless of the weather.

While the United States has not passed a federal ban on nuclear generation, state governments have shouldered the task of regulating future nuclear development. To date, fourteen states have restricted construction of new nuclear sites while one state, Minnesota, has an outright ban on new nuclear construction.[216] The most recent fully

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210 *Id.*

211 Liu, *supra* note 206.

212 Brian Palmer, *Does Coal have a Future in the United States*, PACIFIC STANDARD (May 13, 2015), https://psmag.com/environment/does-coal-have-a-future-in-the-united-states.

213 *Id.*

214 John Muyskens et al., *Mapping How the United States Generates its Electricity*, THE WASHINGTON POST, https://www.washingtonpost.com/graphics/national/power-plants/?utm_term=.c114eb5da81a (last updated Mar. 28, 2017).

215 *Id.*

216 *State Restrictions on New Nuclear Power Facility Construction*, NAT'L CON. OF ST. LEGIS., http://www.ncsl.org/research/environment-and-natural-resources/states-restrictions-on-new-nuclear-power-facility.aspx (last updated Apr. 2016).

operational nuclear reactor to come online was Watts Bar I in Tennessee in May 1996.[217] In 2016, Tennessee brought Watts Bar II online, marking the nation's first new nuclear plant in twenty years,[218] but only five months later, the reactor was pulled from commission.[219] Predictions are that the nuclear reactor will not return to operation. The reactor took forty-three years to complete and cost an estimated $6.1 billion.[220] Despite this seemingly wasted investment, the United States' Nuclear Regulatory Commission currently has four pending applications for new nuclear reactors.[221]

The United States' energy generation for 2016 was comprised of 33.8% from natural gas, 30.4% coal, 19.7% nuclear, and 16% renewable generation. In 2013, the United States emitted approximately 16.4 metric tons of CO_2 per capita.[222] In 2016, the United States emitted 15.9 metric tons of CO_2 per capita.[223] Emissions from natural gas increased by 0.9% while emissions from coal decreased by 8.6%.[224] CO_2 emissions for the country as a whole dropped 2.7% between 2014 and 2015 and by 1.7% between 2015 and 2016.[225]

While the federal government in the United States has been slow to take action in support of renewable generation, overall carbon emissions are declining. This trend is due to an increased market share for renewable and natural gas generation. The market is turning to less expensive energy sources while traditional energy sources that have not adapted to the new market are failing. The United States did not place

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217 Tim Shear & Sara Hoff, *Solar, Natural Gas, Wind Make Up Most 2016 Generation Additions*, U.S. ENERGY INFO. ADMIN. (Mar. 2, 2016), https://www.eia.gov/todayinenergy/detail.php?id=25172.

218 Michael Hiltzik, *America's First '21st Century Nuclear Plant' Already has Been Shut Down for Repairs*, L.A. TIMES (May 8, 2017, 1:35 PM), http://www.latimes.com/business/hiltzik/la-fi-hiltzik-nuclear-shutdown-20170508-story.html.

219 *Id.*

220 *Id.*

221 *Location of Projected New Nuclear Power Reactor Applications*, U.S. NUCLEAR REG. COMMISSION, https://www.nrc.gov/reactors/new-reactors/col/new-reactor-map.html (last updated Dec. 9, 2016).

222 *CO2 Emissions (Metric Tons Per Capita)*, *supra* note 193.

223 Perry Lindstrom, *U.S. Energy-Related CO2 Emissions Fell 1.6% in 2016*, U.S. ENERGY INFO. ADMIN. (Apr. 10, 2017), https://www.eia.gov/todayinenergy/detail.php?id=30712 (stating carbon emissions totaled 5,170 million metric tons); *United States Population*, *supra* note 150 (stating the United States population in 2016 was 324.3 million people).

224 Lindstrom, *supra* note 223.

225 *Id.*

a moratorium on nuclear energy; cost and local opposition to nuclear have resulted in a lack of new nuclear generation over the last twenty years.

VI
FUTURE FOCUS

A. Germany

Germany is facing an uncertain future moving forward with its renewable generation goals. Germany's national Climate Action Plan called for a reduction of emissions to forty percent below 1990 levels by 2020.[226] Currently, Germany has reduced emissions to twenty-seven percent below 1990 levels.[227] At the end of 2016, Germany announced a new Climate Action Plan of 2050 to keep emissions on track with the goals set in the Paris Agreement.[228] Germany's new set goal is to be carbon neutral by 2050.[229] In order to reach this hefty goal, Germany will have to end most of its coal production.[230]

Ending Germany's coal production is easier said than done. Coal remains a significant employer in certain German states and coal miners are well-insulated by a strong union.[231] Coal-mining states are also strongholds for the Social Democratic Party, which has strong ties to unions.[232] Thus, the closure of coal mines will have a concentrated impact on communities reliant on the industry for economic survival and a political party reliant on those communities for support.

However, the political strong-arm of the coal industry may be undermined by a shifting market. The addition of wind and solar in the past two years caused the wholesale price of electricity to plummet, forcing fossil fuel generators to make hard decisions.[233] In November

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226 Jeffrey Ball, *Germany's High-Priced Energy Revolution*, FORTUNE (Mar. 13, 2017), http://fortune.com/2017/03/14/germany-renewable-clean-energy-solar/.

227 *Id.*

228 Sören Amelang et al., *Germany's Climate Action Plan 2050*, CLEAN ENERGY WIRE (Nov. 17, 2016), https://www.cleanenergywire.org/factsheets/germanys-climate-action-plan-2050.

229 *Id.*

230 *Id.*

231 Amelang, *supra* note 177.

232 *Id.*

233 *Energiekonzern Will Switch Off Five Coal-Fired Power Plants*, HANDELSBLATT (Nov. 2, 2016, 5:14 PM), http://www.handelsblatt.com/unternehmen/industrie/steag-energiekonzern-schaltet-fuenf-kohlekraftwerke-ab/14784534.html.

2016, Steag, an energy group representing nuclear and coal operations, announced the decommissioning of five of its coal-fired plants.[234] Steag CEO Joachim Rumstad called it a hard and sad step that was unavoidable to maintain the viability of the company.[235]

The Big Four have also not been isolated from the market reality. In April 2016, Vattenfall confirmed the sale of its lignite assets to the Czech firm EPH.[236] RWE spun off its renewable energy operations into a separately traded company called Innogy SE.[237] The separation of generation sources was done "to give the markets a pure-play renewable energy stock" that would not be tied to fossil fuel generation.[238] RWE retained ownership of coal, gas, and nuclear operations.[239] By March, Innogy's market valuation was double that of RWE's at 18.9 billion euros.[240]

E.ON followed in RWE's footsteps and, in September 2016, segregated its business into two.[241] E.ON retained the renewable generation, networks, and customer solution businesses, but transferred all conventional power operations to a subsidiary called Uniper.[242] Uniper opened on the market at 10.015 euros, valuing the company at 3.8 billion euros.[243]

Thus, stock prices of coal generation are dwindling with the cost of wholesale electricity. The lack of continued financial investment in traditional generation is putting the future of traditional generation in jeopardy. These market realities may be the helping hand that Germany's Climate Action Plan needs to end their coal industry.

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234 *Id.*

235 *Id.*

236 Ruby Russell, *Vattenfall Confirms Sale of German Lignite Assets as Activists Call for Coal Exit*, DEUTSCHE WELLE (Apr. 18, 2016), http://www.dw.com/en/vattenfall-con firms-sale-of-german-lignite-assets-as-activists-call-for-coal-exit/a-19195752.

237 Ball, *supra* note 226.

238 *Id.*

239 *Id.*

240 *Id.*

241 Guy Chazan, *Eon to Float Power Generation Subsidiary in September*, FINANCIAL TIMES (July 20, 2016), https://www.ft.com/content/4d48749e-4e5d-11e6-88c5-db83e98a590a.

242 *Id.*

243 Tino Andresen, *EON Loosens Ties to Old Energy as Uniper Starts Trading*, BLOOMBERG (Sept. 12, 2016, 8:59 AM), https://www.bloomberg.com/news/articles/2016 -09-12/eon-loosens-grip-on-old-power-plants-as-uniper-starts-trading.

B. The United States

The United States does not have a national set goal to reduce greenhouse gas emissions. Individual state governments have taken the responsibility to reduce emissions upon themselves by adopting Renewable Portfolio Standards (RPS).[244] An RPS requires that a certain percentage of energy be derived from renewable sources by a certain date.[245] To date, twenty-nine states have adopted some form of an RPS, accounting for 67.24% of the population in the United States and eight states have set voluntary renewable energy goals.[246] While this approach has been helpful in pushing renewable energy forward, RPSs vary widely among different jurisdictions. Three states have committed to 50% renewable energy by 2030, while twelve states have committed to only 10%.[247]

The United States is also seeing a market shift toward renewable energy. In 2016, renewable generation accounted for 61.5% of new generation added to the grid.[248] Between 2002 and 2006, natural gas made up most of the added capacity each year.[249] 2016 marked the third year in a row that more than 50% of additional generation came from renewable sources.[250] Since 2002, the United States has retired 53GW of coal capacity, 54GW of natural gas capacity, and five nuclear plants.[251] This means that the energy market has dramatically changed in the last decade. Most coal, hydro, and nuclear plants are over 30 years old, while most natural gas, wind, and solar have been built in the last 20 years.[252] Investment in renewables has more than tripled in the last ten years.[253] In 2015, investments in renewable generation increased to $56 billion, up 7.4% from 2014.

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244 *See* Jocelyn Durkay, *State Renewable Portfolio Standards and Goals*, NAT'L CONF. OF ST. LEGIS. (Aug. 1, 2017), http://www.ncsl.org/research/energy/renewable-portfolio-standards.aspx.

245 *Id.*

246 *Id.* (listing the states and the stated goals of the RPS).

247 *Id.*

248 *Renewables Dominated New U.S. Power Generation in 2016*, ECOWATCH (Feb. 2, 2017, 12:50 PM), http://www.ecowatch.com/ferc-renewable-energy-capacity-2233026420.html.

249 Suparna Ray, *U.S. Electric Generating Capacity Increase in 2016 Was Largest Net Change Since 2011*, U.S. ENERGY INFO. ADMIN. (Feb. 27, 2017), https://www.eia.gov/todayinenergy/detail.php?id=30112.

250 *Id.*

251 *Id.*

252 *Id.*

253 *Id.*

CONCLUSION

Germany's path to renewables is not currently feasible for the United States. First, the United States lacks the environmental incentive to move from traditional energy sources to renewables. Second, copying Germany's moratorium on an entire industry would pose the same takings issues under the United States' constitution. Finally, a healthy federal feed-in system would have to pass FERC scrutiny of just and reasonable pricing and is likely to be challenged by any traditional utility as discriminatory.

Germany was able to increase its use of renewable energy because of high federal regulations and a hefty return on investment. However, the rise of the renewable market also brought a rise in the coal market and actually increased Germany's overall CO_2 emissions. Their strategy also brought a slew of lawsuits from utilities that are proving to be costly to their federal government. The drive for additional renewable generation has stalled and the country is projected to fall short of its emissions goals.

The United States has been slow to admit renewable energy into its market. Renewable energy is beginning to find a place in the energy market and its low overhead is proving to be an attractive incentive to invest in the market. However, the lack of a national plan for generation leaves a lot to be desired. The approach taken by individual states run the gambit of renewable goals to do nothing that will bind emitters outside their jurisdictions. The slow, market-driven approach has left the United States behind in the renewable revolution.