ENERGIEWENDE IN THE UNITED STATES AND GERMANY: APPLES AND PEARS OR CAN WE LEARN FROM EACH OTHER?

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I. INTRODUCTION

When looking at the energy transitions occurring in Germany and the United States overall, it appears that Germany is leading the way while the United States struggles to make progress.[1] Germany is meeting almost a third of its energy demand with renewable energy while the United States meets only about 15 percent of demand with renewable energy, just this year breaking 10 percent when looking at wind and solar contributions.[2] Per capita, Germany has more than twice the installed renewable capacity of the United States.[3] Germany has been leading not only in Europe but throughout the world in efforts to address climate change and increase renewable energy. The United States President, on the other hand, has recently rolled back national policy, the Clean Power Plan, but even more significantly has decided to withdraw the United States from the Paris Climate Agreement.

Given their varying levels of progress and national commitment, can the United and States and Germany still learn from each other as they transition their power sectors to renewable energy? Despite their differences, Germany and the United States – and more particularly states and regions in the United States – can compare notes on specific issues and policies. Germany's recognition of the need for widespread support for energy transition policies demonstrates how this approach can facilitate the transition in the long run. Although the United States as a whole lags behind, certain states and regions have implemented policies that would facilitate Germany's move to higher penetrations of renewable energy. In other areas, the United States and Germany face similar challenges in making a successful and just transition away from fossil fuels. In short, although they are in different places, there is nevertheless a great deal of opportunity to learn from each other so that they can facilitate and speed up the transition to much higher shares of renewable power generation.

II. THE HISTORY OF GERMANY'S ENERGIEWENDE

A. Germany's Transition Was Not Just About Climate Policy

Germany's Energiewende did not originate in climate policy, but rather stemmed from widespread opposition to nuclear power. From as early as the 1950s, when a program to

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[1] Agora Energiewende, The Energy Transition In the Power Sector: State of Affairs 2016 (Jan. 5, 2017), available at: https://www.agora-energiewende.de/fileadmin/Projekte/2017/Jahresauswertung_2016/Die_Energiewende_im_Stromsektor_2016_EN.pdf.

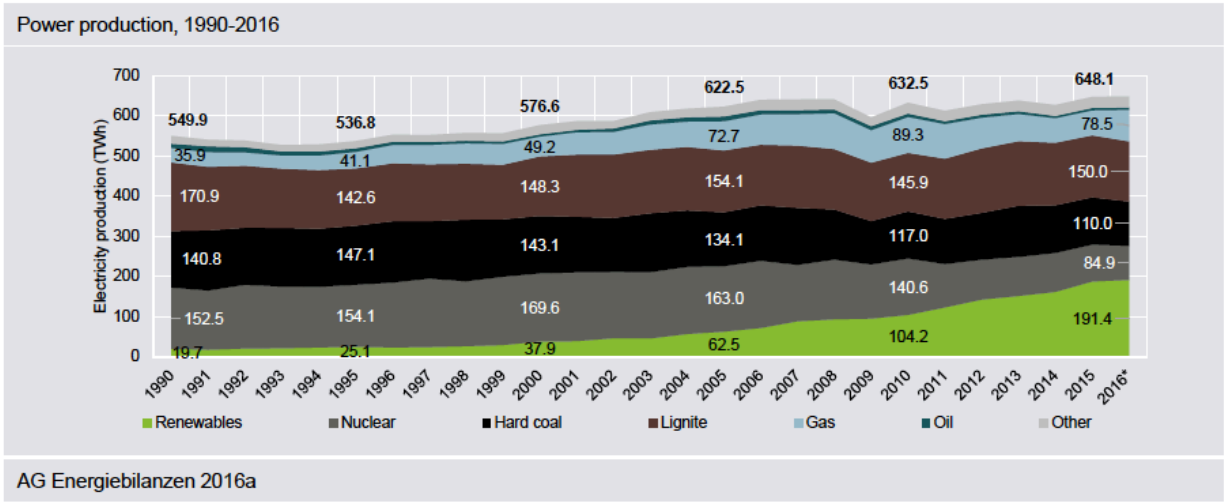
[2] Energy Information Administration, What is U.S. electricity generation by energy source?, https://www.eia.gov/tools/faqs/faq.php?id=92&t=4 (last accessed June 28, 2017); Energy Information Administration, Wind and solar in March accounted for 10% of U.S. electricity generation for first time (June 14, 2017), https://www.eia.gov/todayinenergy/detail.php?id=31632 (last accessed June 28, 2017).

[3] Renewable Energy Policy Network for the 21st Century, Renewables 2016 Global Status Report, 141, available at: http://www.ren21.net/wp-content/uploads/2016/10/REN21_GSR2016_FullReport_en_11.pdf.

develop nuclear capacity was launched in West Germany, there has been intense public opposition to nuclear power in Germany. In the 1970s and 80s, the anti-nuclear movement intensified and protests blocked development at potential reactor sites. The 1986 disaster at Chernobyl solidified opposition, and government policy; Germany did not construct any additional reactors after the accident and decided in 2002 to phase out nuclear energy by 2022. A later decision to delay the phase-out until 2036 was reversed in 2011 after the Fukushima meltdown. Eleven reactors were shut down by 2015, and Germany is on track to shut down the remaining nuclear facilities by 2022.[4]

At the same time, support for environmental protection was growing, and in Germany, the threat of climate change was also gaining attention. In August 1986, Der Spiegel, a Germany news weekly, put a picture of the cathedral in Cologne half underwater above the words "Der Klima Katastrophe." In 1987, Chancellor Helmut Kohl spoke in Parliament of the "grave threat of climate change." The recognition of the need to reduce emissions led to early goals to reduce emissions. Later targets set in the Renewable Energy Act, or Erneuerbare-Energien-Gesetz, call for an 80-90 percent reduction in greenhouse gas emissions, compared to 1990 levels, and for renewable energy to meet a minimum of 80 percent of gross electricity consumption, by 2050.[5]

The confluence of these movements put Germany in a unique place to make its transition to renewable energy. At the same time that the country was retiring significant nuclear generation, it was providing significant incentives for renewable energy development to ensure that the targets of the Erneuerbare-Energien-Gesetz were met. In so doing, Germany allowed for the nuclear power that was being phased out to be replaced with renewable energy. As the chart below illustrates, contribution from renewable resources has been increasing as coal and nuclear generation has decreased.[6]

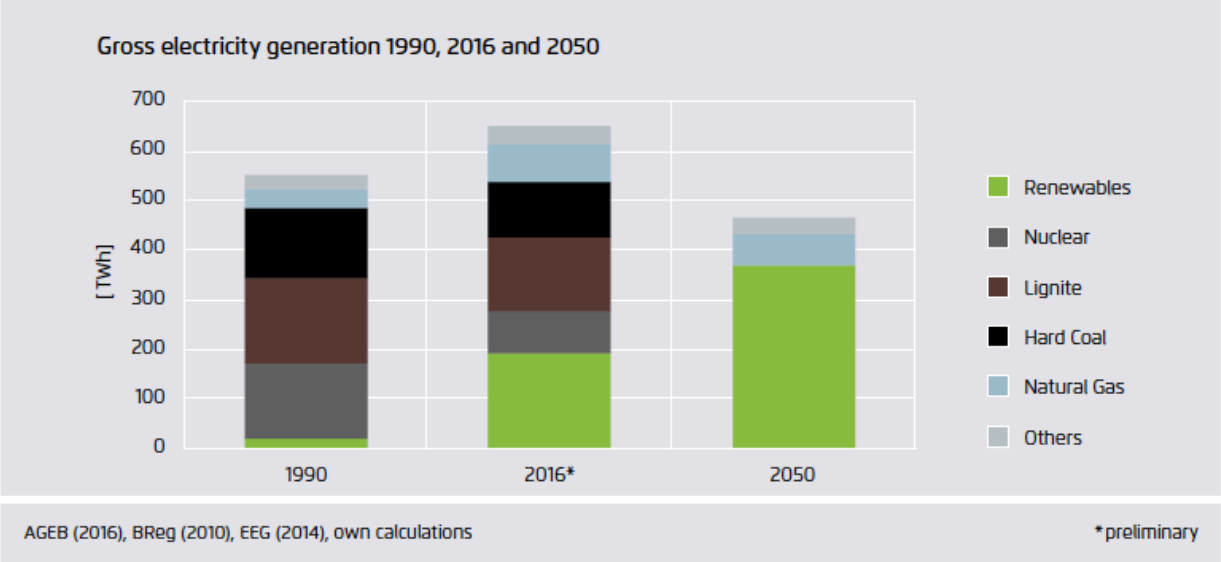


[4] Agora Energiewende, The Energiewende in a Nutshell (March 2017), available at: https://www.agora-energiewende.de/fileadmin/Projekte/2017/Energiewende_in_a_nutshell/Agora_The_Energiewende_in_a_nutshell_WEB.pdf.

[5] The Energiewende in a Nutshell.

[6] The Energy Transition in the Power Sector: State of Affairs 2016.

Additional renewable generation will be required to offset coal and nuclear generation into the future to meet the goals of the Erneuerbare-Energien-Gesetz.[7]

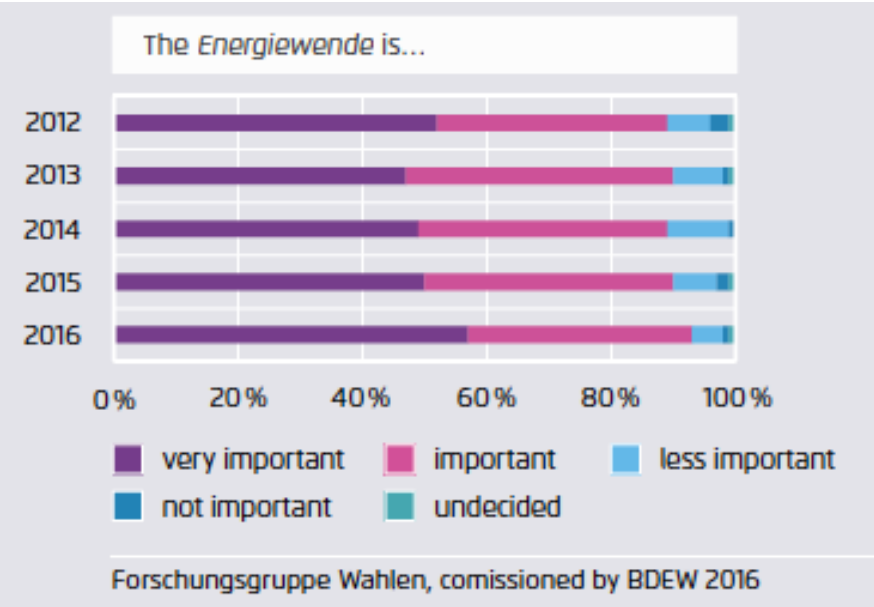


The shift from a so-called baseload nuclear resource to variable renewable resources was not only significant because of the renewable energy goals that caused the shift, but because from a technical perspective, this transition illustrated that high share of variable resources could be incorporated into the system. The implications of this demonstration will be discussed in more detail below.

B. By Ensuring Widespread Acceptance of the Energiewende, Germany has Created Space for Ambitious Targets

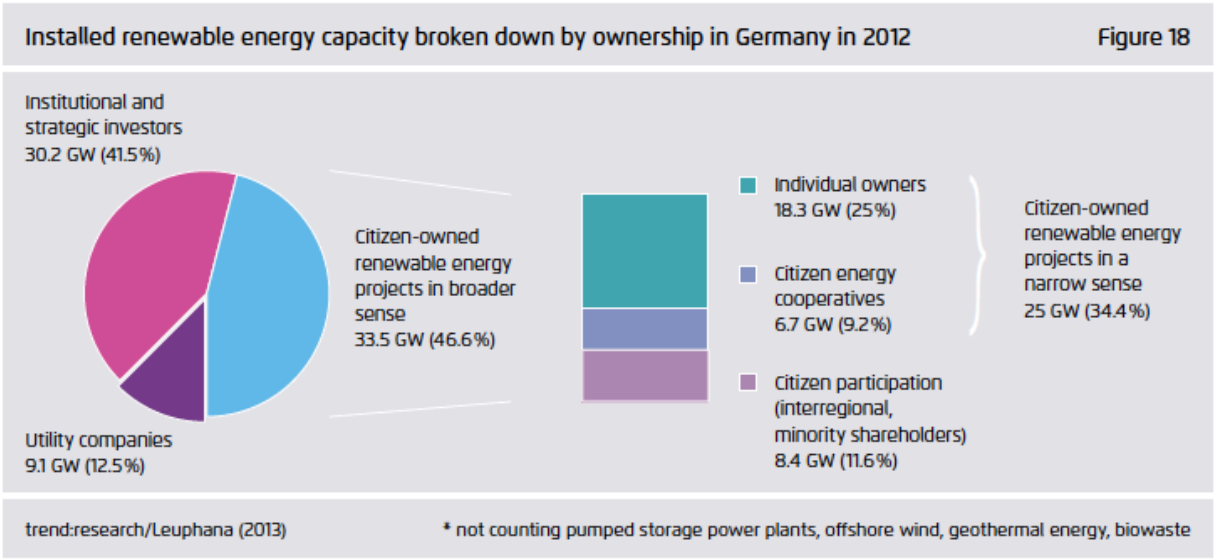
The history of the Energiewende also informs why Germans remain so supportive of the Energiewende: in 2016, 93 percent of Germans saw the Energiewende as very important or important, with 55 percent thinking that the transition to renewables is happening too slowly.[8] Many see Energiewende becoming a generic term used to describe a transition to renewable energy.

[7] The Energiewende in a Nutshell.
[8] BDEW Energy Monitor.



[9]

The Feed-in-tariff, a key part of the Erneuerbare-Energien-Gesetz, has allowed for the opportunity for the public to own the transition. Citizen ownership has been as high as 46 percent of installed renewable capacity, and many have profited from the installation of renewable generation.[10]



Continued acceptance, however, is arguably maintained for a different reason: public acceptance of the Energiewende is a priority of the German government. As State Secretary at the Federal Ministry for Economic Affairs and Energy simply put it: "What is the most important element of a successful energy transition? Winning the public."[11] In keeping with this sentiment, the German government actively promotes a dialogue around the energy

[9] The Energiewende in a Nutshell.
[10] The Energiewende in a Nutshell.
[11] Rainer Baake, Berlin Energy Transition Dialogue, (March 21, 2017), speech available at: https://www.youtube.com/watch?v=lSHdBBUABRw.

transition not only in events promoting the Energiewende, but in discussions about how to continue to implement it.

Acceptance has been maintained even in the face of challenges: Germany's electricity prices are the second highest in Europe in part because of the feed-in-tariff that has fueled the widespread installation of renewables; integration of increased renewables is causing the need for additional investment into controversial transmission lines; and debates about self-consumption and who should bear the costs rage in Germany as in the U.S.

III. HISTORY OF ENERGY POLICY IN THE UNITED STATES

A. Energy Policy in the United States is Primarily State Policy

Unlike in Germany, where federal policy governs energy matters, energy policy in the United States is largely addressed on a state-by-state basis. The Federal Energy Regulatory Commission's jurisdiction includes wholesale power sales, interstate transmission, and wholesale system planning, but states set energy and climate policy, including renewable portfolio standards and energy efficiency targets, and they regulate investor-owned utilities. In addition, the United States also has several independent system operators (ISOs) and Regional Transmission Operators (RTOs), many of which cover several states, including the California Independent System Operator (CAISO), the Electricity Reliability Council of Texas (ERCOT), the Southwest Power Pool (SPP), the Midcontinent ISO (MISO), the New York ISO (NYISO), PJM, and the New England ISO (ISO-NE).[12]

As a result of the joint approach to energy regulation, the United States has numerous regulatory schemes, with various approaches to opting in or out of retail and wholesale markets, different set-ups of public regulation commissions, differing jurisdiction over rural electric cooperatives by state, and starkly different degrees of recognition of the need to decarbonize.[13] The consequence of allowing for state regulation has been both good and bad; energy policy is not cohesive, but the diversity of approaches means that states serve as laboratories of energy policy.

B. Acceptance of the Need for Decarbonization also Varies by Region

Support for energy policy that would move us to a renewable-based system – and perhaps more importantly, away from a fossil-fuel based system – is also not as clear in the United States. After Trump made the decision to pull the United States out of the Paris Agreement, some people cheered while others watched in dismay. There is still great support for coal and natural gas development in certain parts of the country, and skepticism that renewable energy can address all energy needs. While there are substantial party and ideological divides over increasing fossil fuel and nuclear energy sources, strong majorities of all party and

[12] See www.ferc.gov/industries/electric/indus-act/rto.asp.

[13] See generally, W. Boyd and A, Carlson, ACCIDENTS OF FEDERALISM: RATEMAKING AND POLICY INNOVATION IN PUBLIC UTILITY LAW, 63 UCLA Law Review 810 (2016).

ideology groups support more solar and wind production.[14] A coalition of more than 1,400 local governments, corporations, and universities wrote a letter stating their support for the goals of the Paris Agreement; Governors from 17 states have signed the nonpartisan Governors' Accord, which "recognized that the nation's energy landscape is changing," to advance clean energy and plan for a new energy future; and cities and states across the country have set ambitious renewable energy goals.

This diversity of opinion is manifested in the various state policies throughout the country. California, for example, has set a renewable portfolio standard requiring that retail sellers and publically owned utilities procure 50 percent of their electricity from eligible renewable suppliers by 2050.[15] On the other end of the spectrum, Wyoming Legislators proposed a bill that would prohibit utilities from providing electricity generated by large-scale wind or solar facilities.[16] Although this bill did not pass, it reveals the extent of opposition to an energy transition.[17]

IV. SUCCESSES AND FAILURES IN BOTH COUNTRIES CAN SERVE AS POLICY LESSONS

As both countries increase the amount of variable renewable energy on their electricity grids, their different experiences can provide specific examples of policies that have been successful, or not, in the construction of a system that can accommodate these new resources. In some cases, the two countries share challenges, such as move away from coal in a way that is just for the communities dependent on coal as an economic base. In other areas, the two countries can consider specific policies or actions taken as models for moving forward. For example, Germany demonstrates that even in an area of poor resource potential, when development is spurred, renewable energy can offer significant contributions. ISOs in the United States demonstrate how an expansion of a market, and good market design, can allow for greater renewable penetrations without the need for resource curtailment during high production and low load periods.

Key to having successful dialogue about shared opportunities and challenges is looking at specific policies, rather than trying to compare whole systems. Integral to that comparison is taking a deeper dive, and convening experts on specific policy mechanisms, rather than falling into generalized discussions about systems that have many differences that make

[14] http://www.pewinternet.org/2016/10/04/public-opinion-on-renewables-and-other-energy-sources/; https://www.greentechmedia.com/articles/read/new-survey-shows-renewable-energy-polls-ridiculously-well-among-trump-voter; http://midwestenergynews.com/2016/05/04/poll-public-supports-clean-power-plan-as-their-states-fight-it/

[15] See California Energy Commission, http://www.energy.ca.gov/portfolio/ (last accessed June 28, 2017).

[16] Greentech Media, Wyoming Bill Creates Reverse RPS Banning Wind and Solar: 'I Haven't Seen Anything Like This Before,' (Jan. 16, 2017), available at: https://www.greentechmedia.com/articles/read/wyoming-bill-creates-reverse-rps (last accessed June 28, 2017).

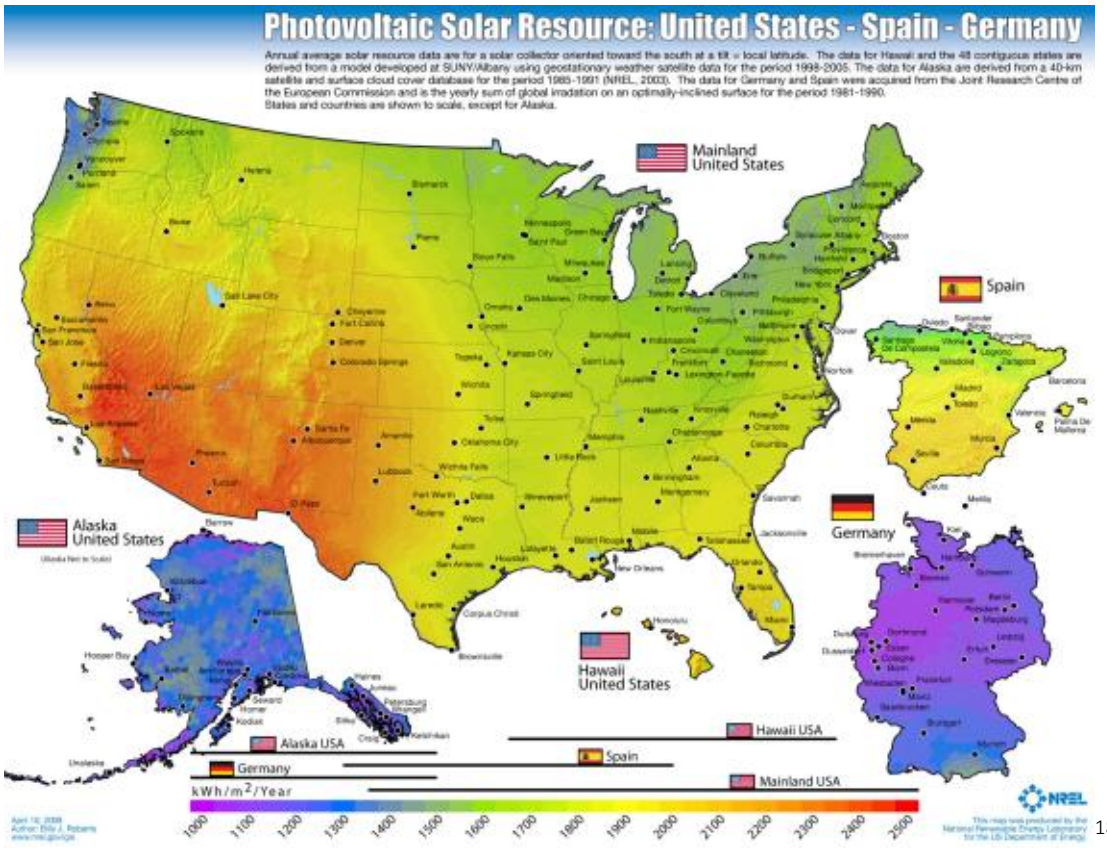
[17] Bill Track 50, https://www.billtrack50.com/BillDetail/766882 (last accessed June 28, 2017).

them difficult to compare as well. This section presents some examples of where Germany and the United States could learn from one another.

A. Resource Potential

A basic lesson that Germany offers for the United States is that a transition to renewable energy can occur even where resource potential is not ideal. Germany's investment into renewable resources through incentive structures in the Erneuerbare-Energien-Gesetz spurred distributed development of those resources throughout Germany. This development has allowed Germany to dramatically increase the share of electricity provided by renewable resources, thus demonstrating that even where resource potential is low, renewable resources in the aggregate can still provide a significant share of electricity generation.

As can be seen from the map below, compared to the United States, only Alaska has comparably poor solar potential, and although wind potential is similar for a given area, fewer areas are available for development as a result of protection, area planning, setbacks, and other constraints.



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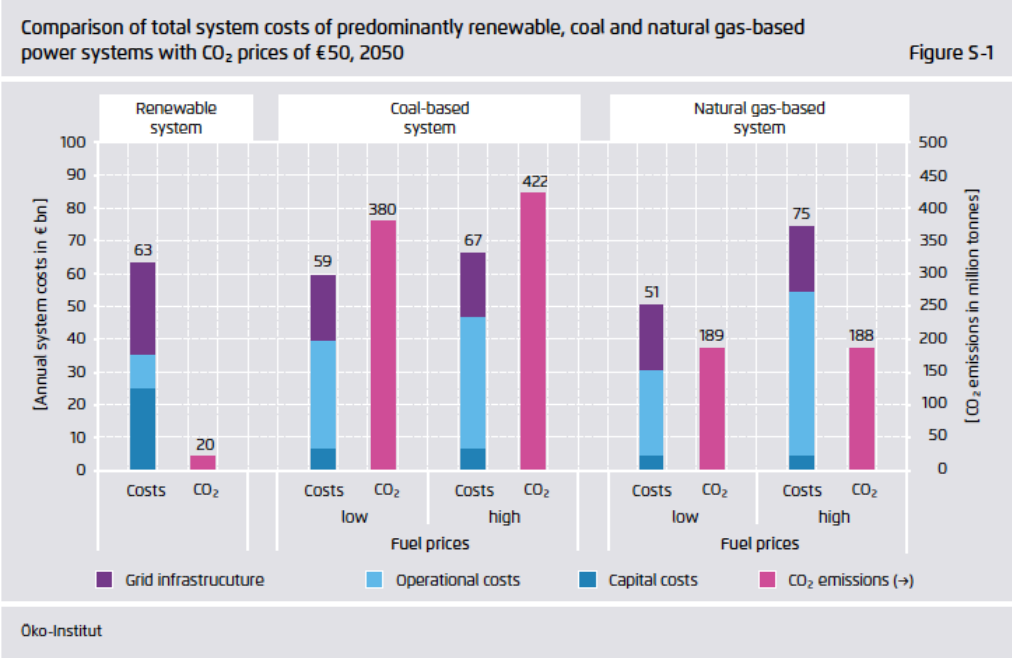
[18] Brad Plumer, Germany Has Five Times as Much Solar Power as the U.S. Despite Alaska Levels of Sun, (Feb. 8, 2013), available at: https://www.washingtonpost.com/news/wonk/wp/2013/02/08/germany-has-five-times-as-much-solar-power-as-the-u-s-despite-alaska-levels-of-sun/?utm_term=.8db0778b8c7d (last accessed June 28, 2017).

Despite these differences in resource potential, Germany is meeting demand with significant amounts of renewable energy, last year meeting 32.3 percent of demand, and much more at certain times. In May 2016, renewables met the highest to-date level of demand, 86 percent. Around Christmas of 2016, during a three-day period, renewable resources served 50 percent of demand continually, reaching up to 76 percent of demand for parts of that period.[19] The United States, by contrast, meets only about 15 percent of demand with renewable energy, just this year breaking 10 percent when looking at wind and solar contributions.[20]

Although high renewable integration is not only possible, but occurring, Germany's transition is sometimes regarded with skepticism because of high electricity prices in the country. Germany, however, is a terrible example to use to determine the expected costs of this transition. Germany began its transition before the astounding drop in the costs of renewable resources; the reason for its feed-in tariff, which accounts for some of higher electricity rates, was to spur rapid development of renewable resources in the face of those high prices. Furthermore, the poor resource potential of the country means that more resources must be developed for high levels of generation. Finally, other factors contribute to the high electricity prices, including network charges, and other taxes and surcharges, not just the costs of the Energiewende. Moreover, a comparison of a renewable-based system to fossil-fuel based systems reveals that with high fuel costs, a renewable system will be less expensive in the long run.

[19] Agora Energiewende, The Energy Transition In the Power Sector: State of Affairs 2016 (Jan. 5, 2017), available at: https://www.agora-energiewende.de/fileadmin/Projekte/2017/Jahresauswertung_2016/Die_Energiewende_im_Stromsektor_2016_EN.pdf.

[20] Energy Information Administration, *What is U.S. electricity generation by energy source?*, https://www.eia.gov/tools/faqs/faq.php?id=92&t=4 (last accessed June 28, 2017); Energy Information Administration, Wind and solar in March accounted for 10% of U.S. electricity generation for first time (June 14, 2017), https://www.eia.gov/todayinenergy/detail.php?id=31632 (last accessed June 28, 2017).



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B. The Coal Challenge

Moving away from coal is a challenge in both Germany and the United States. Although coal mines and coal fired-power plants no longer offer a very large number of job, for those communities dependent on coal as their economic base, the loss of these jobs has a disproportionate effect. In Germany, there are about 20,000 coal jobs, in a total population of 82.8 million (0.024 percent); the percentage is similar in the United States; there are about 77,000 coal jobs in a population of 321.4 million (0.024 percent).

From German labor unions calling a transition away from inefficient lignite "absurd," to President Trump's hollow promises to bring back coal jobs, coal transition issues in both countries are often charged with emotion. As a result, even as steps are taken to transition to renewable energy, there is frustration about the lack of solutions to address impacts to communities built on an industry that has fuelled our economy, and a desire to ensure that those communities are not left out of the larger transition.

In Germany, despite the aggressive targets of Energiewende policies, Germany remains reliant on its coal-fired generation. Specifically, Germany continues to hold on to its lignite fleet, and therefore lignite mining, perpetuating an even dirtier and less efficient resource from both the mining and combustion perspective. Germany also continues to import hard coal, thus sustaining demand and the need for coal mining in other countries.

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[21] Agora Energiewende, Erneuerbare vs. fossile Stromsysteme: ein Kostenvergleich Stromwelten 2050 – Analyse von Erneuerbaren, kohle- und gasbasierten Elektrizitätssystemen (Jan. 2017), available at: https://www.agora-energiewende.de/fileadmin/Projekte/2016/Stromwelten_2050/Gesamtkosten_Stromwelten_2050_WEB.pdf (last accessed June 28, 2017).

The United States has retired numerous coal-fired plants over the last several years as a result of advocacy and simple economics as gas prices have decreased. However, each retirement raises a fight about the need to hold on to these resources even when it has been shown they are no longer needed for system reliability. Furthermore, utilities raise the issue of stranded costs remaining in these plants and want security if plants are retired. Because of the polarized and charged nature of these discussions, they rarely yield positive or concrete solutions about how to transition coal-dependent communities to more sustainable economies. Continued coal exports only exacerbate the situation, as they can require additional investment in infrastructure to transport coal to ports, and can provide false hope that international demand for coal will be sustained even as coal is losing its dominance worldwide.

Both countries have developed ideas around a just transition.[22] Securitization schemes would provide funding for transition while offering some relief for utilities that have invested in these plants; job retraining plans exist more than concrete examples, but at least they offer possibilities for shared discussion. Coal phase out will continue to be an issue in both countries, and given the shared challenge, both countries would be wise to seek new perspective.

C. Reliability and Baseload

The challenge in moving away from not just coal but large, thermal, "baseload" generation sources more generally has become a hot topic in the United States because of Secretary of Energy Perry's call for a study to consider whether baseload is necessary "to a well-functioning electric grid." The study is biased towards the assumption that baseload is necessary to maintain a reliable grid, asking for the study to look at "evolution of wholesale electricity markets," "whether wholesale energy and capacity markets are adequately compensating attributes such as on-site fuel supply and other factors that strengthen grid resilience," and "the extent to which continued regulatory burdens are responsible for forcing the premature requirement of baseload power plants." The United States has many examples of why these built-in assumptions are false, but Germany illustrates in real-time that high renewable penetrations do not correlate to a less reliable system.

At the same time that renewable resources are replacing traditional baseload, Germany's electricity system has remained one of the most reliable in the world.[23] Germany's

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[22] See, e.g., Agora Energiewende, Eleven Principles for a Consensus on Coal (Jan. 2016), available at: https://www.agora-energiewende.de/fileadmin/Projekte/2015/Kohlekonsens/Agora_Kohlekonsens_KF_EN_WEB.pdf (last accessed June 28, 2017); WWF, Zukunft StromSytem Kohleausstieg 2035, Vom Ziel her denken (2017), available at: https://www.wwf.de/fileadmin/fm-wwf/Publikationen-PDF/WWF-Studie_Zukunft_Stromsystem_-_Kohleausstieg_2035.pdf (last accessed June 28, 2017).

[23] Council of European Energy Regulators, 6th CEER Benchmarking Report on the Quality Of Electricity and Gas Supply – 2016, Annex A Electricity – Continuity Of Supply, available at: www.ceer.eu/.../CEER.../4-C16-EQS-72-03_CEER-6thBR_Annexes-Lists.pdf; see also

Unplanned System Average Interruption Duration Index (SAIDI), including exceptional events, has stayed below 36 minutes of interruption per year since 2006; excluding exceptional events, Germany's SAIDI index has remained below 16 minutes since 2009, with fewer outages since 2008 when renewable penetrations have been higher.[24] By comparison, France, a country with a large nuclear and fossil-fuel base, has had on average around 50-60 minutes of outages per year, excluding exceptional events,[25] and the United States, also heavily dependent on traditional baseload, has around 140 minutes of outages per year excluding exceptional events.[26] Denmark, on the other hand, a country with higher renewable penetrations than Germany, had similar outage rates to Germany.[27] In short, reliability does not depend on maintaining high levels of baseload.

Germany's all-in approach to its energy transition has served it well. Germany adopted ambitious renewable goals early on, with a goal of 55-60 percent by 2030 and at least 80 percent by 2050. With the expectation that renewable energy would dominate generation, the discussion around shifted away from baseload and peaking resources to planning for variable and residual supply. Providing a feed-in tariff when prices for renewable energy were high jumpstarted development of renewable resources throughout the country (and likely outside of the country as well). In addition, the feed-in-tariff helped garner widespread acceptance for the transition as, at one point in time, almost half of renewable capacity was owned by German citizens who benefitted from the feed-in tariff.

Recognizing the impact that much lower costs for renewable energy projects are having, the 2017 amendment to the Renewable Energy Law replaces the feed-in tariff for larger systems with an auction based system; the amount of capacity to be auctioned is set, with the auction itself setting the price for renewable energy. Germany also rejected calls to adopt a capacity market, instead opting to continue with existing reserves and focus on scarcity pricing as an investment signal.

In addition to reiterating its commitment to an energy-only market, Germany has adopted additional flexibility measures to maintain reliability. Most fundamentally, and in keeping with dialogue around its transition more generally, it has begun to rely on its renewable resources as primary generation, with other resources being used flexibly to meet residual

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http://www.galvinpower.org/sites/default/files/Electricity_Reliability_031611.pdf; http://www.savivaresearch.com/wp-content/uploads/2013/05/April-2013-DERMS.pdf.

[24] Council of European Energy Regulators, 6th CEER Benchmarking Report on the Quality Of Electricity and Gas Supply – 2016, Annex A Electricity – Continuity Of Supply, available at: www.ceer.eu/.../CEER.../4-C16-EQS-72-03_CEER-6thBR_Annexes-Lists.pdf; see also http://www.savivaresearch.com/wp-content/uploads/2013/05/April-2013-DERMS.pdf.

[25] CEER report; France Country profile https://www.agora-energiewende.de/fileadmin/Projekte/2014/CP-Frankreich/CP_France_1015_update_web.pdf

[26] Lawrence Berkeley National Laboratory, *Assessing Changes in the Reliability of the U.S. Power System* (Aug.2015), available at: https://emp.lbl.gov/sites/default/files/lbnl-188741.pdf (last accessed June 28, 2017).

[27] CEER report; http://www.ren21.net/wp-content/uploads/2017/06/17-8399_GSR_2017_Full_Report_0621_Opt.pdf.

load.[28] Additional measures to increase flexibility, including Increased interconnections with neighboring countries, demand-side management, and the expansion of grid infrastructure, are also being implemented.

Despite Germany's progress, it is holding fast to pieces of a traditional system that are not in line with its goals of being a leader in energy transition. Most importantly, Germany's desire to maintain a single price zone throughout the country is leading to inaccurate signals that are causing unnecessary and inefficient re-dispatch. Adapting its market to allow for nodal pricing, or at the least, increasing the number of price zones within its market, would allow for more accurate market signals and resource investment. Developing a plan to retire additional hard coal and lignite resources is also necessary not only to decrease carbon emissions, but because perpetuation of these plants can add expense in a flexible system.

D. Incorporating Additional Flexibility into Electricity Systems

Numerous other mechanisms for adding flexibility to the power systems of both countries provide opportunities for comparing notes. Adding transmission, which can facilitate system transition, is controversial in both countries, and figuring out best siting practices, how to involve communities, and the considering the costs and benefits of underground cables would facilitate those discussions.

Tariff design is another area where the counties would benefit from shared experiences. Various places in the United States have been discussing the wisdom of increasing fixed charges in tariffs; those discussions are taking place with more frequency in Germany. How this rate design can affect energy efficiency and the incentives for distributed generation is an important topic when considering increased renewable energy systems. Incorporating more energy efficiency and demand side management into both systems will also provide additional flexibility that will allow for higher shares of renewable energy generation.

Regional integration is also an area where Germany and the Western United States, in particular, could share information on the benefits and costs of integrating markets and expand balancing areas. Such integration can result in large benefits to the region and member states or countries, but designing this integration can raise questions of governance, holding onto sovereignty, as well as the attendant technical issues.

Related area that are becoming increasingly important in both countries are increased electrification of cars, appliances, heating, and other areas that have traditionally been run on fossil fuels. Coupling these sectors will become only more important in the future so designing systems that can accommodate those interrelationships will be critical in both places.

[28] *The Energiewende in a Nutshell* at 23.

V. CONCLUSION

The United States and Germany have numerous policy challenges in front of them as they shift their power systems from ones that rely on fossil fuel resources to those relying on renewable energy. Learning from one another does not imply that the situations are or should be the same. Rather, there are different lessons on both sides of the Atlantic. Germany has been leading in many respects, but it should not fail to recognize the areas in which it is struggling. The United States, and the states in particular, should recognize that they do not need to reinvent the wheel; other countries provide important examples. Shifting these systems quickly is critical to addressing climate change, but the task is enormous. We should be learning from one another as we move forward so that we do make mistakes others have already made, or miss opportunities that would allow for a more rapid shift to renewable energy.