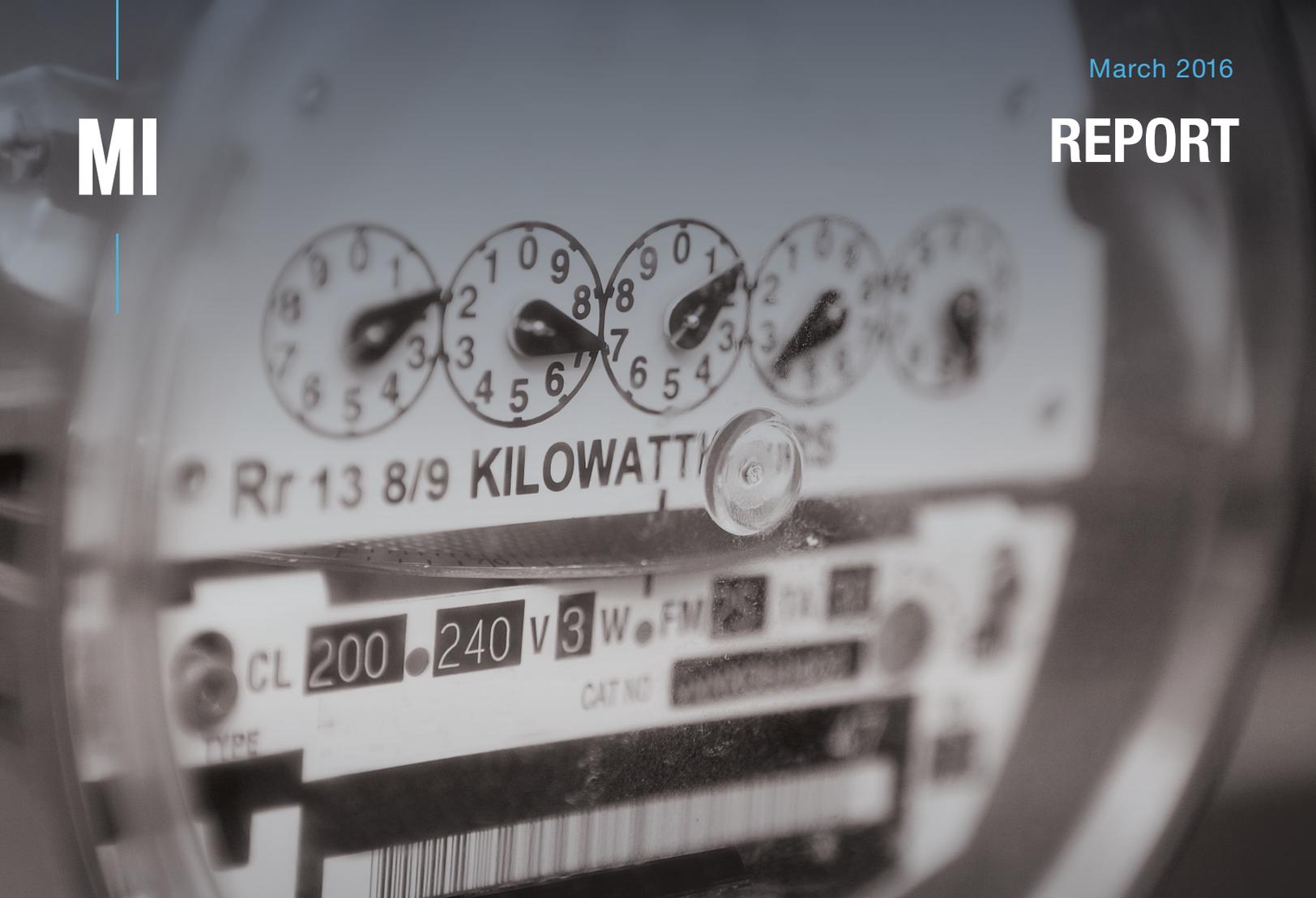


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REPORT



# ENERGY POLICIES AND ELECTRICITY PRICES

CAUTIONARY TALES FROM THE E.U.

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## About the Author



**Robert Bryce** is a senior fellow at the Manhattan Institute. He has been writing about the energy sector for more than two decades, and his articles have appeared in such publications as the *Wall Street Journal*, *New York Times*, *The Atlantic*, and *Sydney Morning Herald*. He is the author of *Pipe Dreams: Greed, Ego, and the Death of Enron*, named one of the best nonfiction books of 2002 by Publishers Weekly; *Cronies: Oil, the Bushes, and the Rise of Texas, America's Superstate* (2004); *Gusher of Lies: The Dangerous Delusions of Energy Independence* (2008); *Power Hungry: The Myths of "Green" Energy and the Real Fuels of the Future* (2010), which the *Wall Street Journal* called "precisely the kind of journalism we need to hold truth to power"; and *Smaller Faster Lighter Denser Cheaper: How Innovation Keeps Proving the Catastrophists Wrong* (2014), which the *New York Times* called a "book well worth reading" and the *Wall Street Journal* called an "engrossing survey."

Bryce has delivered more than 200 invited and keynote lectures to groups of all kinds, ranging from the Marine Corps War College and University of Calgary, to the Sydney Institute and Melbourne's Institute of Public Affairs. He appears regularly on major media outlets, including CNN, Fox News, PBS, NPR, and BBC. Bryce holds a B.F.A. from the University of Texas at Austin.

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## Executive Summary

Since 2005, members of the European Union have aggressively pushed policies aimed at addressing climate change. Those policies are primarily designed to decrease carbon-dioxide emissions and increase the use of renewable energy. In 2011, the European Commission established an Energy Roadmap, which set a goal of reducing E.U. greenhouse gas emissions by at least 80 percent—compared with 1990 levels—by 2050. At the same time, several European countries are restricting the production of natural gas and, in the case of Germany, aiming to phase out nuclear energy. These policies have resulted in dramatic increases in electricity costs for residential and industrial consumers.

Although the E.U. has seen a reduction in its carbon-dioxide emissions since 2005, those reductions pale in comparison with increases in the developing world. The observable results from Europe thus offer a cautionary tale to policymakers in the United States who seek to tackle climate change via government mandate. Nevertheless, two states, New York and California, are mimicking European-style energy policies: both states have adopted aggressive renewable-energy and greenhouse gas emissions-reduction goals that are likely to further increase those states' already-high energy costs. **Key findings include:**

1. Between 2005, when the E.U. adopted its Emissions Trading Scheme, and 2014, residential electricity rates in the E.U. increased by 63 percent, on average. In Germany, those rates increased by 78 percent; in Spain, by 111 percent; and in the U.K., by 133 percent. Over the same period, residential rates in the U.S. rose by 32 percent.
2. During 2005–14, residential electricity rates in Germany, which has the most aggressive support for renewables, increased by 13 cents, to 40 cents per kilowatt-hour—an increase larger than the average cost of residential electricity in the U.S. (12.5 cents).
3. E.U. countries that have intervened the most in their energy markets—Germany, Spain, and the U.K.—have seen their electricity costs increase the fastest. During 2008–12, those countries spent about \$52 billion on interventions in their energy markets.
4. Emissions reductions achieved by the E.U. since 2005 have been greatly exceeded by increases in emissions in the developing world. During 2005–14, the E.U. reduced its carbon-dioxide emissions by 600 million tons per year. Over that same period, the combined emissions of four developing countries—China, India, Indonesia, and Brazil—increased by 4.7 billion tons per year, or nearly eight times the reduction achieved in the European Union.
5. Bans or restrictions on hydraulic fracturing and, therefore, on natural gas production have made European countries more dependent on imported energy and have contributed to higher electricity prices.

**For these reasons, before U.S. policymakers mandate increases in renewable energy, they should be required to:**

- ♦ Estimate the long-term cost of such mandates on consumers and industrial facilities.
- ♦ Estimate the expected reduction in carbon-dioxide emissions from such mandates and the effect that those reductions would have on global temperatures.

# ENERGY POLICIES AND ELECTRICITY PRICES

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## CAUTIONARY TALES FROM THE E.U.

### I. Introduction: Is Europe a Model for America?

European energy policies have long been viewed favorably by U.S. pundits, environmentalists, and politicians. Germany, in particular, is often held up as a model to be copied. For instance, in 2015, *New York Times* columnist Thomas Friedman declared that what the Germans have done by “converting almost 30 percent of their electric grid to renewable energy from near zero in about 15 years has been a great contribution to the stability of our planet and its climate . . . a world-saving achievement.”<sup>1</sup>

In 2014, Bill McKibben, founder of 350.org and one of America’s highest-profile environmental activists, wrote that Germany is “the one country that has taken climate change seriously,” noting that the country has begun overhauling its energy infrastructure and that, for a short period of one day in 2014, “Germany generated 74 percent of its electric needs from renewable sources.”<sup>2</sup>

In 2013, Amory Lovins, chief scientist at the Rocky Mountain Institute, wrote: “[Germany has] provided an impressive model of what a well-organized industrial society can achieve.” Lovins went on, approvingly noting that Spain briefly obtained 61 percent of its electricity needs from wind in April 2012. He concluded by declaring that Germany “offers proof that a heavily industrialized, world-class, politically pluralistic market economy can run well on a self-financing combination of efficiency and renewables.”<sup>3</sup>

In 2015, the left-leaning Center for American Progress noted that “Spain has long been a leader in renewable energy.” It went on to note that wind energy provided nearly 24 percent of Spain’s electricity during January–March 2015.<sup>4</sup> In addition to Germany and Spain, Denmark is also held up as an example to be copied. In 2009, on Earth Day, President Barack Obama said: “Denmark produces almost 20 percent of their electricity through wind power.... When it comes to renewable energy, I don’t think we should be followers. I think it’s time for us to lead.”<sup>5</sup>

The push for leadership on climate issues has led some U.S. policymakers to emulate European-style energy policies. This paper will examine the policies enacted in three countries—Germany, the U.K., and Spain—which have the E.U.’s first-, second-, and fifth-largest economies, respectively;<sup>6</sup> those three countries have also been the most aggressive in their pursuit of renewables. The paper will also discuss the similarities between the energy policies in those three European countries and the policies being pursued in California and New York.

## II. E.U. Energy-Market Interventions: A Brief History

In 2005, the European Commission launched the world’s first cap-and-trade system. In 2007, the E.U. agreed to enact its first “energy action plan,” which resulted in the commitments known as “20/20/20.” By 2020, European governments agreed that they would achieve three goals: establish legally binding agreements to cut their greenhouse gas emissions by 20 percent from 1990 levels; rely on renewables for 20 percent of their energy; and reduce their energy consumption by 20 percent from 2007 levels.<sup>7</sup>

The most ambitious policy on climate change was enacted in 2011, when the European Commission established the Energy Roadmap, which set a goal of reducing the E.U.’s greenhouse gas emissions by at least 80 percent, when compared with 1990 levels, by 2050.<sup>8</sup> The commission has estimated that upgrading the European electricity grid to accommodate the amount of renewable energy needed to reach that goal could cost as much as \$2.4 trillion.<sup>9</sup>

According to a 2014 report by the European Commission, during 2008–12, E.U. members spent a combined total of \$106 billion on energy subsidies (**Figure 1**);<sup>10</sup> the

**Energy Subsidies by E.U. Members, 2008–12**

FIGURE 1.

Country	Total Subsidies (\$, millions)
Austria	2,140
Belgium	3,510
Bulgaria	439
Croatia	32
Cyprus	21
Czech Republic	1,712
Denmark	1,295
Estonia	161
Finland	321
France	7,758
Germany	27,253
Greece	728
Hungary	663
Ireland	546
Italy	11,085
Latvia	235
Lithuania	353
Luxembourg	96
Malta	54
Netherlands	2,932
Poland	1,038
Portugal	845
Romania	728
Slovenia	631
Slovakia	107
Spain	11,160
Sweden	2,878
United Kingdom	14,306
E.U.-Level Interventions	13,332
<b>Total</b>	<b>\$106,358</b>

Source: European Commission, “Subsidies and Costs of EU Energy,” November 11, 2014.<sup>14</sup>

commission defined subsidies as “payments made or revenues forgone as stipulated by all regulations in force, including regulations that were enacted in the past.”<sup>11</sup> About 40 percent of the subsidies, some \$42.8 billion of the total interventions in E.U. energy markets, were paid directly by energy consumers in the form of surcharges on their bills.<sup>12</sup> Roughly that same amount of money, some \$43.1 billion, was allocated to the production of renewable energy. Of that sum, the biggest portion, \$15.7 billion, was provided to solar energy; wind energy production came in second, with \$11.9 billion in subsidies.<sup>13</sup>

Of the \$106 billion that E.U. members spent on energy subsidies during 2008–14, three countries—Germany (\$27.2 billion), Spain (\$11.1 billion), and the U.K. (\$14.3 billion)—accounted for nearly half of the total. Those three countries have also seen the largest increases in residential electricity rates. According to Eurostat, during 2005–14, residential rates in the E.U. increased by an average of 63 percent. In Germany, those rates increased by 78 percent; in Spain, they increased by 111 percent; and in the U.K., they rose 133 percent. For comparison, over that same period, residential rates in the U.S. rose by 32 percent.<sup>15</sup>

### III. Germany, Spain, and the U.K.: A Closer Look

The 28 members of the European Union have a total population of about 500 million people. The E.U. is dominated by several large economies, the most important of which is Germany, which has an annual GDP of about \$3.9 trillion, putting it fourth among the world’s countries. Germany is closely followed by the U.K., which ranks fifth in size among the world’s economies, with a GDP of \$3 trillion. Spain’s economy, with \$1.4 trillion in annual GDP, is the world’s 14<sup>th</sup>-largest economy.<sup>16</sup>

The three countries also account for about 38 percent of the E.U.’s population and about 30 percent of the E.U.’s carbon-dioxide emissions.<sup>17</sup> Given the importance of the three countries to the E.U., it makes sense to look at how their energy policies have developed since 2005, when the E.U. adopted the Emissions Trading Scheme.

Germany has adopted the most ambitious energy policies in the E.U. and, perhaps, the world. The objective of the country’s *Energiewende*, or energy transition, is to produce 40 percent–45 percent of all electricity needs from renewable-energy sources by 2025—rising to 80 percent by 2050. Germany has encouraged renewable production by providing lucrative subsidies to energy producers. Over the past decade, German consumers have spent about \$100 billion on those subsidies.<sup>18</sup> But that may be just a down payment. In November 2015, the Fraunhofer-Institut estimated that *Energiewende* may ultimately cost German taxpayers more than \$1.2 trillion.<sup>19</sup>

Denmark 42%  
Germany 78%  
Italy 32%  
Spain 111%  
E.U. 63%  
U.K. 133%  
France 42%  
U.S. 32%

FIGURE 2.

#### Residential Electricity Prices, 2005–14



Sources: Eurostat, U.S. Energy Information Administration, Forex

Further complicating the *Energiewende* is the decision made by German policymakers to decarbonize their economy without using nuclear energy. In the wake of the Fukushima disaster in 2011, Germany shut down eight of its nuclear reactors.<sup>20</sup> And the German government has committed to retiring all its remaining nuclear reactors by 2022.<sup>21</sup>

Germany has pushed renewable energy as the primary replacement for that nuclear capacity. During 2005–14, Germany’s solar capacity grew 17-fold. In 2014, the country’s solar installations produced about 35 terawatt-hours of electricity from about 38 gigawatts of installed capacity.<sup>22</sup> During 2005–14, Germany more than doubled its wind-energy production, too. In 2014, the country produced about 56 terawatt-hours of electricity from 40 gigawatts of installed wind capacity.<sup>23</sup>

German subsidies for renewables have resulted in more costly electricity. As mentioned, during 2005–14, residential electricity prices increased by 78 percent, to 40 cents per kilowatt-hour, a price that puts Germany in a tie with Denmark for the most expensive residential electricity in the European Union (**Figure 2**).<sup>24</sup> Germany’s industrial prices have not increased as quickly as residential rates because of a policy that exempts about 2,000 energy-intensive industrial companies from renewable-energy surcharges.<sup>25</sup> By 2014, industrial electricity rates in Germany had increased by about 15 percent over 2005 levels, to 11.2 cents per kilowatt-hour. Those rates are nearly 60 percent higher than the average industrial price of electricity in the U.S., which, in 2014, stood at 7.1 cents per kilowatt-hour.

Spain has avidly pursued renewable energy. Like Germany, it has seen significant increases in its electricity prices. During 2005–14, Spain more than doubled its production of electricity from wind. In 2014, Spain was the second-largest wind producer in Europe (and fourth-largest internationally), with production of about 52 terawatt-hours of electricity, from 23 gigawatts of installed wind capacity. Spain has also seen dramatic growth in solar-energy production. During 2005–14, the country’s solar capacity grew 50-fold. In 2014, the country produced 13.7 terawatt-hours of electricity from 5.3 gigawatts of installed solar capacity.<sup>26</sup>

Spanish consumers have seen their bills increase along with the expansion of solar and wind energy. During 2005–14, Spanish households saw the price of their electricity increase by 111 percent, to 29 cents per kilowatt-hour, more

than twice the average residential price in the United States. Spain has also seen huge increases in industrial rates. During 2005–14, those rates jumped by 84 percent, to 15.8 cents per kilowatt-hour, more than two times the average U.S. rate.

The U.K. has also pushed hard for reductions in emissions and increases in renewable-energy production. In 2008, the U.K. approved the Climate Change Act, which committed the country to reduce its carbon-dioxide emissions by 80 percent (from 1990 baseline levels) by 2050. It also set an interim target to reduce GHG emissions by at least 34 percent (against 1990 levels) by 2020.<sup>27</sup>

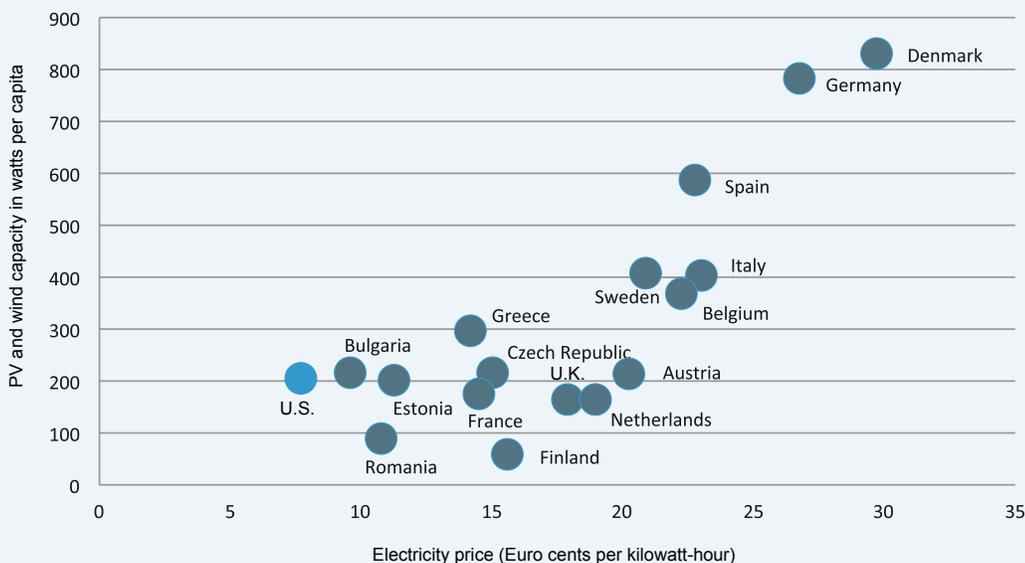
During 2005–14, the U.K. saw a tenfold increase in production of electricity from wind. In 2014, the country produced 31.6 terawatt-hours of electricity from 12.8 gigawatts of installed wind capacity. The U.K. also increased its solar capacity, although the output of its solar installations has been far more modest than in Spain. By 2014, the U.K. had almost as much solar capacity as Spain, about 5.2 gigawatts, from which it produced 3.9 terawatt-hours of electricity.<sup>28</sup>

The increase in renewables has come with major increases in electricity prices. During 2005–14, residential electricity prices in the U.K. jumped by 133 percent, more than twice the rate of increase in the E.U. as a whole. By 2014, residential electricity prices in the U.K. were 25 cents per kilowatt-hour. Rates for industrial electricity grew even faster. During 2005–14, those prices increased by 133 percent, to 16.6 cents per kilowatt-hour, among the highest rates in the European Union.

In 2014, the Swiss consulting firm Finadvice released a report, “Development and Integration of Renewables: Lessons from Germany,” which was commissioned by the Edison Electric Institute and several European clients and examined renewable-energy policies in Europe and their effect on consumers.<sup>29</sup> The report concluded that “a correlation exists between the amount of variable renewable-energy capacity that a country has (PV and wind) and its household electricity prices including taxes, levies, and value added tax.” The report also included a graphic (reproduced in **Figure 3**) that shows the amount of solar and wind capacity in several countries and plotted that capacity with electricity prices. Europe’s experience over the last decade strongly suggests that increasing renewable mandates have been the proximate cause of higher electricity prices for consumers.

FIGURE 3.

### Wind and Solar Capacity and Electricity Prices, Select Countries, 2012



Source: Finadvice<sup>30</sup>

## IV. Hydraulic-Fracturing Bans, Electricity Prices, and the Risk of “Deindustrialization”

Natural gas is an essential fuel for Europe’s economy, providing about 23 percent of the E.U.’s total energy needs.<sup>31</sup> Despite its need for gas, four countries—France, Bulgaria, Germany, and Scotland—have banned hydraulic fracturing, the process used to stimulate recovery of oil and gas by injecting water and sand at high pressure into hydrocarbon reservoirs.<sup>32</sup>

These bans on hydraulic fracturing are important for two reasons. The first is that European countries have become increasingly reliant on expensive natural gas imported from outside the European Union. Second, higher-priced gas is contributing to higher electricity prices. In 1995, the E.U. imported 43 percent of its gas; by 2013, 65 percent. Spain has relied almost exclusively on imported natural gas for decades. The U.K. has seen the biggest increase in import

dependency: in 1995, the U.K. was importing just 1 percent of its natural gas; by 2013, 50 percent.<sup>33</sup>

Europe’s reliance on imported energy of all kinds has been increasing. In 2013, the E.U. imported 53 percent of its total energy requirements, up from 43 percent in 1995. For instance, in 1995, the E.U. imported 74 percent of its oil and petroleum products; by 2013, 87 percent. Coal imports have also increased, from about 30 percent to just over 64 percent during the same period.<sup>34</sup>

In 2015, despite this increasing reliance on imported energy,

Germany extended its ban on hydraulic fracturing for at least five more years. After the ban was announced, the country’s environment minister, Barbara Hendricks, said: “As long as risks are unaccountable or currently can’t be conclusively assessed, fracking will remain forbidden.”<sup>35</sup> The ban will likely make Germany even more dependent on imported natural gas. Germany imports 87 percent of the gas that it consumes,<sup>36</sup> of which 39 percent comes from Russia.<sup>37</sup> Europe’s increased reliance on imported natural gas is occurring at the same time the E.U. is increasing its dependence on gas-fired electricity. In 1990, the E.U. relied on gas for about 7 percent of its electricity needs; by 2013, that figure had more than doubled, to 15.5 percent.<sup>38</sup>

Gas-fired electricity is becoming more important in the E.U. because of its ability to ramp up and down quickly in response to the always-fluctuating output of renewable sources, such as wind and solar. Gas also provides a lower-carbon alternative to coal-fired electricity. That attribute matters as the E.U. attempts to reduce its carbon-dioxide emissions. Further, individual countries—including the three closely analyzed in this paper—are becoming more dependent on gas-fired electricity.

In the early 1990s, the U.K. imported very little gas and produced almost no electricity from gas-fired generators.<sup>39</sup> By 2013, it was importing half its gas and using gas-fired generation stations to produce nearly 27 percent of its electricity.<sup>40</sup> A similar trend can be seen in Germany. In 1990, Germany produced about 40 terawatt-hours of electricity from natural gas. That production amounted to about 7.3 percent of Germany's total electricity production.<sup>41</sup> By 2013, the amount of electricity generated from gas in Germany had increased by 70 percent, to 68.7 terawatt-hours, and gas-fired electricity's share of the country's production had increased to 10.8 percent.<sup>42</sup> Compared with the U.K. and Germany, Spain has seen the biggest increase in its reliance on gas-fired electricity. In 1990, Spain was producing just 1 percent of its electricity needs from gas. In 2013, Spain generated 57 terawatt-hours of electricity from gas, with the fuel providing 20 percent of the country's total electricity production.<sup>43</sup>

### **Declining Competitiveness**

High electricity prices are hampering the E.U.'s competitiveness (**Figure 4**). In 2013, the Center for European Policy Studies, a Brussels-based think tank, found that European steelmakers were paying twice as much for electricity and four times as much for natural gas as U.S. steel producers.<sup>44</sup> In January 2014, Germany's energy minister, Sigmar Gabriel, declared that his country had reached "the limit" with renewable-energy subsidies and that Germany had to reduce its electricity prices or risk "deindustrialization."<sup>45</sup>

The International Energy Agency (IEA) has also reported on the challenges facing Europe's industrial base. In a 2014 report, the agency warned that continued energy imports, along with expensive climate policies, will likely hurt European industry for the next two decades or more. The IEA predicted that the E.U.'s share of "the global export market for energy-intensive goods, especially for chemicals, is expected to fall (by around 10% across all energy-intensive goods, i.e., cement, chemicals, pulp and paper, iron and steel), more than Japan (-3%), while United States and emerging economies are expected to be able to increase their shares in the export markets."<sup>46</sup>

When the report was released, Fatih Birol, then the IEA's chief economist and now its executive director, said: "This is a new thing and it's structural. It's not a one-off."<sup>47</sup> He continued: "Europe didn't realize the seriousness of this competitive issue.... [Renewable-energy subsidies have] become a serious burden in some markets." Further, said Birol, "the high cost of imported energy is being all but

ignored." Birol's comments created a stir in Europe, where about 30 million people work in heavy industry, including sectors like iron, steel, and petrochemicals.<sup>48</sup>

In its 2014 report on Europe's energy situation, the IEA noted that Europe has significant gas-production potential but that "several member states have decided to ban exploration and production of shale gas, citing environmental concerns.... However, technology innovation and environmental performance are evolving with growing experience in North America which should be harnessed and shared across the European Union."<sup>49</sup>

The lack of indigenous natural gas production is saddling Europe with higher prices at the same time that U.S. gas production, thanks to the country's shale revolution, is rising. Increased production has meant lower prices for Americans. As **Figure 5** shows, the U.S. and Europe were paying similar prices for their natural gas during 1997–2008. But with the onset of the shale revolution, U.S. consumers began seeing dramatic reductions in price; by 2014, U.S. natural gas prices, as measured at the Henry Hub, were roughly half the prevailing prices in Europe.

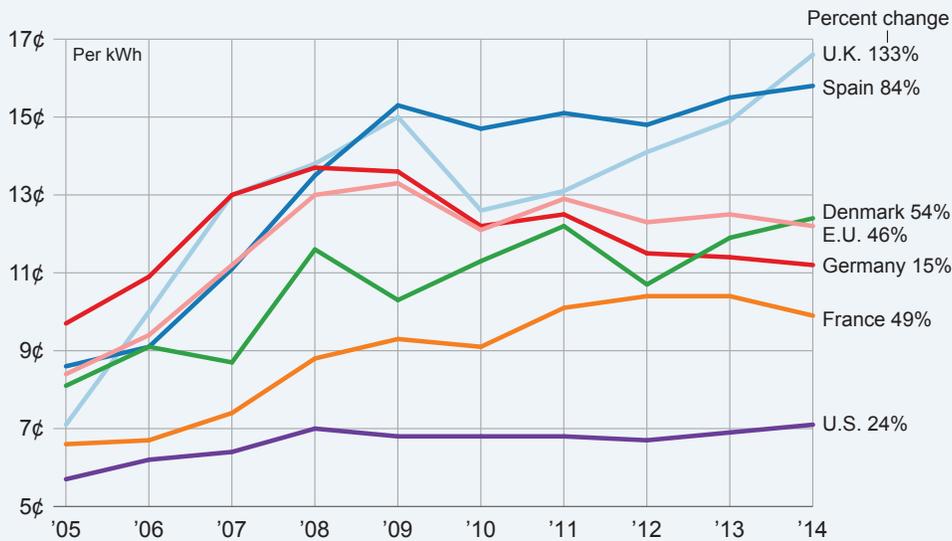
The shale revolution has also resulted in dramatic increases in U.S. oil production. That, in turn, has helped reduce America's overall reliance on imported energy. In 1995, the U.S. was importing about 20 percent of its total energy needs. By 2013, that figure had declined to 15 percent.<sup>51</sup> In 2015, the EIA estimated that total U.S. energy imports had fallen to about 11 percent. Further, the EIA projected that the U.S. could completely eliminate energy imports during 2020–30.<sup>52</sup>

## **V. How Significant Are the E.U.'s Emissions Reductions?**

In the wake of the climate-change talks in Paris that concluded in December 2015, there were many claims that the meeting, known as COP 21, was a milestone in global efforts to reduce carbon-dioxide emissions. The European Commission hailed the talks as yielding the "first-ever universal, legally binding global climate deal."<sup>53</sup> The United Nations secretary general, Ban Ki-moon, said: "For the first time, we have a truly universal agreement on climate change."<sup>54</sup> President Barack Obama declared that the Paris agreement "sends a powerful signal that the world is fully committed to a low-carbon future.... We've shown that the world has both

FIGURE 4.

### Industrial Electricity Prices, 2005–14



Sources: Eurostat, U.S. Energy Information Administration, Forex

FIGURE 5.

### Natural Gas Prices (USD per Million BTU)—U.S., Germany, U.K., and Japan, 1997–2014



Source: BP Statistical Review of World Energy 2015<sup>50</sup>

the will and the ability to take on this challenge.”<sup>55</sup>

The E.U. has reduced its carbon-dioxide emissions. During 2005–14, its emissions fell by about 19 percent, from 5.9 billion tons to 5.3 billion tons.<sup>56</sup> That reduction of 600 million tons is significant. But it is essential to put that reduction in context. Over that same period, the U.S., without a national mandate for renewable energy, decreased its emissions by 500 million tons per year. Further, the U.S. cut its per-capita emissions by about 1.6 tons, while the E.U. reduced its per-capita emissions by a smaller amount, 1.2 tons. Indeed, America’s per-capita reduction was greater than what occurred over the same period in France and Germany (Figure 6).

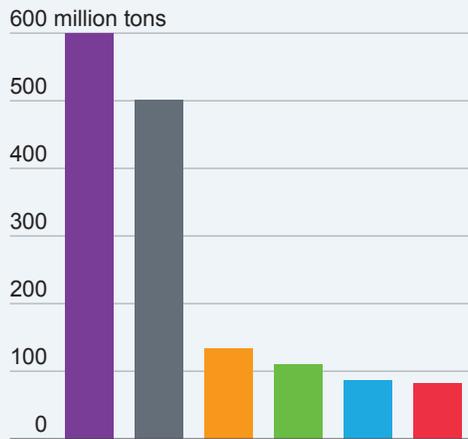
Given the recent Paris talks and the discussion about the need for lower-carbon forms of electricity generation, it’s essential to compare what occurred in the E.U. with what has been happening in the developing world. For instance, during 2005–14, India’s annual carbon-dioxide emissions increased by 908 million tons per year. China’s emissions increased by 3.4 billion tons per year. Two other rapidly developing countries, Indonesia and Brazil, saw their annual emissions increase by 190 million tons and 198 million tons, respectively.

FIGURE 6.

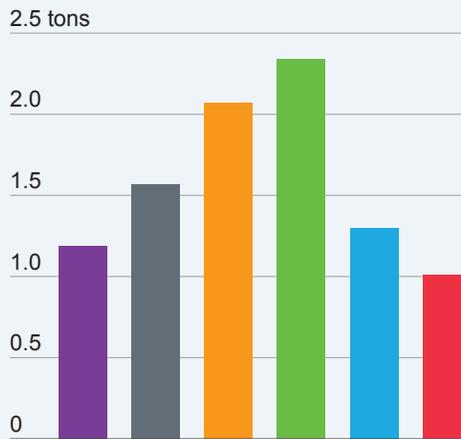
### Carbon-Dioxide Emissions, 2005–14

■ E.U. (pop. 503 million)   
 ■ U.S. (pop. 319 million)   
 ■ U.K. (pop. 64 million)  
■ Spain (pop. 47 million)   
 ■ France (pop. 66 million)   
 ■ Germany (pop. 81 million)

**Annual emissions reductions achieved, 2005–14**



**Annual per-capita emissions reductions achieved, 2005–14**



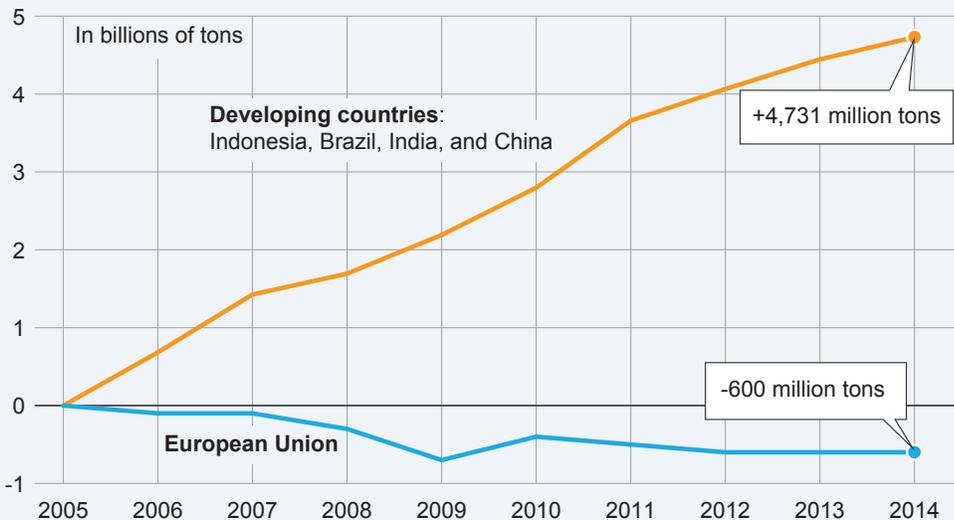
Sources: BP Statistical Review of World Energy 2015, Google

Together, the growth in carbon-dioxide emissions of those four developing countries totaled 4.7 billion tons per year: the increase in carbon-dioxide emissions from China, India, Indonesia, and Brazil was thus nearly *eight times* the reduction achieved in the E.U. during 2005–14 (Figure 7).

It should be noted, too, that economic growth in the E.U. has been substantially slower than that experienced in the U.S.—and slower economic growth usually results in slower growth in carbon-dioxide emissions. During 2004–14, GDP growth in the E.U. averaged 0.9 percent per year, far less than America’s 1.6 percent annual average over the same period. Growth was particularly sluggish in Spain, where GDP grew by just 0.6 percent per year, while annual growth in the U.K. (1.2 percent) and Germany (1.3 percent) was also slower than in the U.S.<sup>57</sup>

FIGURE 7.

### Change in Carbon-Dioxide Emissions, 2005–14



Sources: BP Statistical Review of World Energy 2015, PBL Netherlands Environmental Assessment Agency

## Renewable Subsidies: Buyers' Remorse

Surging electricity prices have led Germany, Spain, and the U.K. all to reduce their support for renewable energy. In December 2015, U.K. energy secretary Amber Rudd announced that the government was cutting the subsidies it provides to small-scale solar producers by 64 percent. Rudd said that “we have to get the balance right and I am clear that subsidies should be temporary, not part of a permanent business model.”<sup>58</sup> U.K. policymakers have also indicated that they are going to restrain the growth of wind energy. In mid-2015, the British government announced that it would eliminate subsidies for onshore wind projects beginning in April 2016. The result: more than 200 proposed wind projects will be canceled.<sup>59</sup> In addition, the government promised to give local communities more power to reject proposed wind projects. “We are reaching the limits of what is affordable and what the public is prepared to accept,”<sup>60</sup> added Rudd.

In 2011, after years of generous support, Spain began cutting subsidies for renewable-energy producers. The cuts were essential: at one time, the Spanish government was subsidizing solar energy at a rate that was 12 times the market price for electricity. During 2012–13, the country cut the subsidies even further.<sup>61</sup> In spite of the cuts, Spanish utilities ultimately accumulated a deficit of more than \$32 billion because they weren’t charging enough to cover the entire cost of subsidizing, producing, and transporting electricity. The result, according to David Robinson of the Oxford Institute for Energy Studies, was that the utilities had to pass the costs on to consumers. By 2015, the accumulated debt accounted “for about 55 percent of a typical customer’s electricity cost, with the remaining 45 percent associated with the wholesale price of energy.”<sup>62</sup>

The subsidy cuts effectively ended the growth of Spain’s renewable-energy sector. In 2014, the country’s wind capacity and solar capacity were essentially the same as they were in 2011.<sup>63</sup> Further, no new wind capacity was added in 2015, making it the first year since the 1980s that the Spanish wind sector failed to add new capacity.<sup>64</sup>

In mid-2014, German legislators cut subsidies for renewable energy, citing the high cost of electricity as a key reason.<sup>65</sup> The move reduced the subsidy for wind and solar by about 29 percent.<sup>66</sup>

## VI. Lessons for California and New York

California (38.8 million) and New York (19.7 million) are the first- and fourth-most populous states in the United States. The two states also contribute mightily to the U.S. economy. California has a gross state product of \$2.4 trillion, and New York’s gross state product is about \$1.4 trillion.<sup>67</sup> Thus, the two states account for about 18 percent of the U.S. population (about 319 million people) and about 22 percent of U.S. GDP (about \$17 trillion).

In addition to their size and economic clout, the two states have been in the vanguard of U.S. energy policy. Several energy policies being adopted by the two states—including lofty renewable-energy mandates and, in the case of New York, a ban on hydraulic fracturing—mimic the moves made in Germany, Spain, and the United Kingdom.

### **California**

In October 2015, for instance, California governor Jerry Brown signed into law a bill that requires the state’s electric utilities to get 50 percent of their power from renewables

by 2030.<sup>68</sup> While Brown and other Democratic politicians in California were pleased to increase the state’s renewable mandate (which had previously required the state’s electric utilities to get 33 percent of their energy from renewables by 2030), they remain eager to pass still more aggressive mandates.

In September 2015, by a margin of just two votes, the California Assembly narrowly rejected SB 32, a bill—pushed by the state’s Democratic leadership, including Brown, Senate president Kevin de Leon, and the state’s U.S. senators, Barbara Boxer and Dianne Feinstein<sup>69</sup>—that would have required California to achieve an 80 percent reduction in its carbon-dioxide emissions by 2050. While SB 32 failed, Brown has made it clear that he intends to continue pushing for the 80 percent reduction by 2050.<sup>70</sup>

In 2013, California officials signed a memorandum of understanding with Chinese officials, pledging to reduce the state’s greenhouse gas emissions by 80 percent below 1990

levels by 2050.<sup>71</sup> That memorandum of understanding, the Under 2 MOU, pledges signatories to commit to emissions standards that would limit annual carbon-dioxide emissions to two metric tons per capita by 2050<sup>72</sup>—a level of annual per-capita emissions equal to those of current-day residents of Vietnam.<sup>73</sup>

Today, California is getting about 20 percent of its electricity from non-hydro renewables.<sup>74</sup> Obtaining an additional 30 percent will require increased reliance on wind and solar energy. While it's not possible to know how expensive the renewable mandates will be, a 2009 analysis by the California Public Utilities Commission estimated that the state would have to spend about \$115 billion on new infrastructure to achieve a 33 percent renewable goal by 2020.<sup>75</sup> That amounts to about \$2,900 for each Californian.<sup>76</sup> With the latest renewable-energy mandate, those costs will likely increase significantly.

California residents already pay some of America's highest prices for electricity. In 2014, the average residential rate was 16.25 cents per kilowatt-hour—nearly twice the rate paid by residents of Washington State and nearly 30 percent more than the national average (about 12.5 cents).<sup>77</sup> Further, California's rate for commercial customers is about 45 percent more than the national average; the state's industrial customers pay about 73 percent more than the national average.<sup>78</sup>

Like Germany, California is shuttering its nuclear plants. In 2013, Southern California Edison closed the 2,254-megawatt San Onofre Nuclear Generating Station, located in San Diego County.<sup>79</sup> According to Lucas Davis, a professor at the University of California at Berkeley's Energy Institute, after the closure of the nuclear plant, the state had to rely on natural gas-fired generation facilities to meet demand. The result: California's carbon-dioxide emissions rose by 9 million tons in the first year after San Onofre was closed. The closure of San Onofre, noted Davis, was “the equivalent of putting 2 million cars on the road in terms of carbon dioxide impacts.”<sup>80</sup> In 2014, another energy analyst, James Conca, estimated that the closure of San Onofre cut California's low-carbon electricity production by 25 percent—“an amount greater than the production from all wind and solar in the state.”<sup>81</sup>

The only remaining commercial nuclear-energy facility in California is the 2,200-megawatt Diablo Canyon Power Plant, located in San Luis Obispo County, which produces about 9 percent of the state's electricity needs.<sup>82</sup> But antinuclear activists are pushing to close the plant. One group, San

Luis Obispo Mothers for Peace, has been pushing to close the project since 1973. The power plant's operating license is set to expire in 2025. Pacific Gas & Electric Co., which owns Diablo Canyon, is pursuing a 20-year extension to the operating license with the Nuclear Regulatory Commission.<sup>83</sup>

Closing the plant may also result in further increases in California's electricity prices. PG&E has said that Diablo Canyon generates electricity at a cost of 5–6 cents per kilowatt-hour. In 2014, the company paid about twice that much, an average of 10.1 cents per kilowatt-hour, to purchase electricity from other electricity producers. Given that Diablo Canyon is the largest power plant in California, closing it would likely mean that PG&E would have to replace that electricity with higher-cost electricity from gas-fired generators or renewable-energy producers.<sup>84</sup>

Attempting to replace Diablo Canyon with electricity produced from solar-energy projects could be particularly expensive. For instance, the electricity produced at Ivanpah, the solar-thermal project located in the Mojave Desert, is believed to cost at least 13.5 cents per kilowatt-hour—more than two times the cost of the electricity produced by the nuclear plant.<sup>85</sup> According to PG&E, Diablo Canyon produces about 18,000 gigawatt-hours of electricity per year.<sup>86</sup> Therefore, solar-generated electricity, such as that from Ivanpah, will cost 7 cents per kilowatt-hour more than the electricity produced at Diablo Canyon. Under that scenario, replacing Diablo Canyon with solar electricity could increase the cost to California ratepayers by about \$1.26 billion per year.<sup>87</sup>

### **New York**

Like California, New York has some of America's highest electricity costs. In 2014, state residents paid an average of 20 cents per kilowatt-hour for electricity—about 60 percent more than the national average. The state also has commercial electricity prices that are far higher (about 50 percent) than the U.S. average. (New York's rate for industrial electricity, 6.58 cents per kilowatt-hour, is slightly below the national average.)

Despite those high rates, in December 2015, New York governor Andrew Cuomo directed the state's Department of Public Service to “design and enact a new Clean Energy Standard mandating that 50 percent of all electricity consumed in New York by 2030 result from clean and renewable energy sources.”<sup>88</sup> Cuomo said that the move was required because “climate change is one of the defining issues of our time, and we must act now.”

In his letter to the Department of Public Service, Cuomo said that the push for increased renewable-energy use will help “achieve our environmental objective of reducing carbon emissions by 40 percent by 2030. This plan is both rational and among the most aggressive in the nation.”<sup>89</sup> At the same time that Cuomo is pushing for more renewable energy, he has also banned hydraulic fracturing. In mid-2015, after a de facto ban had been in place for seven years, New York regulators officially banned the process.<sup>90</sup> The ban effectively prevents development of natural gas in the state, even though shale deposits in New York may contain as much as 7.1 trillion cubic feet of gas.<sup>91</sup>

New York, which generates about 29 percent of its electricity from nuclear energy, is also shuttering significant amounts of its nuclear-generation capacity.<sup>92</sup> In November, Entergy Corporation announced it would close its 838-megawatt<sup>93</sup> FitzPatrick Nuclear Power Plant in Oswego, New York, by early 2017.<sup>94</sup> Entergy’s announcement was denounced by Cuomo, who said that New York officials would “pursue every legal and regulatory avenue in an attempt to stop Entergy’s actions and its callous disregard for their skilled and loyal work force.”<sup>95</sup> While Cuomo opposes the closing of the FitzPatrick facility, he is eagerly pushing for the closure of New York’s biggest nuclear power plant, the 2,069-megawatt Indian Point Energy Center,<sup>96</sup> located in Westchester County.<sup>97</sup>

Indian Point provides up to one-fourth of New York City’s electricity and is an essential generation asset during the summer months. Like their counterparts in California, local environmental groups are pushing to close all of New York’s nuclear plants. A coalition of environmental groups, the Alliance for a Green Economy, is pushing for a “carbon-free, nuclear-free energy system in New York.”<sup>98</sup> Members of the group include the Sierra Club and Citizen Action.<sup>99</sup>

Although closing Indian Point might cheer some antinuclear activists, it would be expensive for consumers. In a 2012 report for the Manhattan Institute, Jonathan Lesser, president of Continental Economics, a consulting firm, estimated that closing the twin-reactor facility would

increase electricity costs in New York State by as much as \$2.2 billion per year during 2016–30.<sup>100</sup> California and New York’s carbon-dioxide emissions must be seen in a global context, too. Together, the two states emit about 510 million tons per year<sup>101</sup>—equal to about 8.5 percent of U.S. emissions (6 billion tons in 2014) and about 1.4 percent of global emissions (35.5 billion tons in 2014).<sup>102</sup>

## VII. Conclusion

Europe’s energy-policy lessons are easily deduced: while renewable energy may be politically fashionable, it imposes real costs on consumers and industry. Policymakers from California to New York would do well to heed the warnings provided in the 2014 report by the Swiss firm Finadvice: “[T]he lessons learned in Europe prove that the large-scale integration of renewable power does not provide net savings to consumers, but rather a net increase in costs to consumers and other stakeholders.... [L]arge-scale integration of renewables into the power system ultimately leads to disequilibrium in the power markets, as well as value destruction to both renewable companies and utilities, and their respective investors.”<sup>103</sup>

To avoid the kinds of mistakes seen in Europe, U.S. policymakers should be required to do rigorous cost-benefit analyses before imposing renewable-energy mandates and carbon-dioxide emissions reductions on consumers and industrial facilities. Those cost-benefit analyses must include estimates of the total cost of the mandates, as well as estimates of the effect that the resulting emissions-reductions efforts will have on global carbon-dioxide emissions—and, therefore, on projected future global temperatures.

Finally, U.S. policymakers must keep their efforts to reduce carbon dioxide in global perspective. Reductions made in the E.U. and the U.S. cannot stop the growth of emissions in the developing world: renewable mandates may simply end up costing consumers a lot of money while doing effectively nothing for the global climate.

# Endnotes

- <sup>1</sup> See [http://www.nytimes.com/2015/05/06/opinion/thomas-friedman-germany-the-green-superpower.html?\\_r=2](http://www.nytimes.com/2015/05/06/opinion/thomas-friedman-germany-the-green-superpower.html?_r=2).
- <sup>2</sup> See <http://www.nybooks.com/articles/2014/07/10/climate-will-we-lose-endgame>.
- <sup>3</sup> See [http://blog.rmi.org/blog\\_2013\\_04\\_17\\_germanys\\_renewables\\_revolution](http://blog.rmi.org/blog_2013_04_17_germanys_renewables_revolution).
- <sup>4</sup> See <http://thinkprogress.org/climate/2015/04/02/3642093/spain-renewable-energy-march>.
- <sup>5</sup> CBSNews.com, "Transcript: Obama's Earth Day Speech," April 22, 2009. <http://www.cbsnews.com/blogs/2009/04/22/politics/politicalhotsheet/entry4962412.shtml>.
- <sup>6</sup> See <http://statisticstimes.com/economy/european-countries-by-gdp.php>.
- <sup>7</sup> See [http://ec.europa.eu/clima/policies/strategies/2020/index\\_en.htm](http://ec.europa.eu/clima/policies/strategies/2020/index_en.htm).
- <sup>8</sup> See <https://ec.europa.eu/energy/en/topics/energy-strategy/2050-energy-strategy>.
- <sup>9</sup> See [https://ec.europa.eu/energy/sites/ener/files/documents/2012\\_energy\\_roadmap\\_2050\\_en\\_0.pdf](https://ec.europa.eu/energy/sites/ener/files/documents/2012_energy_roadmap_2050_en_0.pdf). This document puts the cost of the "cumulative grid investment costs" at 1.5 to 2.2 trillion euros. At a valuation of 1 euro to 1.07 dollars, the 2.2 trillion euros amounts to 2.37 trillion U.S. dollars.
- <sup>10</sup> This figure uses an exchange rate of \$1.07 per euro.
- <sup>11</sup> See [https://ec.europa.eu/energy/sites/ener/files/documents/ECOFYS%202014%20Subsidies%20and%20costs%20of%20EU%20energy\\_11\\_Nov.pdf](https://ec.europa.eu/energy/sites/ener/files/documents/ECOFYS%202014%20Subsidies%20and%20costs%20of%20EU%20energy_11_Nov.pdf), p. iii.
- <sup>12</sup> *Ibid.*, p. 21.
- <sup>13</sup> *Ibid.*, p. 23.
- <sup>14</sup> *Ibid.*, p. 26.
- <sup>15</sup> See [https://www.eia.gov/electricity/data/state/generation\\_monthly.xlsx](https://www.eia.gov/electricity/data/state/generation_monthly.xlsx).
- <sup>16</sup> World Bank, <http://data.worldbank.org/indicator/NY.GDP.MKTP.CD>.
- <sup>17</sup> Germany's population is 80.9 million; the U.K.'s, 64.5 million; and Spain's, 46.4 million. See <http://data.worldbank.org/indicator/SP.POP.TOTL>. In 2014, E.U.-wide CO<sub>2</sub> emissions totaled 5.3 gigatons—of which Germany produced about 800 million tons; the U.K., about 471 million tons; and Spain, about 286 million tons.
- <sup>18</sup> See <http://www.ft.com/intl/cms/s/0/03486cb0-3587-11e3-b539-00144feab7de.html>.
- <sup>19</sup> See <http://www.politico.eu/article/the-good-green-german-gets-sticker-shock>.
- <sup>20</sup> See <http://www.eia.gov/todayinenergy/detail.cfm?id=13151>.
- <sup>21</sup> See <http://www.bbc.co.uk/news/world-europe-13592208>.
- <sup>22</sup> In 2014, Germany produced 34.9 TWh of electricity from solar. Global production was 185.9 TWh. See BP Statistical Review of World Energy 2015.
- <sup>23</sup> *Ibid.*
- <sup>24</sup> Eurostat, <http://ec.europa.eu/eurostat/web/energy/data/main-tables>.
- <sup>25</sup> See <http://www.theguardian.com/environment/2015/nov/02/germanys-planned-nuclear-switch-off-drives-energy-innovation>.
- <sup>26</sup> BP Statistical Review of World Energy 2015.
- <sup>27</sup> See [https://www.gov.uk/government/uploads/system/uploads/attachment\\_data/file/414241/20150319\\_Progress\\_to\\_emissions\\_reductions\\_targets\\_final.pdf](https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/414241/20150319_Progress_to_emissions_reductions_targets_final.pdf).
- <sup>28</sup> BP Statistical Review of World Energy 2015.
- <sup>29</sup> See [http://www.finadvice.ch/files/germany\\_lessonslearned\\_final\\_071014.pdf](http://www.finadvice.ch/files/germany_lessonslearned_final_071014.pdf).
- <sup>30</sup> *Ibid.*, p. 33.
- <sup>31</sup> See [https://ec.europa.eu/energy/sites/ener/files/documents/PocketBook\\_ENERGY\\_2015%20PDF%20final.pdf](https://ec.europa.eu/energy/sites/ener/files/documents/PocketBook_ENERGY_2015%20PDF%20final.pdf), p. 22.
- <sup>32</sup> See <http://www.onegreenplanet.org/environment/countries-except-united-states-that-have-banned-fracking>.
- <sup>33</sup> E.U. Energy in Figures, Statistical Pocketbook 2015, [https://ec.europa.eu/energy/sites/ener/files/documents/PocketBook\\_ENERGY\\_2015%20PDF%20final.pdf](https://ec.europa.eu/energy/sites/ener/files/documents/PocketBook_ENERGY_2015%20PDF%20final.pdf), p. 72.
- <sup>34</sup> *Ibid.*, p. 24.
- <sup>35</sup> See <http://www.wsj.com/articles/german-cabinet-approves-anti-fracking-draft-law-1427896555>.
- <sup>36</sup> E.U. Energy in Figures, Statistical Pocketbook 2015. [https://ec.europa.eu/energy/sites/ener/files/documents/PocketBook\\_ENERGY\\_2015%20PDF%20final.pdf](https://ec.europa.eu/energy/sites/ener/files/documents/PocketBook_ENERGY_2015%20PDF%20final.pdf), p. 72.
- <sup>37</sup> See <http://www.wsj.com/articles/german-cabinet-approves-anti-fracking-draft-law-1427896555>.
- <sup>38</sup> See [http://ec.europa.eu/eurostat/statistics-explained/index.php/File:T1Gross\\_electricity\\_generation\\_by\\_fuel,\\_GWh,\\_EU-28,\\_1990-2013.png](http://ec.europa.eu/eurostat/statistics-explained/index.php/File:T1Gross_electricity_generation_by_fuel,_GWh,_EU-28,_1990-2013.png).
- <sup>39</sup> See <http://euanmearns.com/uk-electricity-generation-statistics-1920-2012>.
- <sup>40</sup> See [https://www.gov.uk/government/uploads/system/uploads/attachment\\_data/file/487838/Electricity.pdf](https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/487838/Electricity.pdf).
- <sup>41</sup> See <http://www.iea.org/statistics/statisticssearch/report/?country=GERMANY&product=electricityandheat&year=1990>.
- <sup>42</sup> See <http://www.iea.org/statistics/statisticssearch/report/?year=2013&country=GERMANY&product=ElectricityandHeat>.

- <sup>43</sup> See <http://www.iea.org/statistics/statisticssearch/report/?country=SPAIN&product=electricityandheat&year=2013>.
- <sup>44</sup> See <http://www.energypost.eu/climate-policy-bumps-competitiveness-europe>.
- <sup>45</sup> See <http://www.bloomberg.com/news/articles/2014-01-21/eu-must-get-grip-on-energy-costs-or-risk-deindustrialization->.
- <sup>46</sup> See <https://www.iea.org/Textbase/npsum/EU2014SUM.pdf>, p. 6.
- <sup>47</sup> See <http://www.ft.com/cms/s/0/80950dfe-8901-11e3-9f48-00144feab7de.html#axzz41aHoaGna>.
- <sup>48</sup> See <http://www.ft.com/intl/cms/s/0/80950dfe-8901-11e3-9f48-00144feab7de.html?siteedition=intl#axzz3wslgbLcc>.
- <sup>49</sup> See <https://www.iea.org/Textbase/npsum/EU2014SUM.pdf>, p. 8.
- <sup>50</sup> See <http://www.bp.com/en/global/corporate/energy-economics/statistical-review-of-world-energy/natural-gas-review-by-energy-type/natural-gas-prices.html>.
- <sup>51</sup> See <http://data.worldbank.org/indicator/EG.IMP.CON.S.ZS?page=4>.
- <sup>52</sup> See <https://www.eia.gov/todayinenergy/detail.cfm?id=20812>.
- <sup>53</sup> See [http://ec.europa.eu/clima/policies/international/negotiations/future/index\\_en.htm](http://ec.europa.eu/clima/policies/international/negotiations/future/index_en.htm).
- <sup>54</sup> See [http://www.nytimes.com/2015/12/13/world/europe/climate-change-accord-paris.html?\\_r=0](http://www.nytimes.com/2015/12/13/world/europe/climate-change-accord-paris.html?_r=0).
- <sup>55</sup> Ibid.
- <sup>56</sup> Netherlands Environmental Assessment Agency, "Trends in Global CO2 Emissions Report," 2015, [http://www.pbl.nl/sites/default/files/cms/publicaties/pbl-2015-trends-in-global-co2-emissions\\_2015-report\\_01803.pdf](http://www.pbl.nl/sites/default/files/cms/publicaties/pbl-2015-trends-in-global-co2-emissions_2015-report_01803.pdf), Table 2.3.
- <sup>57</sup> See [http://ec.europa.eu/eurostat/statistics-explained/images/2/2c/Real\\_GDP\\_growth%2C\\_2004-14\\_%28%25\\_change\\_compared\\_with\\_the\\_previous\\_year%3B\\_average\\_2004-14%29\\_YB15.png](http://ec.europa.eu/eurostat/statistics-explained/images/2/2c/Real_GDP_growth%2C_2004-14_%28%25_change_compared_with_the_previous_year%3B_average_2004-14%29_YB15.png).
- <sup>58</sup> See <http://www.bbc.com/news/business-35119173>.
- <sup>59</sup> See <http://www.bbc.com/news/uk-politics-33227489>.
- <sup>60</sup> See <http://www.express.co.uk/news/uk/586219/Windfarms-cuts-taxpayer-subsidies-axed>.
- <sup>61</sup> See <http://www.economist.com/news/business/21582018-sustainable-energy-meets-unsustainable-costs-cost-del-sol>.
- <sup>62</sup> See <http://www.renewableenergyworld.com/articles/print/volume-18/issue-4/features/solar/is-the-spanish-government-putting-the-brakes-on-solar-pv.html>.
- <sup>63</sup> BP Statistical Review of World Energy 2015.
- <sup>64</sup> See <http://www.bloomberg.com/news/articles/2016-01-26/spain-installed-no-wind-power-for-first-time-since-80s-in-2015>.
- <sup>65</sup> See <http://www.thelocal.de/20140627/german-mps-cut-green-energy-subsidies>.
- <sup>66</sup> See <http://www.wsj.com/articles/SB10001424052702304632204579336220103661350>.
- <sup>67</sup> See [https://en.wikipedia.org/wiki/List\\_of\\_U.S.\\_states\\_by\\_GDP](https://en.wikipedia.org/wiki/List_of_U.S._states_by_GDP).
- <sup>68</sup> See <http://www.windpowermonthly.com/article/1363977/california-sets-50-renewable-energy-target>.
- <sup>69</sup> See <http://www.sfchronicle.com/opinion/editorials/article/California-Legislature-fails-us-on-climate-change-6499384.php>.
- <sup>70</sup> See <https://www.gov.ca.gov/news.php?id=18938>.
- <sup>71</sup> See <http://www.csmonitor.com/USA/Politics/2015/1007/Another-day-another-landmark-bill-signing-for-California-governor-video>.
- <sup>72</sup> See <http://www.calepa.ca.gov/Climate>.
- <sup>73</sup> See <http://data.worldbank.org/indicator/EN.ATM.CO2E.PC>.
- <sup>74</sup> See [http://energyalmanac.ca.gov/electricity/total\\_system\\_power.html](http://energyalmanac.ca.gov/electricity/total_system_power.html).
- <sup>75</sup> See <http://www.cpuc.ca.gov/NR/rdonlyres/B123F7A9-17BD-461E-AC34-973B906CAE8E/0/ExecutiveSummary33percentRPSImplementationAnalysis.pdf>.
- <sup>76</sup> California has about 39 million residents. See <http://www.census.gov/search-results.html?q=california+population&search.x=0&search.y=0&search=submit&page=1&stateGeo=none&utf8=%26%2310003%3B&affiliate=census>.
- <sup>77</sup> See [http://www.eia.gov/electricity/sales\\_revenue\\_price/pdf/table4.pdf](http://www.eia.gov/electricity/sales_revenue_price/pdf/table4.pdf).
- <sup>78</sup> EIA data for 2014. See [http://www.eia.gov/electricity/sales\\_revenue\\_price/pdf/table4.pdf](http://www.eia.gov/electricity/sales_revenue_price/pdf/table4.pdf). California's commercial rate was 15.62 cents per kilowatt-hour, and its industrial rate was 12.34. The national rates were 10.74 and 7.12, respectively.
- <sup>79</sup> See <http://www.latimes.com/business/la-fi-consumer-advocate-settlement-20150810-story.html>.
- <sup>80</sup> See <http://www.sandiegouniontribune.com/news/2015/nov/09/nuclear-retirements-challenge-san-onofre>.
- <sup>81</sup> See <http://www.forbes.com/sites/jamesconca/2014/10/02/are-california-carbon-goals-kaput/#2715e4857a0b3675cd7461da>.
- <sup>82</sup> See [https://en.wikipedia.org/wiki/Diablo\\_Canyon\\_Power\\_Plant](https://en.wikipedia.org/wiki/Diablo_Canyon_Power_Plant).
- <sup>83</sup> See <http://www.sfgate.com/bayarea/article/Feds-to-decide-whether-state-s-last-nuclear-6371664.php>.
- <sup>84</sup> See <http://www.sfchronicle.com/business/article/Nuclear-power-s-last-stand-in-California-Will-6630933.php>.
- <sup>85</sup> See <http://www.greentechmedia.com/articles/read/Ivanpah-Worlds-Biggest-Solar-Power-Tower-Project-Goes-Online>.

- <sup>86</sup> See [https://www.pge.com/includes/docs/pdfs/shared/edusafety/systemworks/dcpp/PGE\\_Economic\\_Impact\\_Report\\_Final.pdf](https://www.pge.com/includes/docs/pdfs/shared/edusafety/systemworks/dcpp/PGE_Economic_Impact_Report_Final.pdf), p. 10.
- <sup>87</sup> 18,000 gigawatt-hours is equal to 18 billion kilowatt-hours. See <http://www.convertunits.com/from/gigawatt+hour/to/kilowatt-hours>. Therefore, \$0.07 x 18 billion = \$1.26 billion.
- <sup>88</sup> See <https://www.governor.ny.gov/news/governor-cuomo-directs-department-public-service-begin-process-enact-clean-energy-standard>.
- <sup>89</sup> See [https://www.governor.ny.gov/sites/governor.ny.gov/files/atoms/files/Renewable\\_Energy\\_Letter.pdf](https://www.governor.ny.gov/sites/governor.ny.gov/files/atoms/files/Renewable_Energy_Letter.pdf).
- <sup>90</sup> See [http://www.syracuse.com/news/index.ssf/2015/06/new\\_york\\_officially\\_bans\\_hydrofracking.html](http://www.syracuse.com/news/index.ssf/2015/06/new_york_officially_bans_hydrofracking.html).
- <sup>91</sup> See [http://www.dec.ny.gov/docs/materials\\_minerals\\_pdf/nyserda4.pdf](http://www.dec.ny.gov/docs/materials_minerals_pdf/nyserda4.pdf).
- <sup>92</sup> EIA; see <http://www.eia.gov/state/?sid=NY#tabs-4>.
- <sup>93</sup> See [http://www.entergy-nuclear.com/plant\\_information/fitzpatrick.aspx](http://www.entergy-nuclear.com/plant_information/fitzpatrick.aspx).
- <sup>94</sup> See [http://www.syracuse.com/politics/index.ssf/2015/11/schumer\\_fitpatrick\\_nuclear\\_plant\\_closing\\_will\\_harm\\_ny\\_power\\_reliabilty.html](http://www.syracuse.com/politics/index.ssf/2015/11/schumer_fitpatrick_nuclear_plant_closing_will_harm_ny_power_reliabilty.html).
- <sup>95</sup> See [http://www.nytimes.com/2015/11/03/nyregion/entergy-to-close-nuclear-plant-on-lake-ontario-angering-cuomo.html?\\_r=0](http://www.nytimes.com/2015/11/03/nyregion/entergy-to-close-nuclear-plant-on-lake-ontario-angering-cuomo.html?_r=0).
- <sup>96</sup> See [http://www.entergy-nuclear.com/plant\\_information/indian\\_point.aspx](http://www.entergy-nuclear.com/plant_information/indian_point.aspx).
- <sup>97</sup> See <http://www.capitalnewyork.com/article/albany/2015/10/8581199/cuomo-cautions-against-comparing-indian-point-and-fitpatrick-nuclear>.
- <sup>98</sup> See <http://allianceforagreeneconomy.org/content/carbon-free-nuclear-free-pledge>.
- <sup>99</sup> See <http://www.allianceforagreeneconomy.org/about>.
- <sup>100</sup> See <https://www.manhattan-institute.org/html/economic-impacts-closing-and-replacing-indian-point-energy-center-5988.html>.
- <sup>101</sup> See <http://www.eia.gov/state/rankings/?sid=CA#series/226>. In 2013, California's emissions were 353 million tons; New York's, 160 million tons.
- <sup>102</sup> BP Statistical Review of World Energy 2015.
- <sup>103</sup> See [http://www.finadvice.ch/files/germany\\_lessonslearned\\_final\\_071014.pdf](http://www.finadvice.ch/files/germany_lessonslearned_final_071014.pdf), p. 59.



## Abstract

Since 2005, members of the European Union have aggressively pushed policies aimed at addressing climate change. These policies have resulted in dramatic increases in electricity costs for residential and industrial consumers.

## Key Findings

1. Between 2005, when the E.U. adopted its Emissions Trading Scheme, and 2014, residential electricity rates in the E.U. increased by 63 percent, on average; over the same period, residential rates in the U.S. rose by 32 percent.
2. E.U. countries that have intervened the most in their energy markets—Germany, Spain, and the U.K.—have seen their electricity costs increase the fastest.
3. Emissions reductions achieved by the E.U. since 2005 have been greatly exceeded by increases in emissions in the developing world: during 2005–14, the E.U. reduced its carbon-dioxide emissions by 600 million tons per year; over that same period, the combined emissions of four developing countries—China, India, Indonesia, and Brazil—increased by 4.7 billion tons per year, or nearly eight times the reduction achieved in the European Union.