

Renewables Are Driving up Electricity Prices **WAIT, WHAT?**

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Executive Summary

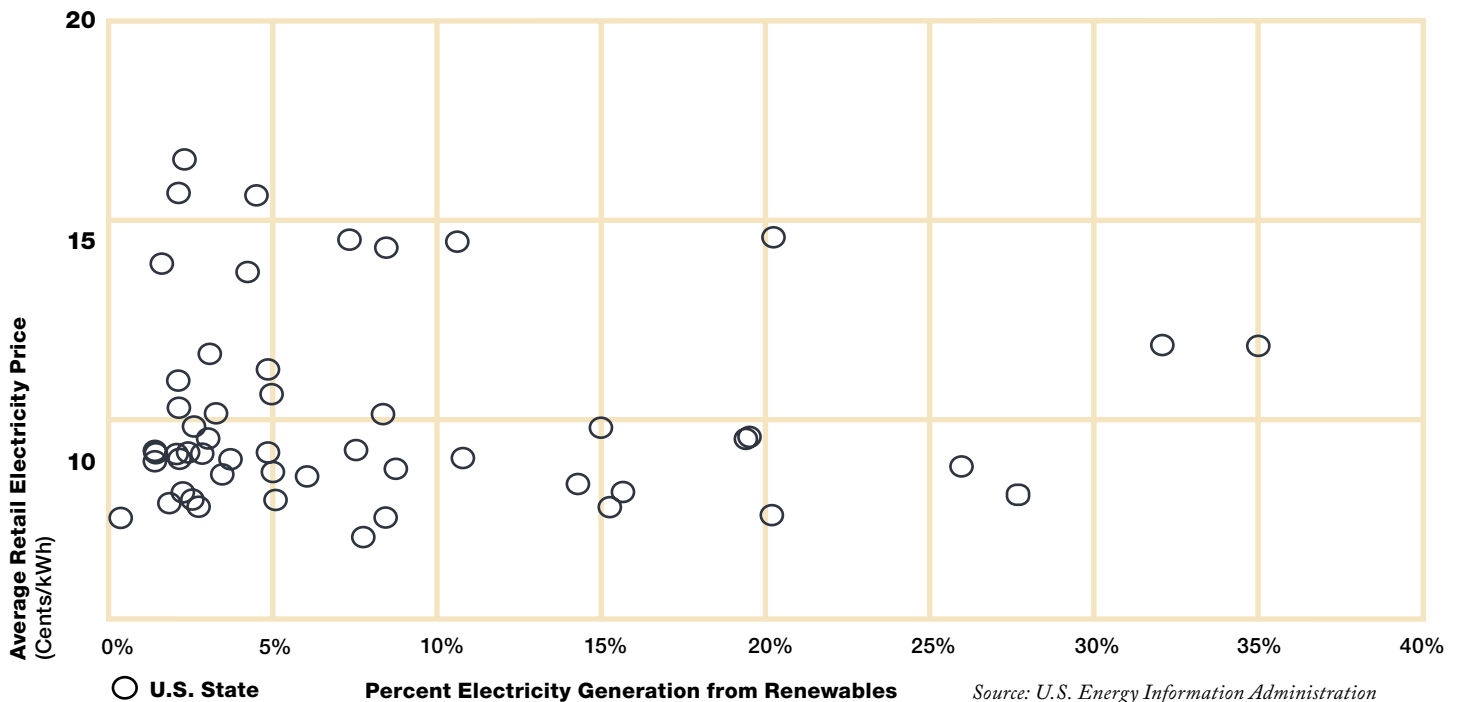
Has increased reliance on renewable energy in the United States meant expensive electricity in the United States? This question has pervaded debates on renewables and fossil fuels, and this paper sheds light on this critical issue, including a look at the top and bottom 10 renewable states. Determination of the top 10 and bottom 10 states here is based on share of total electricity generated from all renewable sources. The top 10, therefore, includes states like South Dakota, which has significant wind generation, as well as states like California, which has significant solar generation. It reveals that states with the greatest share of electricity generation from renewable sources

have often experienced average retail electricity prices that are cheaper than both the national average and also states with the smallest share of electricity generation from renewable sources.

In 2013, U.S. states generated electricity from renewable sources at a variety of different levels. And yet, as the graph below demonstrates, greater generation from renewables did not mean skyrocketing electricity prices. In fact, states generating more electricity from renewables often experienced average retail electricity prices well below states producing less electricity from renewables.

No Cause for Alarm:

Electricity Prices in States Across the Renewable Generation Spectrum



Average retail electricity price represents an average of residential, commercial, and industrial electricity prices.

A similar trend has emerged over time. In 2001, in the ten states with the greatest share of electricity from renewable sources, retail electricity prices, on average, were slightly more expensive than in the ten states with the smallest share of electricity from renewable sources. However, by 2013, these states had switched places: the

ten states relying most on renewables experienced average retail electricity prices slightly cheaper than the ten states relying least on renewables. The graph on the following page depicts this trend. In addition, electricity prices in leading renewable states also fared better in terms of rates of change. Between 2002 and 2013,

the average annual rate of change in retail electricity prices was less in states that led on renewables, as depicted in the second chart below.

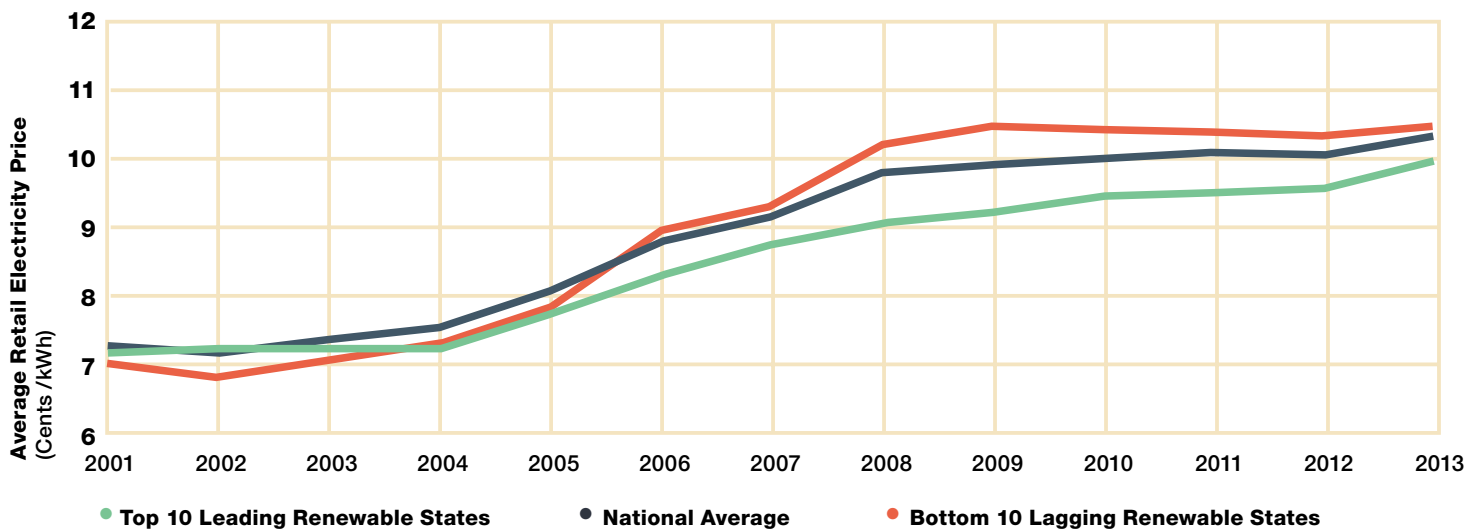
This analysis draws no direct correlation or causation between renewable generation and average retail electricity prices, yet it indicates that states leading on renewables have not experienced

disproportionate electricity price growth, as some critics have implied.

Looking forward, the electricity market remains ripe for fundamental change. Key economic drivers of this change include the falling cost of renewables, mounting economic benefits from clean energy, and growing uncertainty for carbon-based fuels.

Renewable Leaders and Laggards:*

Average Retail Electricity Prices 2001 - 2013



● Top 10 Leading Renewable States

● National Average

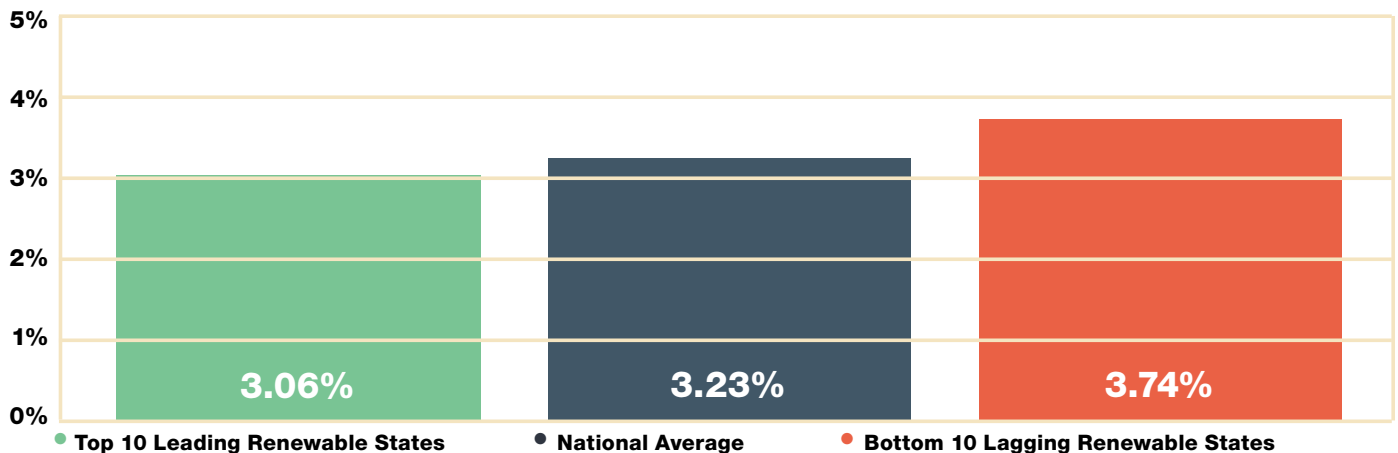
● Bottom 10 Lagging Renewable States

Source: U.S. Energy Information Administration

* The Top 10 Renewable States have experienced low retail prices for a variety of reasons, including, in many cases, abundant wind resources.

Renewable Leaders and Laggards:

Average Annual Increases in Retail Electricity Prices 2002 - 2013



● Top 10 Leading Renewable States

● National Average

● Bottom 10 Lagging Renewable States

Source: U.S. Energy Information Administration

Introduction

States across the country have hit the accelerator on clean energy. Deployments of clean and renewable sources of energy are taking off at breakneck speed, and represent a growing percentage of new U.S. electricity generation capacity. In 2013, U.S. electricity generation capacity increased 15,886 megawatts (MW).¹ Wind and solar supplied 35 percent of this increase, while natural gas and coal provided 56 percent. In 2014, U.S. electricity generation capacity increased 15,384 MW. The share of wind and solar additions grew to 47 percent of new capacity, while the share of natural gas and coal fell to 49 percent.

Reliance on renewables will continue to grow as their costs decline, and as states shift away from a fossil fuels focus and move towards a cleaner energy future.

And yet, growing reliance on clean energy has met criticism and concern that renewables are costing consumers dearly in their electricity bills. Fears are alive that electricity prices are shooting through the roof as clean energy takes off. Americans for Prosperity, a group backed by the Koch brothers, stated that clean electricity generation, and in particular policies that support it, amount to an “attack on any state’s economy. Not only does it take more money from consumers, but it also keeps businesses from expanding and creating jobs.”³ Rooftop solar, according to one California legislator, “is becoming a significant burden to both utilities and consumers.”⁴ And in Arizona, the utility Arizona Public Service (APS) reportedly “spent more than \$3.7 million to convince the public that homeowners using solar panels are costing other customers money.”⁵

Much of this fire has been trained on two programs: Renewable Portfolio Standards (RPS) and net energy metering (NEM) programs. Nearly 30 states have adopted an RPS, which requires production of a certain percentage of overall electricity from renewable sources. One Los Angeles Times report characterized RPS programs as a “[problem] confronting the electricity system.”⁶ According to the same Americans for Prosperity analyst, RPS policies amount to “gouging job creators and American families with higher electricity bills.”⁷

Like RPS, net energy metering (NEM) programs have also borne criticism. NEM initiatives compensate customers who have photovoltaic installations by allowing them to provide their excess electricity to the grid, and by counting this excess generation against consumption at other times.⁸ Colorado’s Xcel Energy proposed reducing NEM reimbursements to rooftop solar customers because, in their view, such payments provided “an unfair subsidy to solar users.”⁹ Similarly, many states have proposed charging solar use fees or taxing NEM. In Utah, Rocky Mountain Power proposed a \$4.65 per month surcharge to customers with distributed solar.¹⁰ (In response, the Utah PUC denied the request, stating, “Simply using less energy than average, but about the same amount as the most typical of PacifiCorp’s residential customers, is not sufficient justification for imposing a charge...”). Taken together, these assessments can create the impression of increasing renewable energy and skyrocketing electricity prices. Yet the data in recent years lack such alarming trends. In fact, states relying more on renewable generation have experienced retail electricity prices comparable to, or cheaper than, states relying less on renewable generation.

Methodology

This paper assesses state-level trends in average retail electricity prices and generation from renewable sources.¹¹ By comparing states' percent of electricity generated from renewables and their average retail electricity prices, the analysis sheds light on whether states with more generation from renewables have also experienced the highest electricity prices. The analysis focuses on generation because it reveals how electricity is produced within the state. The paper uses neither in-state capacity, which may include facilities that lay idle for part or much of their lives, nor consumption, which may include electricity imported from other states, as a basis for analysis.

Generation data is drawn from multiple sources. Utility-scale generation data is sourced from the U.S. Energy Information Administration (EIA).¹² Distributed solar generation data is sourced from the Interstate Renewable Energy Council (IREC) and the Solar Energy Industries Association (SEIA).

Average retail electricity rates are also drawn from the EIA. These rates represent an average of residential, commercial, and industrial electricity prices. Consequently, the average retail rate reflects impacts across the U.S. economy.

This approach recognizes the complexity of electricity pricing. The generation mix represents one among many factors that impact retail electricity prices. The range of factors include fuel costs (particularly for fossil fuels), power plant construction and operation costs, transmission and distribution lines, the weather (extreme heat or cold may increase demand), regulation (electricity markets may be regulated, deregulated, or partially deregulated), and rate design.¹³ In addition, many states may export the electricity they produce.

Therefore, this paper assesses the question of whether states with more renewables have also had higher electricity prices – without attempting to draw a direct correlation or causation between renewable generation and retail prices. The answer to this question, explained further below, is that states with greater reliance on renewables have not experienced dramatically higher retail electricity prices. This conclusion calls into question a prominent criticism of renewable energy. The analysis does not explain in detail the array of potential causes of this phenomenon, and it does not address the counterfactual question of how electricity prices might have reacted if leading renewable states had relied instead on fossil fuels.

The analysis is broken into two sections. The first section reviews electricity prices in states leading the way in renewable generation, defined in terms of their share of electricity generated from utility-scale and distributed renewable sources. Leading renewable states' prices are compared to national averages and to states lagging in renewable generation.¹⁴ Next, the analysis addresses the concern that Renewable Portfolio Standard (RPS) adoption has proven tantamount to electricity price increases. "RPS States" are defined here as states with mandatory RPS in place. States with voluntary RPS are excluded because their policies are non-binding.

The paper concludes with an analysis of trends reshaping the electricity sector. This analysis emphasizes the partial but significant impact of the generation mix, and renewables in particular, on prices.

Analysis:

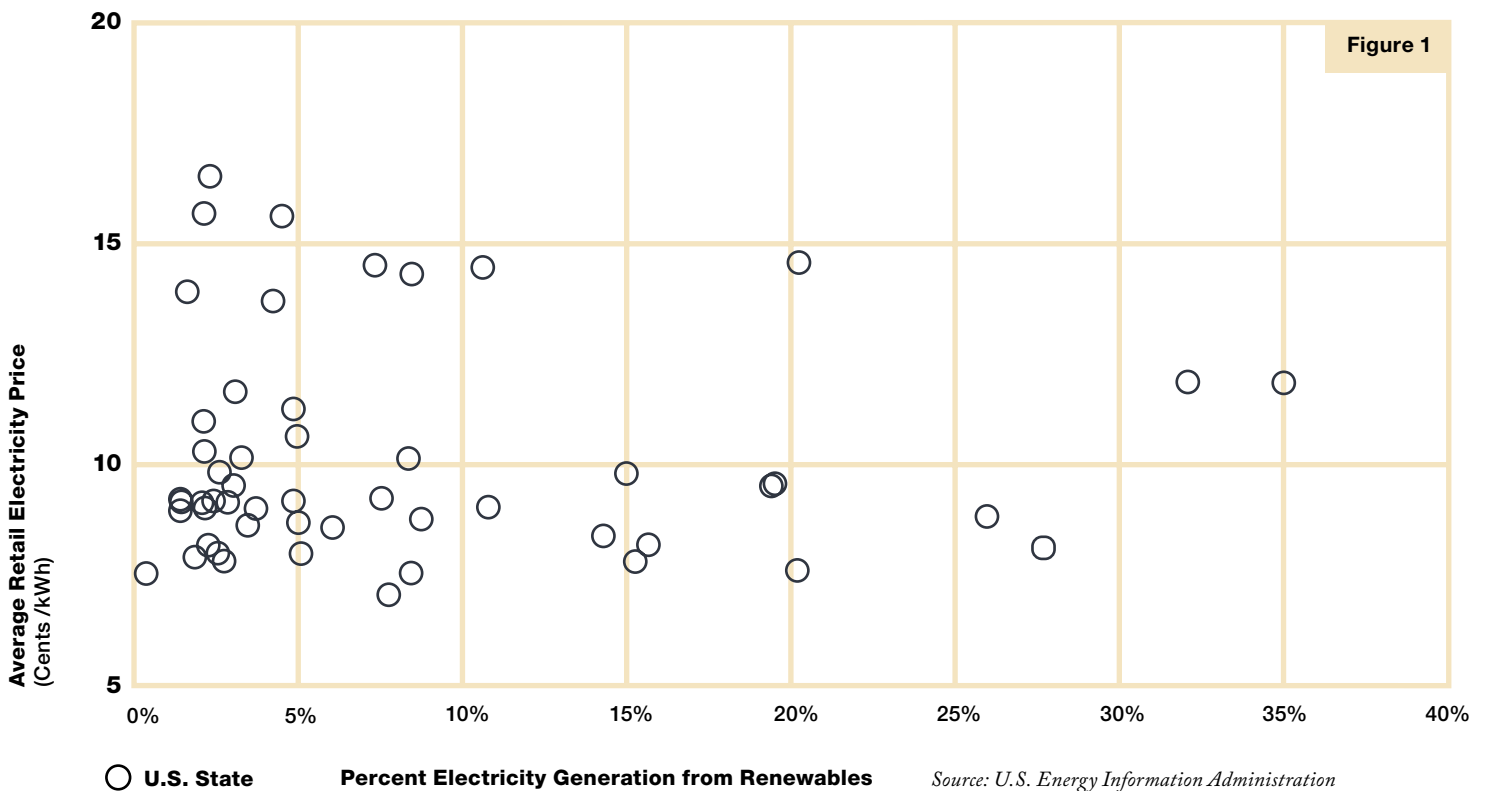
Retail Electricity Prices in the Rear View Mirror

In 2013, states relied on renewable generation to varying degrees, but average retail electricity prices diverged only to a limited degree. Average retail prices ranged between 8 cents/kWh and 12 cents/kWh for thirty-three out of fifty locations. Among the top 15 states with the greatest share of generation from renewables,

electricity prices in 12 states ranged from 8 cents/kWh to 12 cents/kWh. In addition, the national average price of electricity, 10.14 cents/kWh, exceeded electricity prices in 10 out of the top 15 renewables states. Figure 1 depicts state shares of generation from renewables against average retail electricity prices.

No Cause for Alarm:

Electricity Prices in States Across the Renewable Generation Spectrum

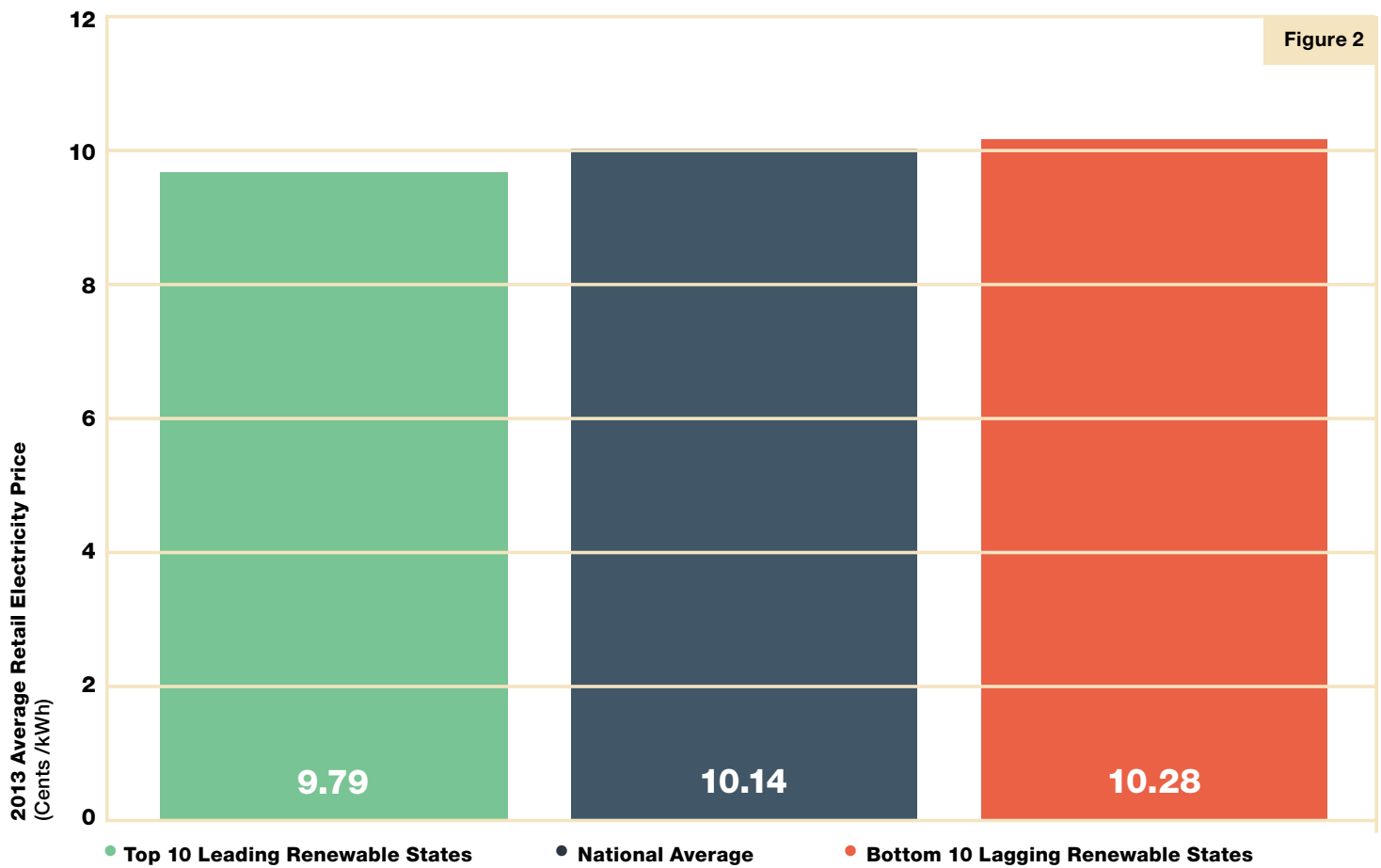


A similar trend emerges when directly comparing leading renewable states to lagging renewable states. Figure 2 draws a distinction among states at different stages of transition toward reliance on renewables, depicting the top 10 and bottom 10 states in terms of share of electricity generated from renewables. Determination of the top 10 and bottom 10 states is based on share of total electricity generated from all renewable sources, which includes wind and solar as well as other sources such as biomass and geothermal. The top 10, therefore, includes states like South Dakota, which has significant wind generation, as well as states like California,

which has significant solar generation. Recognizing that many factors affect retail electricity prices, this comparison helps explain whether states leading on renewables have experienced dramatically higher prices than other states (as critics have alleged), including those states that have eschewed renewable energy. The 10 states with the greatest share of generation from renewables averaged a retail electricity price of 9.79 cents/kWh in 2013. The ten states with the least share of generation from renewables averaged 10.28 cents/kWh in 2013. In 2013, the national average price of retail electricity was 10.14 cents/kWh.

Renewable Leaders and Laggards:

2013 Average Retail Electricity Prices in States Based on Total Generation from All Renewable Sources



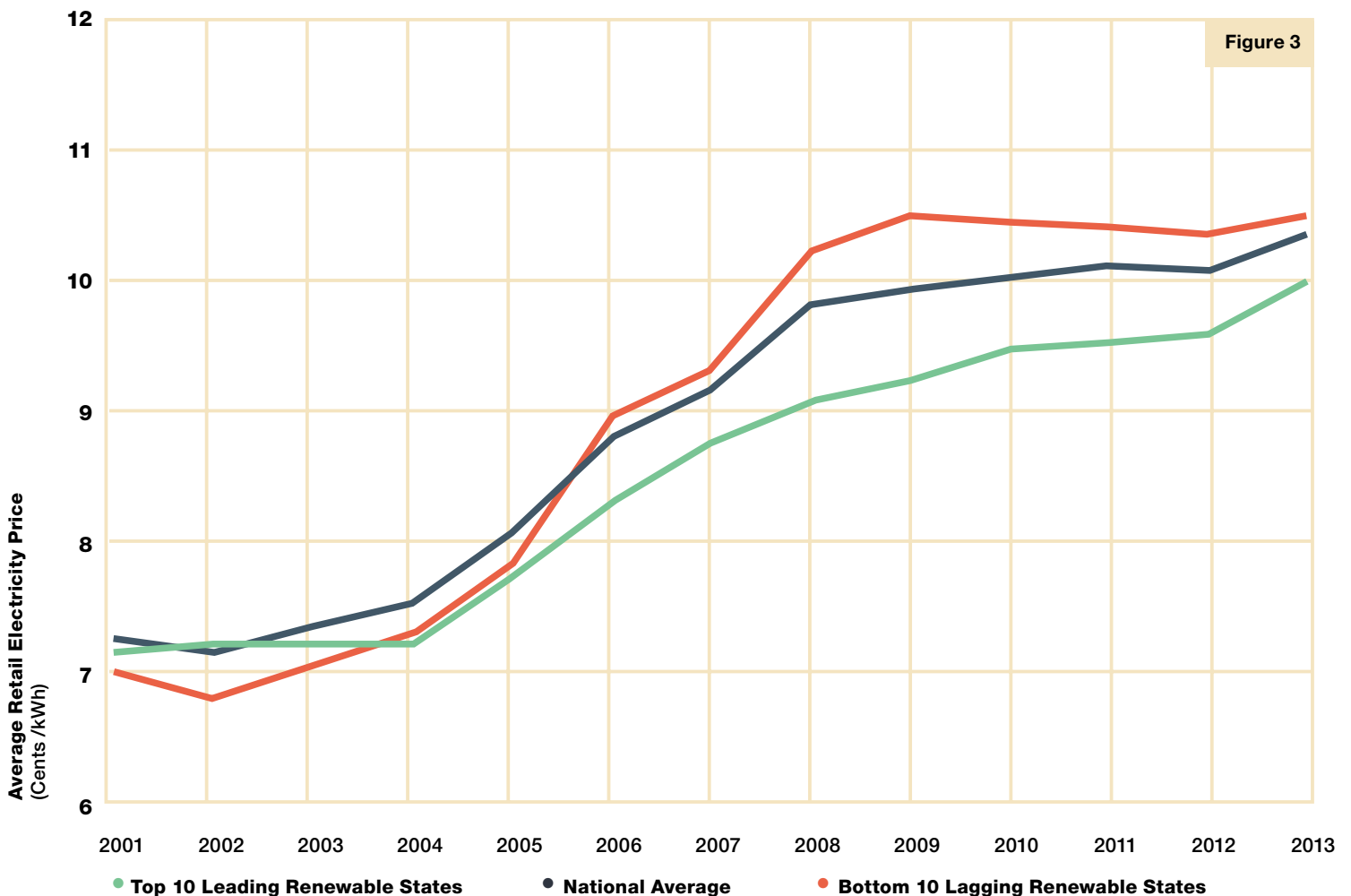
Source: U.S. Energy Information Administration

Assessing a time series, average retail prices in states that led on renewables in 2013 improved since 2001, in comparison to other states. In the top 10 states, average retail electricity was cheaper than the national average in 2001 by .08 cents/kWh. This discrepancy grew from 2001 to 2013, leaving the 10 leading states cheaper than the national average by .35 cents/kWh in 2013. Average retail electricity in leading renewable states also increased less, in reference to lagging renewable states. In 2001, the aver-

age electricity price in the top 10 states was .15 cents/kWh more expensive than the bottom 10 renewable states, but by 2013, the average electricity prices in the top states was cheaper than in the bottom states by .49 cents/kWh. The gap between leading and lagging states, albeit small, reveals that prices in leading renewable states have remained at least as low, on average, as prices in lagging renewable states. Figure 3 depicts the trend.

Renewable Leaders and Laggards:

2001-2013 Average Retail Electricity Prices in States Based on Total Generation from All Renewable Sources



Source: U.S. Energy Information Administration

The top 10 renewable states also fare slightly better than other states when assessing annual changes in electricity prices. The average annual percent increase in retail electricity prices from 2002 through 2013 totaled 3.06 percent in the 10 states generating the most electricity from renewables. In comparison, the average annual percent increase in the 10 states generating the least electricity from renewables totaled 3.74 percent over the 2002-2013 period. Average rates of change in leading renewable states also fared better than the national average rate of 3.23 percent.

This analysis demonstrates that average retail electricity prices are often cheaper in more renewable-reliant states. Many consumers have not, therefore, borne outsized hardship in their electricity bills as their states have transitioned to a cleaner energy future. In light of these findings, according to EIA and industry data sources, many critiques of states' leadership on renewables are misplaced.

Renewable Leaders and Laggards:

Average Annual Increases in Retail Electricity Prices 2002 - 2013

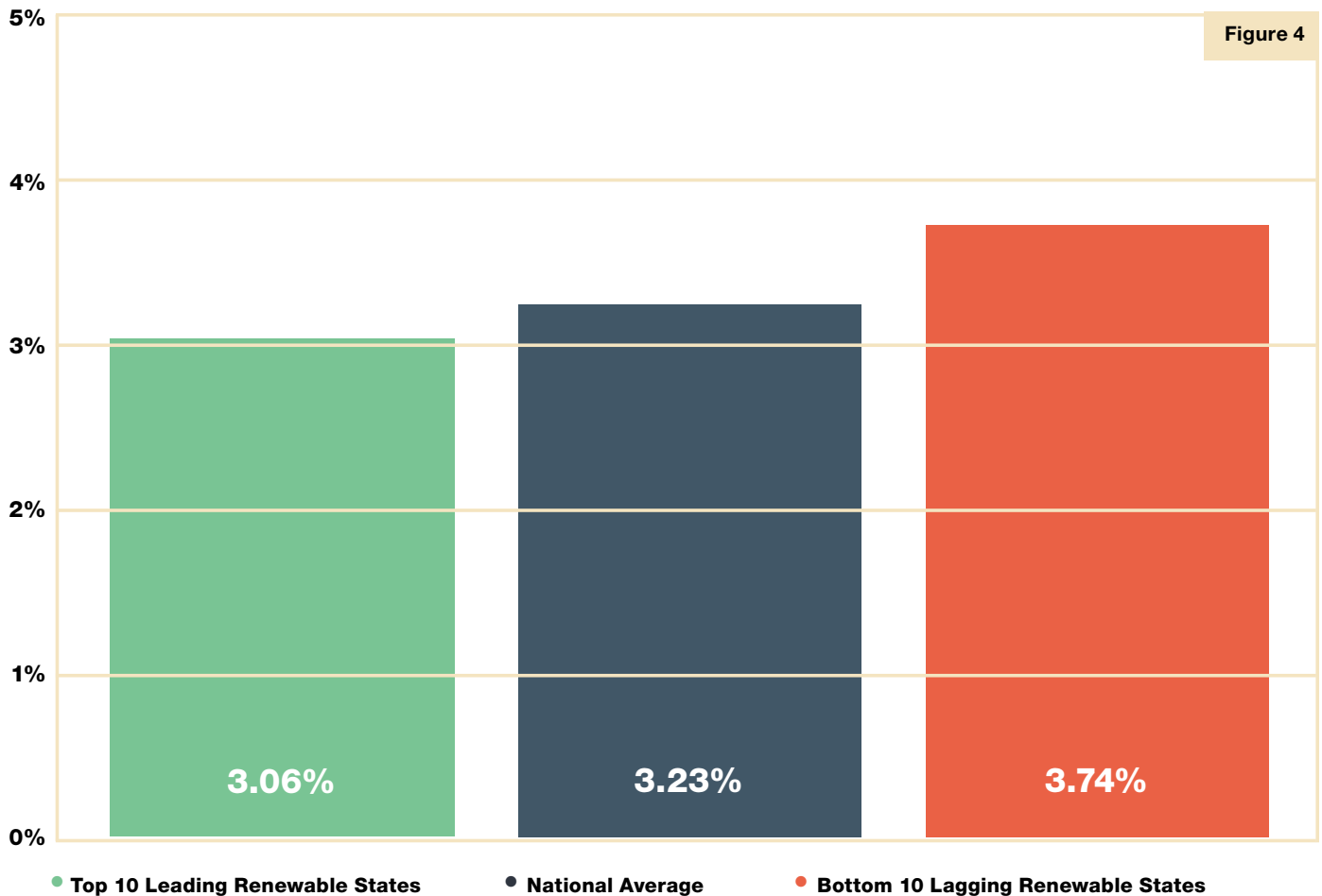


Figure 4

Source: U.S. Energy Information Administration

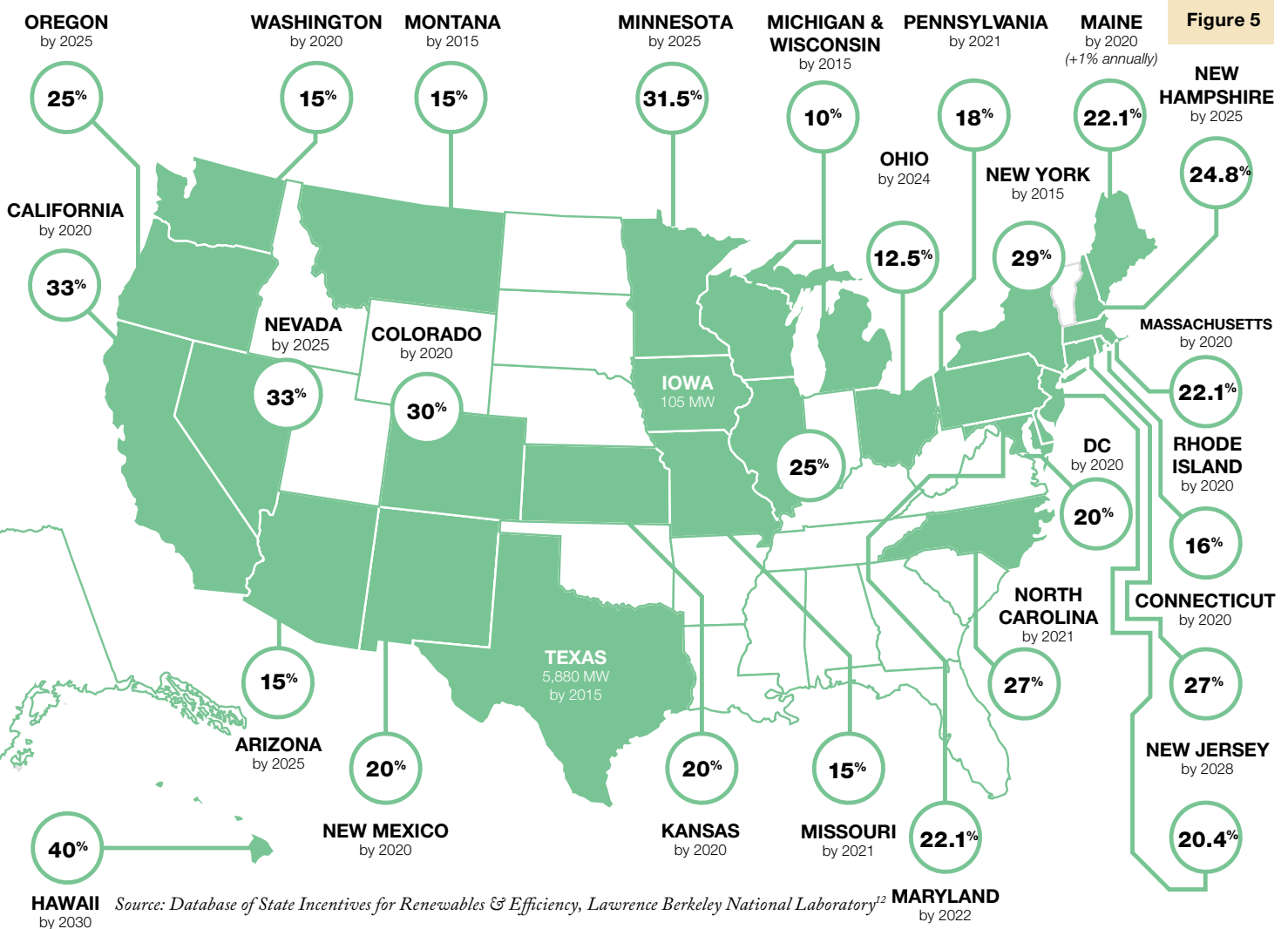
Putting RPS in perspective

Renewable Portfolio Standards have helped spur adoption of clean energy in states across the country. These standards create “a regulatory mandate to increase production of energy from renewable sources such as wind, solar, biomass and other alternatives to fossil and nuclear electric generation.”¹⁵ RPS mandates vary in terms of the total required amount of renewable generation, the specific mix among various renewable resources, the regulated

party (all utilities or investor-owned utilities), start date, target year, and policy duration. According to the Lawrence Berkeley National Laboratory, 67 percent of all non-hydro renewable capacity additions between 1998 and 2012 occurred in states with active or impending RPS obligations.¹⁶ Figure 5 depicts states with binding RPS policies.

RPS Roadmap:

U.S. States With Renewable Portfolio Standards



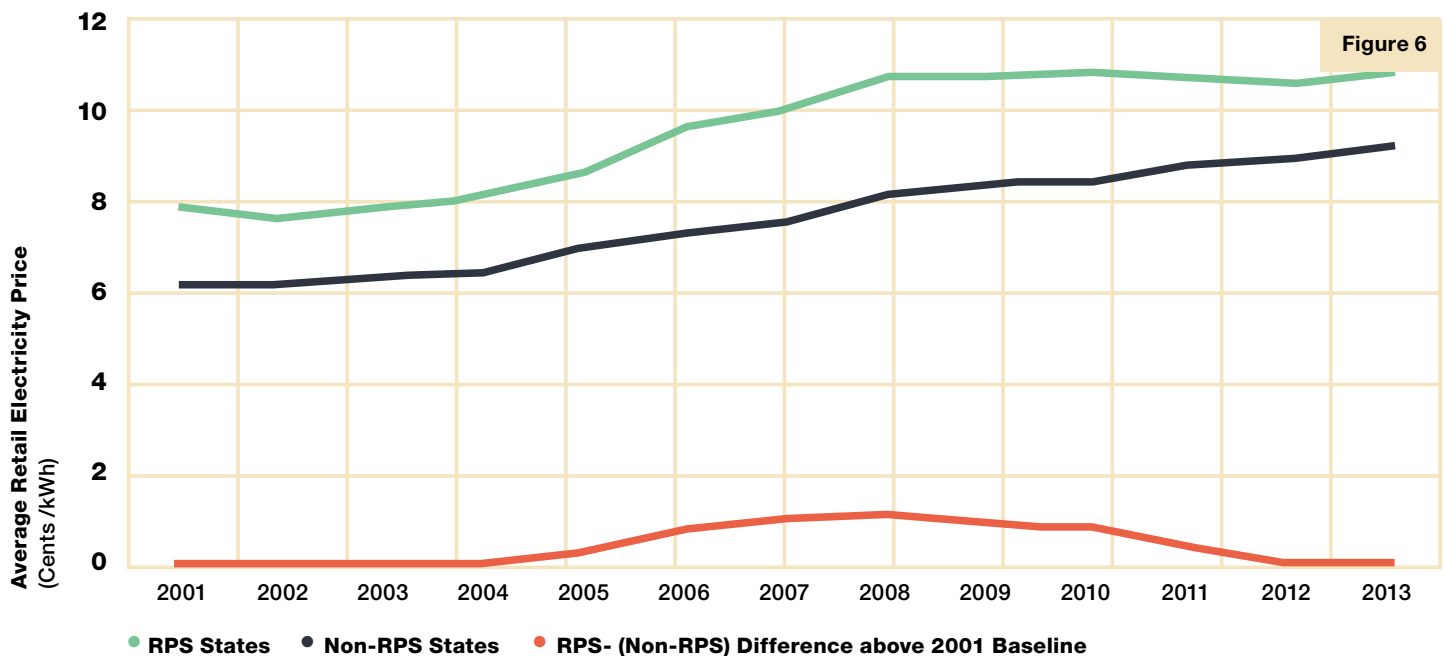
RPS programs have traditionally focused on utility and large-scale renewable generation. For example, California’s RPS requires that 33 percent of retail sales come from renewables by 2020, and eligible sources include solar photovoltaic and thermal plants, wind farms, biomass, geothermal, ocean wave, and landfill gas, among other sources.¹⁸ Increasingly, however, more states are adopting “set-asides,” which may require solar generation from sources such as distributed solar installations. 11 states have adopted solar or distributed generation set-asides since 2007, bringing the total number of states with set-asides to 17.¹⁹

Many RPS policies were initiated as renewable technologies began to scale. As detailed later in this paper, when an increasing number of states began adopting RPS policies in the 2000s, wind and solar were far more expensive than today. Still, according to the Lawrence Berkeley National Laboratory, the incremental rate impact of RPS on electricity prices has been “generally modest.”²⁰ The gap in electricity prices between RPS states and non-RPS states has remained relatively constant since the early 2000s,

when states began to adopt the policies. Figure 6 depicts electricity prices in RPS and non-RPS states from 2001 through 2013. Recognizing that states joined the RPS program in different years, “RPS states” here includes all states that enacted an RPS before 2013. The data indicate that retail electricity prices in RPS states were approximately 1.6 cents/kWh more expensive than prices in non-RPS states in 2001. Between 2001 and 2013, the price discrepancy between RPS states and non-RPS states increased only a limited amount above this 1.6 cent/kWh “baseline” difference that existed in 2001. As depicted in Figure 6, this discrepancy remained small through 2004, peaked in 2008, and then subsided. The peak may be attributed to a variety of factors, such as an increasing number of states joining the RPS program, deploying renewable technologies and only subsequently experiencing the declining cost of renewables. By 2013, the difference in average retail electricity prices in RPS and non-RPS states above the initial 2001 discrepancy was minimal: .09 cents/kWh.

RPS States From Bulge to Baseline:

Average Retail Electricity Prices 2001-2013 in RPS and Non-RPS States



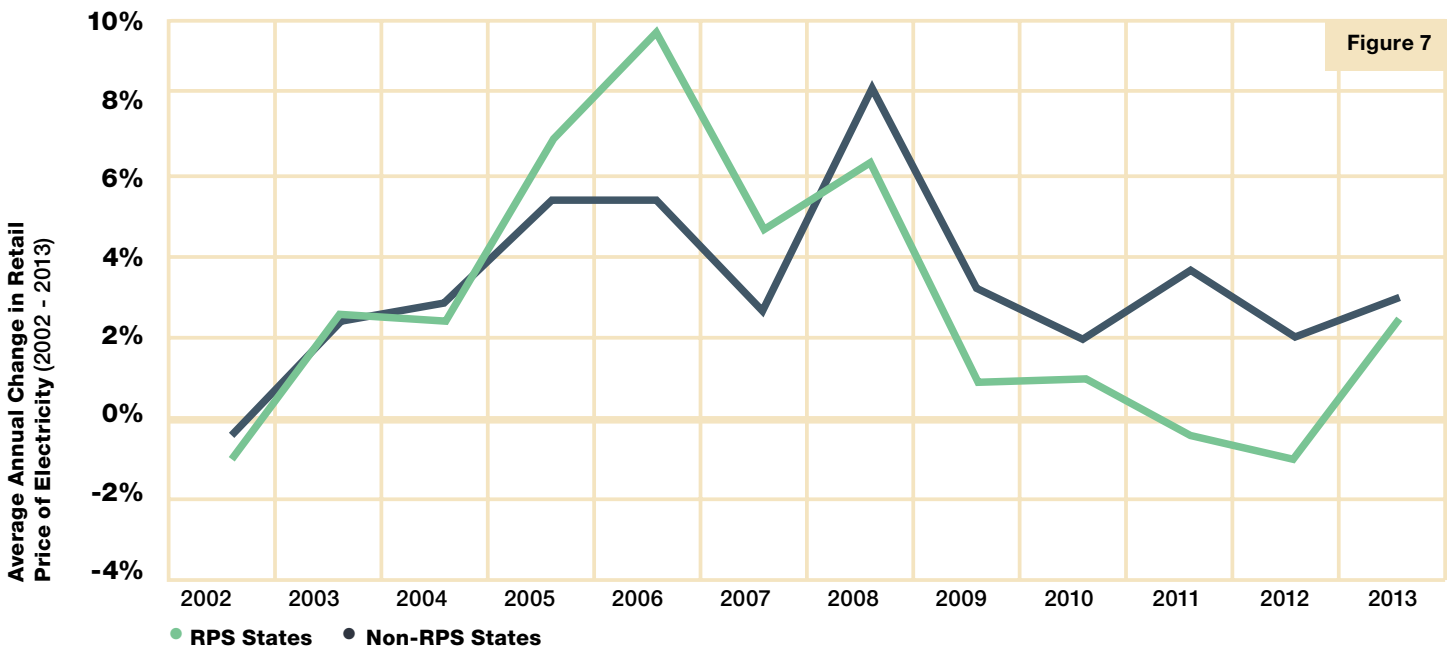
Source: U.S. Energy Information Administration, Database of State Incentives for Renewables & Efficiency

RPS states and non-RPS states have also experienced similar annual price changes. On average, RPS states experienced annual price increases of 3.02 percent, while non-RPS states experienced price increases of 3.52 percent. In addition, in 9 out of 12 years

assessed, price increases were greater on a percentage basis in non-RPS states than in RPS states. Figure 7 depicts annual changes from 2002 to 2013. These results further call into question statements implying RPS states endure skyrocketing electricity prices.

Meeting in the Middle:

Annual Retail Electricity Prices in RPS and Non-RPS States²¹



Source: U.S. Energy Information Administration

The Road Ahead:

Driven by Economics

As in the car service industry, consumers in the electricity industry have begun to encounter novel products and services. When incumbents (think taxi monopolies and electric utilities) meet new players (think Uber/Lyft and SolarCity/Vivint), tension can arise because long-standing industry structures are altered by new products and services. In the electricity industry, this dislocation is especially strong because renewables are becoming substantially cheaper than and increasingly competitive with fossil fuels on a cost basis. The relationship between incumbents and new entrants will continue to evolve as renewable penetration increases,

Distributed Solar: Distributed Savings

Although the object of some disagreement, analysis has accrued suggesting that solar power has saved the grid money. Net energy metering (NEM) programs have helped increase demand for rooftop solar and, unsurprisingly, assessments of the programs have become something of a Rorschach Test for whether a particular business model stands to gain or lose from NEM. Industry incumbents, including many electric utilities, have argued that NEM disadvantages ratepayers who do not have access to distributed solar generation.²² A growing number of studies, however, have found contrary results. A 2013 study by Crossborder Energy on the effects of NEM in Arizona found that customers of Arizona Public Service would save \$34 million per year, beginning in 2015, from NEM.²³ On a per-dollar basis, the authors note, customers saved \$1.54 for every \$1 spent on NEM. The sources of these savings included reduced operations at more expensive power plants, reduced investment in transmission and distribu-

and as other innovative technologies and strategies take off, including battery storage, demand response, and grid integration. In the end, this industry change will impact the price of retail electricity.

This section focuses on key economic drivers of this industry change. These trends include increasing consumer savings, falling Power Purchase Agreement (PPA) prices, and growing job gains in the solar and wind sectors – which have all coincided with price uncertainty for many carbon-based fuels.

tion infrastructure, and decreased electricity loss over power lines. Studies in other states have revealed similar results. The Nevada Public Utilities Commission requested a study into NEM in the state, and found in 2014 that the benefits of systems installed in 2014 and 2015 exceeded their costs by at least \$168 million over the course of the systems' lives.²⁴ In California, a 2013 analysis revealed that NEM neither shifts costs nor raises expenses for non-users of distributed solar and, instead, creates a modest net benefit.²⁵ Net metering in California would save the grid approximately \$92 million each year. Finally, in Vermont, the legislature tasked the state's Department of Public Service with determining whether NEM imposed a net cost or benefit on ratepayers. The Vermont Department of Public Service found a 4.3 cent/kWh statewide net benefit from 4 kW photovoltaic fixed systems and a 3.3 cent/kWh statewide net benefit from 4 kW 2-axis photovoltaic systems.²⁶

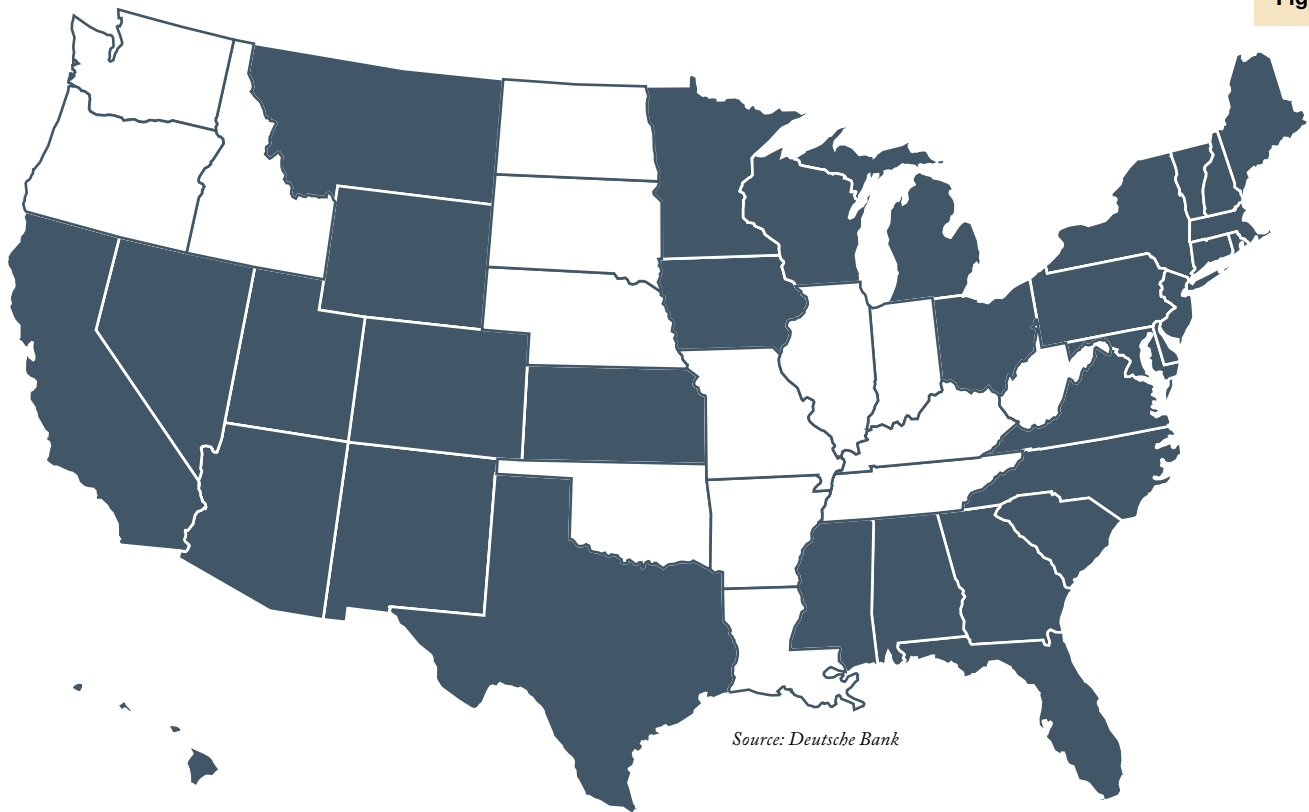
Solar Grid Parity: Coming to a State Near You

Consumer savings from solar also emerge as more states reach grid parity. Grid parity is the “point where the cost of PV-generated electricity equals the cost of electricity purchased from the grid.”²⁷ Key factors influencing grid parity include the cost of electricity, rate structure, solar financing availability, solar resource, transmission and distribution infrastructure, and incentives. Solar adoption has proliferated, becoming economically competitive in states where it was not just a few years ago, large-

ly as a result of cost reduction in the solar industry. According to Deutsche Bank, 36 states are poised to reach grid parity by 2016.²⁸ This means that consumers in well over half of the U.S. will have the opportunity to purchase clean solar electricity at a cheaper price than traditional grid-provided electricity. Figure 8 depicts the states Deutsche Bank projects will achieve parity in 2016; notably, the map highlights regions in nearly every corner of the country, revealing that the benefits of solar extend into areas with varying solar resource.

From Sea to Sun Shining Sea: States at Solar Grid Parity by 2016

Figure 8



This progress translates into significant potential on a national level. In the United States, according to one estimate, 14,800 MW of residential solar parity potential and 5,500 MW of commercial solar parity existed in 2012.²⁹ By 2022, 190,000 MW of

residential solar parity potential and 122,000 MW of commercial solar parity potential will exist, with the possibility of generating a full nine percent of total U.S. electricity through residential and commercial solar power.

Proof in the Renewable Pudding:

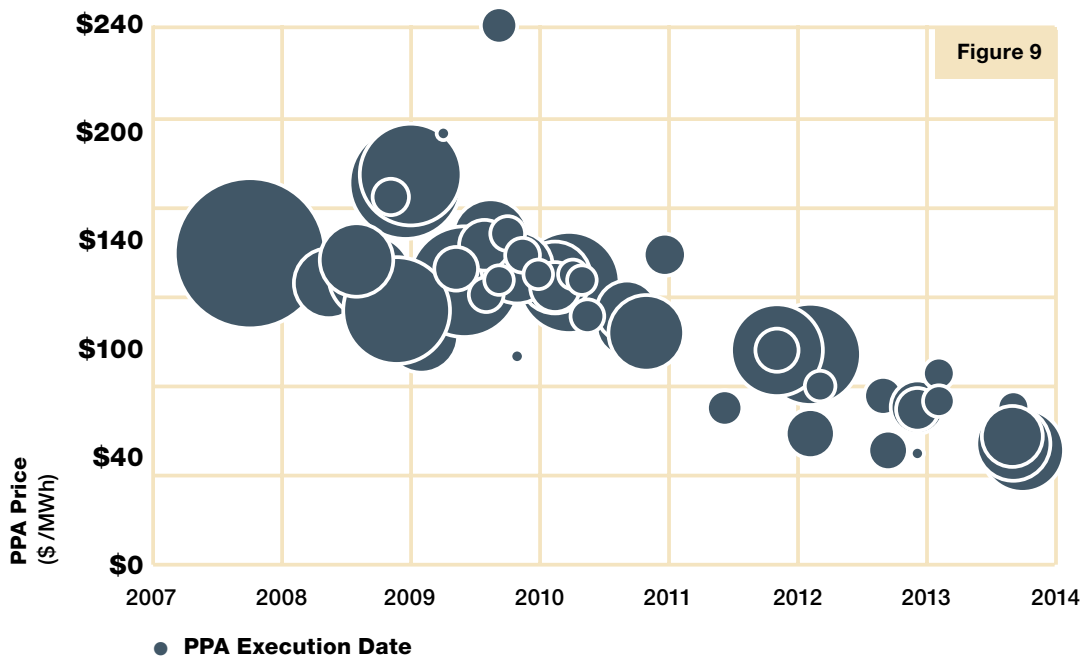
Utility-Scale Solar and Declining Power Purchase Agreement Prices

Just as distributed solar has taken off, Power Purchase Agreement (PPA) prices for utility-scale solar have also declined. Under a PPA, a third-party develops, operates, maintains, and owns a source of generation, and a buyer purchases a quantity of power generated at a contracted price for a specified period of time.³⁰ These PPA prices, among other previously mentioned factors, affect retail prices of electricity borne by consumers. And because of the length of many contracts, PPAs may impact retail prices for years to come.

PPA prices for utility-scale solar have fallen since 2007. As depicted in Figure 9, PPA prices remained largely above \$100/MWh through 2008 and 2009.³¹ Prices declined from 2011 through the first half of 2014. In 2013, PPAs signed were largely at or below \$85/MWh, and PPAs in the first half of 2014 ranged between \$50 and \$70/MWh. In one of the cheapest contracts to date, Austin Energy reportedly signed a solar PPA for 150 MW at a price of approximately \$50/MWh for a 20-year period.³² The price was reportedly lower than the utility's price estimates for nuclear, coal, and natural gas.

The Seven Year Switch:

Solar PPA Price by Contract Execution Year and System Size



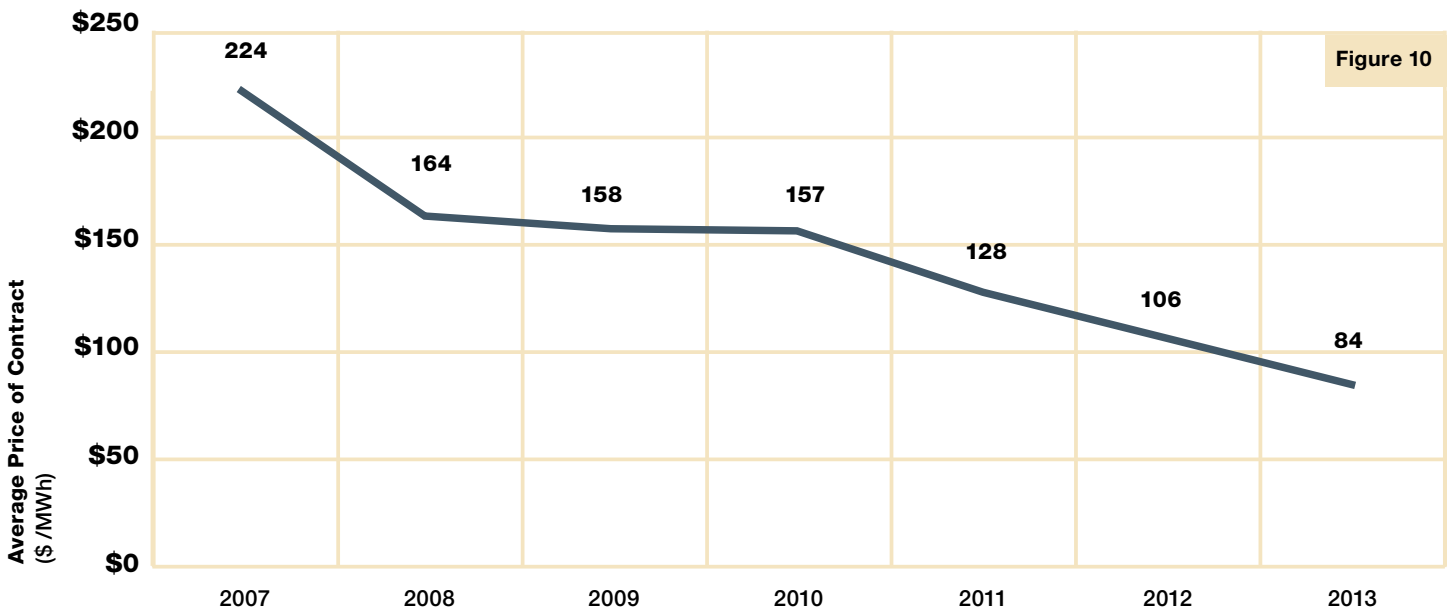
Source: Greentech Media³³

California solar PV PPAs exemplify this decline. The average PPA approved by PG&E, SCE, and SDG&E declined between 2007 and 2013.³⁴ Over the course of this period, the average contract price declined approximately \$160/MWh, falling from \$224/MWh in 2007 to \$84/MWh in 2013. This decline, shown in Figure 10, mirrors the national trend downward depicted in Figure 9.

The 2014 Padilla Report to the California Legislature, which documents California PPA prices, also points to the downward trend in PPA prices for renewables more broadly, noting, “Contract prices for 2013 show a steady decline from the prices in prior years (2003-2012). The downward trending prices prove that the renewable market in California is robust and competitive, and has matured since the start of the RPS program.”³⁶

A Tale of Three Utilities:

Average Price of Utility-Scale Solar PV contracts for PG&E, SCE, SDG&E



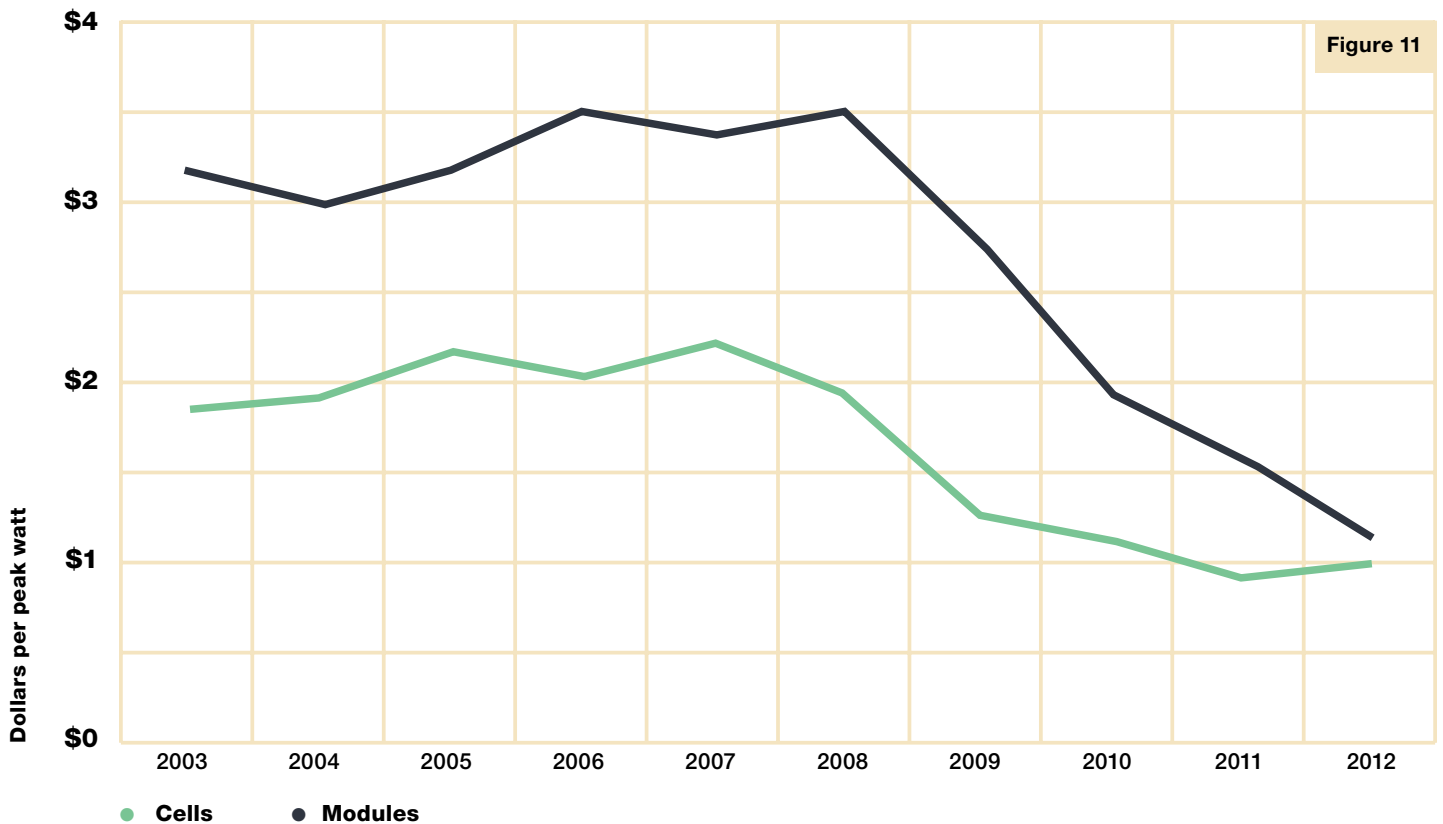
Source: Padilla Report to the Legislature, California Public Utilities Commission³⁵

The Fundamentals: Falling Solar Component Prices

Falling component prices have helped drive the aforementioned PPA price declines and savings. Solar panels in 2012 cost 1 percent of their price 35 years before.³⁷ From 2003-2012, the cost of photovoltaic modules fell dramatically, from \$3.17 to \$1.15 per peak watt.³⁸ The annual pace of decline picked up steam from

2008-2012, as shown in Figure 11. The price of solar photovoltaic cells, the components of solar modules, has also gone down dramatically, dropping from \$1.86 per peak watt in 2003 to \$1 in 2012.

Going Down, Down, Down: Average Price of Photovoltaic Cells and Modules



Source: U.S. Energy Information Administration³⁹

Consumer Savings Part Deux: The Wind Power Edition

Solar is not the only source of renewable generation transforming the electricity industry – wind power has created savings as its cost has also declined. More than a dozen analyses across the country have concluded that increasing wind generation reduces retail electricity costs.⁴⁰ These savings reportedly include \$231 million over 20 years in Colorado and \$177 million per year in Illinois.⁴¹ According to a report from the American Wind

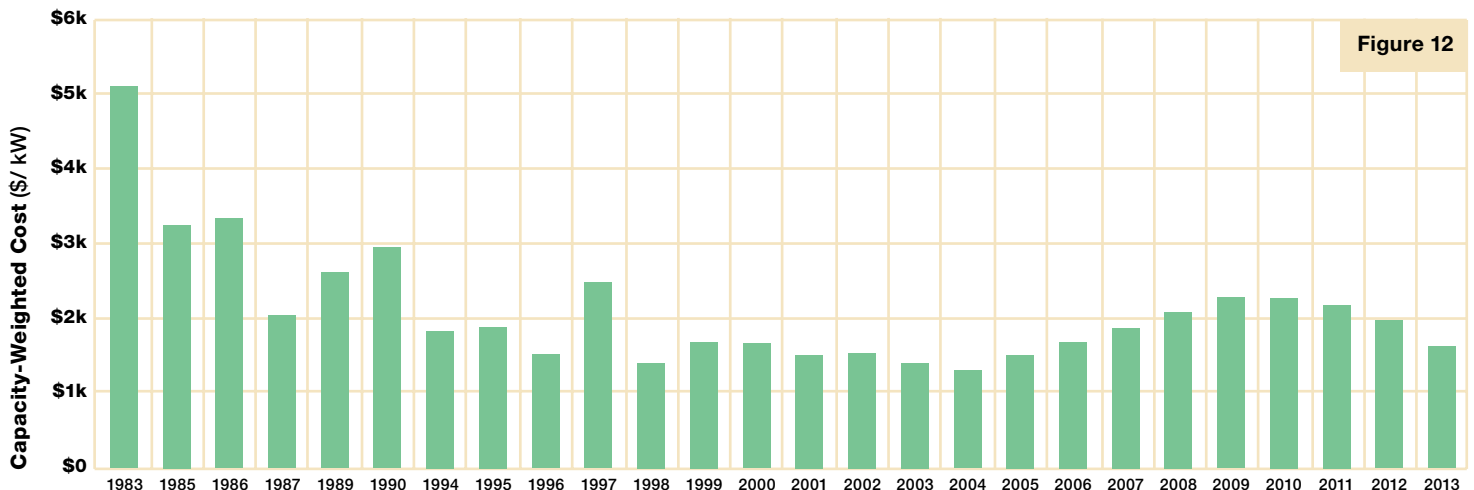
Energy Association, in the PJM region (which includes the District of Columbia and all or parts of 13 states in and around the Mid-Atlantic region), doubling the region’s RPS requirements for wind would result in nearly \$7 billion in consumer savings per year.⁴² In the Midwest, investments in wind would lead to reduced power supply costs between \$3 billion and \$9.4 billion per year.⁴⁴

Wind Power Costs: Thirty Years and Falling

Declining deployment costs have contributed to these consumer savings. Since the 1980s, the wind industry has scaled, and the cost of wind generation has fallen.⁴⁵ As shown in Figure 12,

wind power project costs exceeded \$5,000 per kW in 1983. This cost has fallen steeply. By 2013, project costs had dropped nearly 70 percent to a cost of \$1,630 per kW.

Smooth Sailing: Installed Wind Power Project Cost

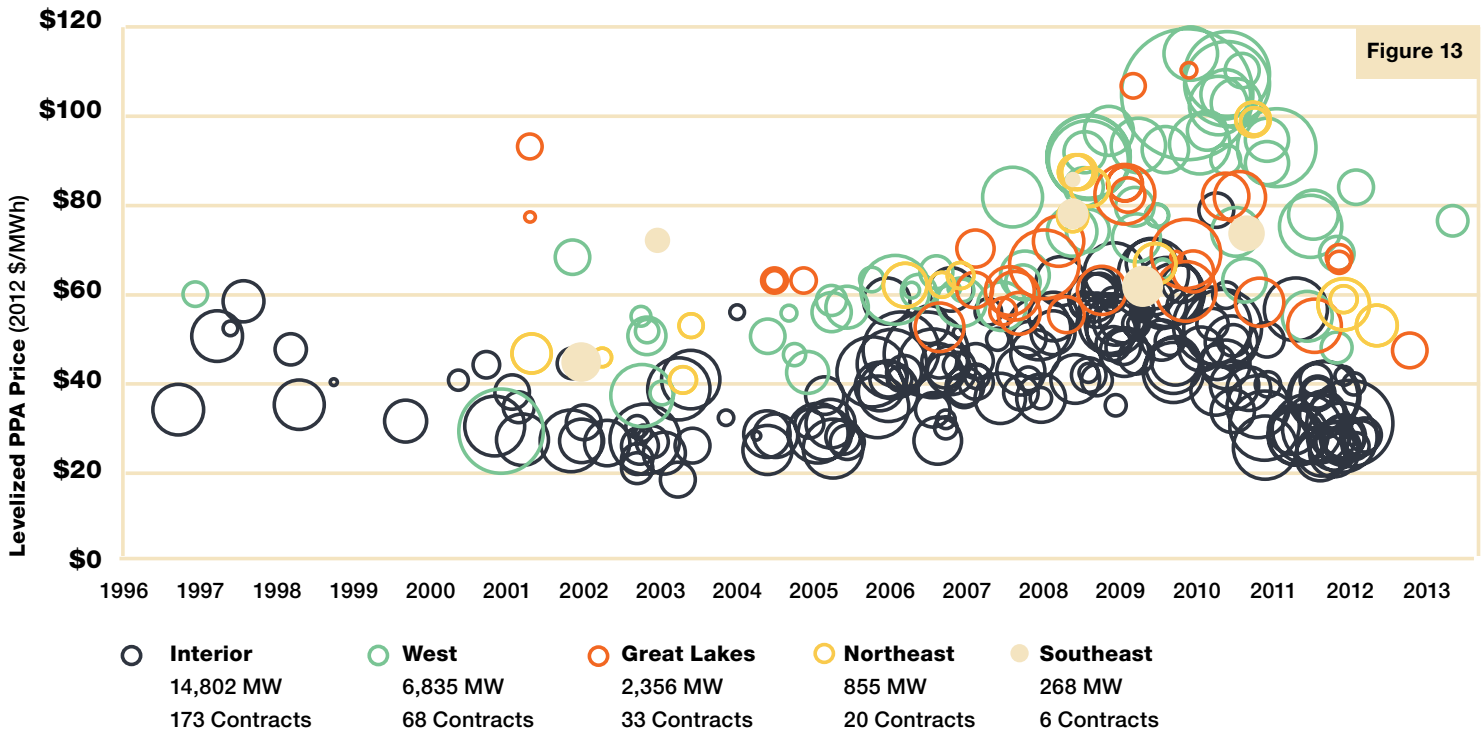


Source: Department of Energy⁴⁶

Wind PPAs have proliferated over the past fifteen years, and prices have remained competitive with conventional fuels. As depicted in Figure 13, PPAs for wind in the Interior region have been lower than any other part of the country, owing to the region's natural wind resource.⁴⁷

Other regions have begun to adopt wind generation, with divergent PPA prices to date. Over this period of national expansion, wind has remained largely competitive with fossil fuels, and in many cases is cheaper than many conventional sources.

Wind PPAs: Growing Numbers and Falling Prices



Source: U.S. Department of Energy⁴⁸

Surge Employment: Jobs in Renewable Energy

As the financial benefits of wind and solar have grown increasingly clear, job creation in the clean energy sector has generated additional momentum toward disruption in the electricity sector. According to the Union of Concerned Scientists, renewable energy is more labor-intensive than many fossil fuel technologies, which are often mechanized and capital intensive.⁴⁹ And on average, more jobs are created per unit of electricity from renewables, as compared to fossil fuels.⁵⁰ Specifically, the Union of Concerned Scientists reports that a 25 percent renewable energy requirement by 2025 would lead to three times as many jobs as creating the same amount of electricity from fossil fuels; such a requirement would mean 202,000 new jobs by 2025.⁵¹ In 2013 alone, the sector created 78,000 new jobs at 260 projects.⁵² And the benefits were felt across the country; the 10 states leading in clean energy

job creation spanned from Maryland and Missouri to Texas and Hawaii.⁵⁴

The wind and solar industries in particular have proven major drivers of job creation. In 2013, the wind industry employed more than 50,000 individuals in positions ranging from manufacturing to operations and services.⁵⁵ In 2014, the solar industry provided more than 173,000 jobs, up from 100,000 in 2011.⁵⁶ In the state of California, the solar industry employs more than the employment of the major utilities (PG&E, SCE, LADWP, and SDG&E) combined.⁵⁷ The solar workforce is also increasingly diverse, with women, racial and ethnic minorities, and veterans representing a larger percentage of the workforce in 2014 than in prior years.⁵⁸ According to the Solar Foundation's 2014 National Solar Jobs Census, nearly 30 percent of solar workers are non-white, nearly 22 percent are women and nearly 10 percent are veterans.

Riding the Fossil Fuel Cost Roller Coaster: Carbon Pricing, Uncertainty, and Volatility

Just as the cost of renewables drops, costs remain uncertain for many fossil fuels. Approximately 40 national and more than 20 sub-national jurisdictions across the world have implemented carbon pricing programs, which drive up the fully loaded price of fossil fuels.⁵⁹ The state of California enacted a price on carbon through its cap and trade system, which went into effect in 2013. The program initially covered the power and industrial sectors, and now will expand to include natural gas and transportation fuels in 2015.⁶⁰ In 2014, the price per ton of carbon in California has fluctuated between \$11 and \$13, and carbon prices have varied in carbon exchange markets across the world. In December 2014, Washington Governor Jay Inslee proposed a cap and trade system for the state. The program requires legislative approval and is proposed to begin in 2016.⁶¹ Looking forward, many analyses, including one from the energy consulting firm Synapse Energy Economics, forecast a nationwide price on carbon.⁶² According to Synapse, carbon will be priced between \$22.36 and \$51.79 per

ton of CO₂, depending on low, mid, or high-case scenarios.

A growing number of businesses and institutions have already incorporated such carbon pricing into their operations and have called for a national carbon pricing program. Multinational companies including Wal-Mart, Google, and Shell have developed a shadow price on carbon.⁶³ These companies recognize the climate consequences and risk associated with fossil fuels. As of June 2014, more than 250 companies, including Unilever, Ernst & Young, and Swiss Re, joined a statement organized by the World Bank calling on governments to explore carbon pricing models and to establish a price on carbon.⁶⁴

Leading investors have also expressed the view that a carbon price, or a lower-carbon future, may be on the horizon. The Carbon Asset Risk Initiative represents 75 global investors, including CalPERS and the New York State Common Retirement Fund, and more than \$3 trillion in assets.

The group recently called on fossil fuel companies to explain how their business plans and financial risks would shift in a low-carbon environment, writing:

We would like to understand [the company's] reserve exposure to the risks associated with current and probable future policies for reducing greenhouse gas emissions by 80 percent by 2050... We would also like to understand what options there are for [the company] to manage these risks by, for example, reducing the carbon intensity of its assets, divesting its most carbon intensive assets, diversifying its business by investing in lower carbon energy sources or returning capital to shareholders.⁶⁵

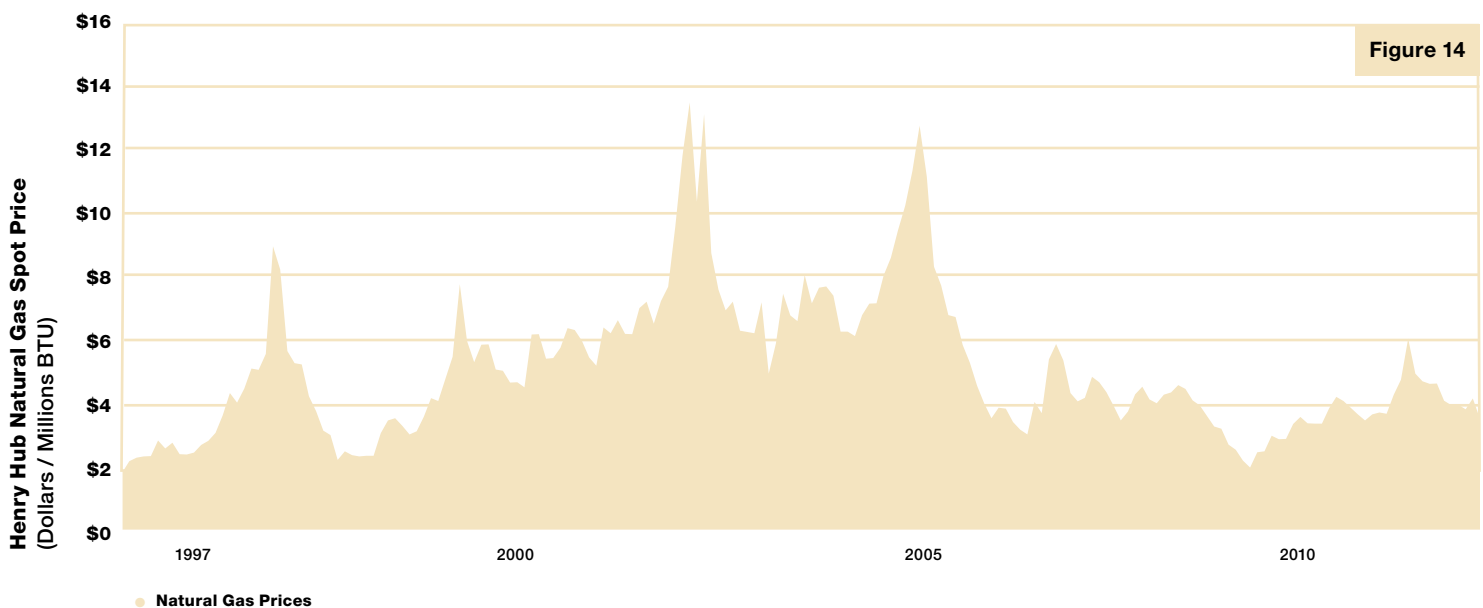
This investor action reveals an expectation of continued policy action on carbon-intensive fuels, including a possible price on carbon.

An example of future potential uncertainty in carbon-based fuels, the U.S. Environmental Protection Agency took action in June

2014 to effectively restrict electricity production from certain carbon-based fuels. The EPA issued a draft rule proposing that existing U.S. power plants cut carbon dioxide emissions 30 percent below 2005 levels by 2030. The regulation establishes targets for each state, based on an analysis of states' carbon intensity and their ability to improve through increased coal plant efficiency, increased natural gas use, more renewable and nuclear generation, and greater energy efficiency.⁶⁶ According to one report, more than 32 plants largely powered by coal are slated for closure, and 36 additional plants may be required to close.⁶⁷ Ultimately, this regulation impacts the value of fossil fuels like coal, and may serve as a harbinger of future regulatory action restricting their use.

Conventional fuels have also experienced significant price fluctuations. In particular, natural gas, which increasingly supplies U.S. electricity generation, has experienced significant oscillation. Figure 14 highlights shifts in natural gas prices since 1997.

The Natural Gas Roller Coaster: Prices 1997 - 2014



Source: U.S. Energy Information Administration

Even as natural gas prices have moved downward in recent years, the fuel's volatility is not lost on utility executives who confront wholesale energy prices. Tom Fanning, CEO of the Southern Company, based in Georgia and one of the largest utilities in the United States, has expressed concerns about natural gas price volatility, noting, "you're buying a more volatile product. You're creating a higher-Beta energy policy."⁶⁸

In addition to natural gas, the nuclear sector has also brought unexpected costs at times, raising concerns about its price predictability.⁶⁹ Together, price increases and volatility, regulatory changes, and carbon pricing regimes paint an uncertain picture for conventional fuels. This trajectory contrasts with decreasing prices and growing adoption of renewables.⁷⁰

Conclusion

As clean energy takes off, it is critical to understand how electricity prices have fared. On average, states that have led on renewables over the past ten years have had cheaper average retail electricity than both the national average and states that lag in generation from renewables. Moreover, the average annual rate of change in prices has been lower in leading renewable states. And from the perspective of Renewable Portfolio Standards, criticism of RPS states has been overblown. Electricity in RPS states was more expensive than electricity in non-RPS states before many of these policies were enacted, and above this baseline difference, average retail electricity in 2013 was cheaper in non-RPS states than in RPS states by less than a penny per kWh.

Looking ahead, retail electricity prices and the entire electricity market are ripe for change. Your grandfather's electricity system, a government-sponsored monopoly reliant on conventional and centralized energy sources, is entering the 21st century. The utility business model we have lived with for over 100 years will be altered by a series of economic trends, including cheaper renewable sources of energy and potential uncertainty in the market for conventional sources. In this new environment, all electricity providers must act nimbly, and work alongside one another, rather than trying to turn back the climate clock. In fact, one can envisage a future in which analysts criticize over-reliance on conventional energy sources for driving up electricity prices, much the same way renewables are characterized by some today. Yet in this alternate case, the accompanying question will not be, "Wait, What?" but rather, "Why on Earth?"

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Top 10 Leading States in Electricity Generated from Renewable Energy Sources in 2013:

D.C., Maine, Iowa, South Dakota, California, Idaho, Kansas, Minnesota, North Dakota, and Oklahoma

Bottom 10 Lagging States in Electricity Generated from Renewable Energy Sources in 2013:

Florida, Connecticut, Delaware, South Carolina, West Virginia, Rhode Island, Ohio, Missouri, Tennessee, and Kentucky