Exhibit No.:	
Issues:	Charge Ahead Programs
Witness:	James Owen
Sponsoring Party:	Renew Missouri Advocates
Type of Exhibit:	Surrebuttal Testimony
Case Nos.:	ET-2018-0132
Date Testimony Prepared:	November 16, 2018

MISSOURI PUBLIC SERVICE COMMISSION

ET-2018-0132

SURREBUTTAL TESTIMONY

OF

JAMES OWEN

ON BEHALF OF

RENEW MISSOURI ADVOCATES

November 16, 2018

BEFORE THE PUBLIC SERVICE COMMISSION
OF THE STATE OF MISSOURI

In the Matter of the Application of Union Electric Company d/b/a Ameren Missouri for Approval of Efficient Electrification Program	))))	File No. ET-2018-0132

AFFIDAVIT OF JAMES OWEN

STATE OF MISSOURI)
) **ss**
COUNTY OF BOONE)

COMES NOW James Owen, and on his oath states that he is of sound mind and lawful age; that he prepared the attached surrebuttal testimony; and that the same is true and correct to the best of his knowledge and belief.

Further the Affiant sayeth not.

James Owen

Subscribed and sworn before me this 16th day of November 2018.

Notary Public

My commission expires: 1-19-20

MATTHEW PATTERSON
Notary Public, Notary Seal
State of Missouri
Boone County
Commission # 11274306
My Commission Expires 01-19-2020

TABLE OF CONTENTS

I. Introduction

Q: Please state your name, title, and business address.

A: James Owen, Executive Director, Renew Missouri Advocates d/b/a Renew Missouri ("Renew Missouri"), 409 Vandiver Dr. Building 5, Suite 205, Columbia, MO 65202.

Q: Please describe your education and background.

A: I obtained a law degree from the University of Kansas as well as a Bachelor of Arts in Business and Political Science from Drury University in Springfield.

Q: Please summarize your professional experience in the field of utility regulation.

A: Before becoming Executive Director of Renew Missouri, I served as Missouri's Public Counsel, a position charged with representing the public in all matters involving utility companies regulated by the State. While I was Public Counsel, I was involved in several rate cases, CCN applications, mergers, and complaints as well as other filings. As Public Counsel, I was also involved in answering legislators' inquiries on legislation regarding legislation impacting the regulation of public utilities. In my role as Executive Director at Renew Missouri, I continue to provide information and testimony on pieces of proposed legislation that may impact how Missouri approaches energy efficiency and renewable energy.

Q: Have you been a member of, or participant in, any workgroups, committees, or other groups that have addressed electric utility regulation and policy issues?

A: In May 2016 I attended the National Association of Regulatory Utility Commissioners ("NARUC") Utility Rate School. In the Fall of 2016, I attended Financial Research Institute's 2016 Public Utility Symposium on safety, affordability, and reliability. While I was Public Counsel, I was also a member of the National Association of State Utility

Consumer Advocates ("NASUCA") and, in November of 2017, the Consumer Council of Missouri named me the 2017 Consumer Advocate of the Year.

Q: Have you testified previously, participated in cases, or offered testimony before the Missouri Public Service Commission ("Commission")?

A: In my prior role as Acting Public Counsel I participated in a number of PSC cases as an attorney and director of the office. During that time period I also offered testimony in rulemaking hearings before the Commission. Since becoming Executive Director of Renew Missouri I contributed to Renew Missouri's filed testimony in a number of matters. Attached as **Schedule JO-1** is a list of my case participation.

II. Purpose and summary of testimony

Q: What is the purpose of your testimony?

A: To respond to the testimony filed by the Office of the Public Counsel ("OPC") and the Commission's Staff ("Staff") regarding their recommendations to reject Ameren Missouri's proposed "Charge Ahead" electrification programs. In particular, I address the critiques that this proposal is a "load building" program[1] and that it is not necessary to encourage Electric Vehicle ("EV") adoption[2]. (At times, I will refer to Ameren Missouri as such or simply "Ameren" or "the Company.")

Q: What is Renew Missouri's interest in this application?

A: Renew Missouri advocates for energy efficiency and renewable energy policy. As a state-wide advocate, Renew Missouri has an interest in Ameren Missouri's approach to electrification and how it will impact the Company's pursuit of renewable energy resources. In this case, Ameren Missouri proposes its "Charge Ahead" programs as a way

[1] Marke Rebuttal, pp. 3, 10; Murray Rebuttal, p. 2.
[2] Marke Rebuttal, p. 16; Murray p. 10.

to promote the adoption of electrically-powered equipment as well as charging stations to promote EV adoption.[3]

Q: What is your recommendation to the Commission in this case?

A: Renew Missouri supports these program offerings as a way to further encourage renewable development. In recent years, Renew Missouri has focused on Ameren Missouri's lack of wind capacity and the benefits its customers were missing out on. Many of those concerns were included in Renew Missouri's report from last August "Opportunity Blowing By." That report is attached to my testimony as **Schedule JO-2**. Had these electrification programs been proposed at that time, Renew Missouri's position would have been different. However, in the interim, we have seen Ameren Missouri take significant steps to add renewable energy to its resource portfolio. The recently approved proposal to add 400 MW of wind energy, its recently approved "green tariff" program, and its pending application for an additional 157 MW of wind in the northwest part of Missouri demonstrate the Company is making progress towards adding renewable generation in order to provide its customers with cost-effective, renewable energy.

Because of this recent progress, Renew Missouri is encouraged that Ameren Missouri's efforts on EVs – to the extent they successfully encourage load growth – will be fueled by an increasing amount of wind and solar generation. The role EVs will play in modernizing the grid, battery development, and the future development of time-of-use pricing have potential to make EVs a natural and logical compliment to additional renewable resources. Despite the reluctance of certain stakeholders, regulated utilities in Missouri should play a role in developing EV charging infrastructure and encouraging EV

[3] Wills Direct, p. 3

adoption just as they have done in other states. Ameren Missouri's proposal in this case is a step in that direction and should be encouraged.

III. Load building programs

Q: Summarize the concerns that this is a "load building" program.

A: Both OPC and Staff offer testimony explaining this program will increase the energy sold by Ameren Missouri. OPC's Dr. Marke states that this is a "load building program to encourage the adoption of electrically powered equipment in place of fossil-fuel powered equipment. Such adoption should have the effect of reducing average rates to electric customers and may reduce environmental emissions."[4] Staff's Mr. Oligschlaeger testifies that the program is designed to "promote new loads in order to improve efficient utilization of the company's distribution system, with an ultimate goal of achieving certain financial benefits for its shareholders and customers."[5]

Q: How do you respond?

A: As an advocate for renewable energy and energy efficiency, I tend to look at load building programs with a skeptical eye. While I do not dispute the testimony offered in the case that transitioning to EVs can have some environmental benefits in terms of reduced emissions and create downward pressure on customer rates, the relationship between EVs and renewable generation remains complicated. For example, some within the coal industry have started looking to EVs as a way to boost their industry struggling to compete with more economic renewable generation.[6] Boosting coal sales should not be the goal of EVs;

[4] Marke Rebuttal, p. 3.
[5] Oligschlaeger Rebuttal, p. 4.
[6] *See* Holdman, Jessica. "Coal Sees Opportunity in Electric Cars." Bismark Tribune, 4 October 2018, https://bismarcktribune.com/business/local/coal-sees-opportunity-in-electric-cars/article_f5f56546-8470-55f3-9545-c1a83f1d7287.html.

if you want to drive "clean" you should fuel "clean". It is our belief that customers who want to purchase electric vehicles also want to see solar and wind be the primary source of power for such a vehicle. Yet, despite the posture from some in the coal industry, I believe EV adoption will encourage greater investment in renewable generation for a number of reasons. First, renewable generation is cost-effective. In its Levelized Cost of Energy ("LCOE") Report for 2018, the consulting firm Lazard – who is considered an eminent source on this topic – showed the mean LCOE for solar has decreased by thirteen percent in 2018 and wind has decreased by seven percent in 2018.[7] This decrease occurred after years of additional decreases in the levelized costs of these energies. That report is attached to my testimony as **Schedule JO-3**. As Ameren moves forward with its IRP and other relevant management planning, why should the Commission promote any other resources other than the lowest cost available. This is not going to be coal and this is not going to be gas. It is inconceivable why polices that promote anything other than the use of renewables would be considered.

Second, a growing number of customers want more access to renewable energy resources to meet their own sustainability metrics. This is evidenced by the 74 major companies that have signed on to support the Corporate Renewable Energy Buyers' Principles.[8] Furthermore, governmental bodies in Missouri are beginning to establish their own clean energy goals. The largest being the City of St. Louis, leading the way with a commitment to transition to 100 percent clean energy by 2035.[9] With this pressure from

[7] Lazard's Levelized Cost of Energy Analysis – Version 12.0, November 2018, available at https://www.lazard.com/perspective/levelized-cost-of-energy-and-levelized-cost-of-storage-2018/
[8] https://buyersprinciples.org/about-us/
[9] Board of Alderman of the City of St. Louis, Resolution No. 124, Session 2017-2018 available at https://www.stlouis-mo.gov/internal-apps/legislative/upload/resolution/res124-pres.pdf

large utility customers that are industry leaders and local governments utilities must continue to look to renewable generation to meet customers' need and preferences.

Third, as Staff's Mrs. Lange notes in her testimony, the Missouri Renewable Energy Standard ("RES") requirements are calculated based on a percentage of kWh energy sales.[10] This means that if EV adoption increases Ameren Missouri's energy sales the company must expand its renewable energy investments.

The combination of economics, customer preferences, and statutory requirements – taken together – provide a scenario where EV adoption should encourage and facilitate additional renewable generation. With that in mind, the Commission should view efficient electrification as a complimentary, and necessary, step towards a renewable future.

IV. Encouraging EV adoption

Q: How do OPC and Staff view Ameren Missouri's proposal to encourage EV adoption?

A: For OPC, Dr. Marke offers his view that the Commission should reject the "Business Solutions" programs because the technology (electric equipment) already has a commanding market share.[11] His view, then, is that additional rebates from the utility are not necessary. Regarding the "Electric Vehicle" component to the "Charge Ahead" program, Dr. Marke opposes the program because he believes that the best way for a utility to promote EV adoption would be through time-of-use rates that encourage charging during low-cost, off-peak hours rather than offering incentives.[12]

Staff's opposition is similarly based on its perception that rebate dollars from the utility are not necessary. Mr. Murray describes that funding from the VW Environmental

[10] Lange Rebuttal, p. 4.
[11] Marke Rebuttal, p. 10.
[12] Marke Rebuttal, p. 16.

Mitigation Plan presents opportunities to develop EVs and related charging infrastructure in Missouri.[13] Noting that, because of these funds, he believes the corridor charging program proposed by Ameren Missouri is not necessary.[14] Mr. Murray also discusses the market share of certain electric measures in Ameren Missouri's "Business Solutions" program while acknowledging that the market is not yet saturated.[15]

Q: How do you respond to Staff and OPC's concerns?

A: From an electrification perspective, the fact that electric forklifts and other equipment exist in the market to some degree is a good step, and if OPC is correct, will occur anyway eventually. Ameren Missouri's proposal is an attempt to *accelerate* that adoption in order benefit the environment and create financial benefits for shareholders and customers. If those are outcomes the Commission believes are good for the public and customers, it should encourage policies that accelerate those benefits.

The VW settlement funds, while nice to have, should be viewed as a *deus ex machina* – when a problem is solved by an unexpected and unlikely occurrence – rather than a consistent and structured policy. These funds, as well as the plan to spend them, certainly play a role in electrification. But the Commission and electric utilities also have a role. Kansas City Power & Light ("KCPL") installed and owns hundreds of charging stations as a way to EV adoption. Here, Ameren Missouri has taken a different approach, endorsed in Rebuttal testimony by ChargePoint's witness as one that has been successfully employed in other utility service territories and offers the "fastest deployments of charging stations, greatest competitive choice for customers, and least administrative burden to

[13] Murray Rebuttal, pp. 3-4.
[14] Murray Rebuttal, p. 10.
[15] Murray Rebuttal, pp. 5-6.

utilities and customers."[16] Permitting Ameren Missouri's programs here is a way for the Commission to lead in this important policy area and encourage investment in EVs and EV infrastructure rather than deferring to the stakeholders administering VW settlement funds.

Lastly, I agree with Dr. Marke that utilities should promote EV adoption through time-of-use rates that encourage charging during low-cost, off-peak hours. But I disagree that it should be the only way to promote EV adoption. Incentives have been successful in encouraging customer behavior as demonstrated by MEEIA programs and can be successful in encouraging electrification and EV adoption if the Commission permits this familiar, and tested, approach.

Q: Does this conclude your testimony?

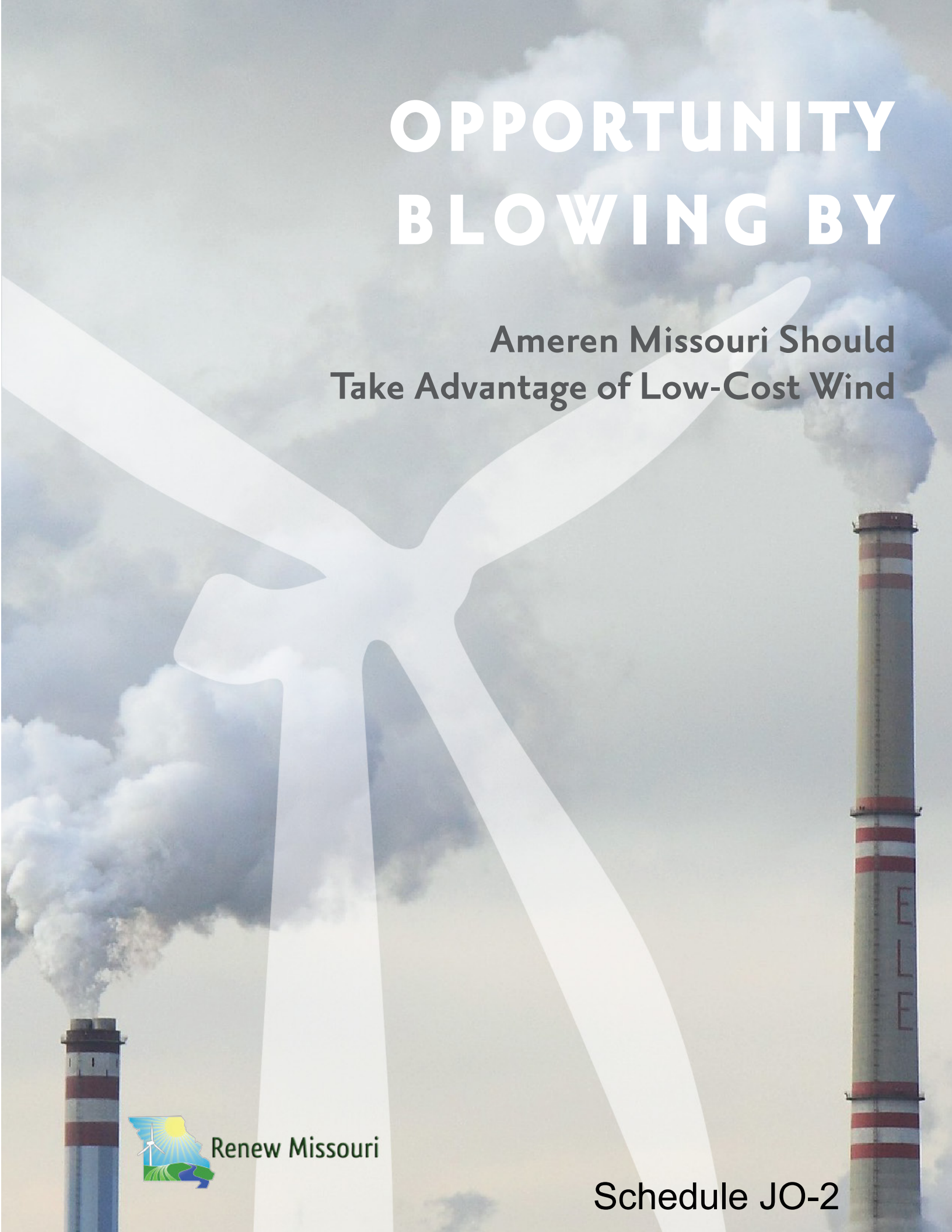
A: Yes.

[16] Ellis, p. 14.

CASE PARTICIPATION OF
JAMES OWEN

Date	**Proceeding**	**Docket No.**	**On Behalf of:**	**Issues**
10/20/2017	In the Matter of a Working Case to Explore Emerging Issues in Utility Regulation	EW-2017-0245	Renew Missouri Advocates	**Comments:** Distributed Energy Resources
2/7/2018	In the Matter of the Application of The Empire District Electric Company for Approval of Its Customer Savings Plan	EO-2018-0092	Renew Missouri Advocates	**Rebuttal**: Customer savings plan, wind generation, Asbury retirement, federal tax changes
Rebuttal 7/27/2018 Surrebuttal (9/4/2018)	In the Matter of KCP&L Greater Missouri Operations Company's Request for Authority to Implement a General Rate Increase for Electric Service In the Matter of Kansas City Power & Light Company's Request for Authority to Implement a General Rate Increase for Electric Service	ER-2018-0145/ER-2018-0146	Renew Missouri Advocates	**Rebuttal:** Demand Response Program **Surrebuttal:** Demand Response Program
6/8/2018	In the Matter of the Application of Union Electric	ET-2018-0063	Renew Missouri Advocates	**Surrebuttal:** Eligibility parameters, wind generation

	Company d/b/a Ameren Missouri for Approval of 2017 Green Tariff			
9/17/2018	In the Matter of Union Electric Company d/b/a Ameren Missouri's 3rd Filing to Implement Regulatory Changes in Furtherance of Energy Efficiency as Allowed by MEEIA	EO-2018-0211	Renew Missouri Advocates	**Surrebuttal:** Statutory Requirements of MEEIA
9/28/2018	In the Matter of the Application of Union Electric Company d/b/a Ameren Missouri for Permission and Approval and a Certificate of Public Convenience and Necessity Authorizing it to Construct a Wind Generation Facility	EA-2018-0202	Renew Missouri Advocates	**Surrebuttal:** Second Non-unanimous Stipulation and Agreement; Need for the project; Conservation conditions



OPPORTUNITY BLOWING BY

Ameren Missouri Should Take Advantage of Low-Cost Wind

Renew Missouri

Schedule JO-2

SEPTEMBER 2017

ABOUT RENEW MISSOURI

Renew Missouri, is a 501(c)(3) committed to promoting renewable energy and energy efficiency in Missouri. Since 2006, Renew has represented these policy interests before the Missouri General Assembly, the Public Service Commission, and in the hallways of local government all throughout the state. In this work, Renew Missouri works closely with businesses, residential consumer groups, and utility companies to develop practical solutions to these very real issues. Renew Missouri has successfully championed and advocated for laws including the creation of renewable energy standards as well as protections for the customers of solar, wind, and energy efficiency programs.

CONTACT US

You can reach Executive Director James Owen by email at james@renewmo.org. More information can be found at www.renewmo.org and you can follow us on Twitter at @renewMO.

Schedule JO-2

TABLE OF CONTENTS

LIST OF FIGURES

Schedule JO-2

EXECUTIVE SUMMARY

Ameren Missouri ("Ameren"), the largest investor-owned utility in the State of Missouri, is filing its long-term Integrated Resource Plan ("IRP") with regulators in the fall of 2017. This filing is a unique opportunity for Ameren to reverse its historical reliance on dirty energy—namely coal—and focus more on renewable energy options such as wind and solar. The changing economics of the energy marketplace make wind more affordable and less risky while dirtier forms of energy have become more expensive. Many other utilities similar to Ameren have already made the switch and seen the practical, pragmatic benefits of renewable energy. Located in one of America's windiest states and regions, Ameren can do the same and diversify a generation portfolio comprised almost exclusively of coal and nuclear sources. In turn, this long-needed transition will give Missouri homeowners and businesses a boost and open the door for economic opportunities previously unseen. This report recommends that Ameren commit to a multi-gigawatt wind addition, which will lower long-term electricity rates, protect against potential fossil fuel price increases, and decrease fossil fuel pollution. It will also have the added benefit of increasing Ameren's rate base and bottom line. Other utilities in the U.S. interior have recognized this win-win-win for their ratepayers, the environment, and their shareholders.
It's time for Ameren to do the same.[1]

KEY FINDINGS

- Ameren serves more customers than many of its closest peers but has the least amount of wind capacity, producing less than 1 percent of its energy from wind.

- Ameren has zero wind projects in development despite its location in one of the country's windiest states and regions. Missouri wind development lags far behind states with similar wind potential such as Illinois, Indiana and Michigan.

- Ameren's residential and business customers are paying more for electricity than customers in many neighboring states with more wind capacity. Other utilities in the U.S. interior have kept stable, low-priced rates while also rapidly transitioning their fleets to cleaner technology.

- Of the nation's 20 largest power producers, Ameren ranks as the second most coal dependent, with more than 70 percent of its electricity produced from coal. Coal generation and nuclear output from Ameren's single unit Callaway Energy Center total about 95 percent of Ameren's energy mix.

- Cost data suggests energy produced by Ameren's coal plants is now more expensive than energy that could be provided by new wind farms. These plants also are decades old—some dating to the 1950s—and soon will need to be replaced.

- Ameren has not produced a plan for meeting Missouri's Renewable Energy Standard ("RES"), which requires 10 percent renewable energy by 2018 and 15 percent by 2021. Ameren now supplies about 5 percent of its power through renewable sources, most of which comes from Ameren's legacy hydropower generators. The intent behind Missouri's RES is to spur new renewable capacity.

- Some of the largest, most successful companies in the country, including major Missouri employers such as WalMart, General Motors and Anheuser-Busch, have set 100 percent renewable goals. Although it has several renewable options now in development, Ameren currently offers no meaningful way for its corporate customers to access renewable energy. Moreover, Ameren's power mix offers no enticement for new or expanding companies to locate in the St. Louis area or other parts of Missouri served by Ameren.

- Financial analysts are now beginning to question Ameren's resistance to wind. On the company's most recent quarterly earnings call, its executive team was asked by three separate analysts about whether and to what extent wind investments were being considered.

INTRODUCTION

On Ameren's website, the investor-owned utility company states its vision plainly: "Leading the way to a secure energy future."[2] But Ameren's over-reliance on coal and lack of wind investments threatens that secure energy future, leaving customers open to fuel price spikes and preventing shareholders from realizing the benefits of the dominant technologies of tomorrow. Over the last generation, Ameren has done little to transition its generation portfolio to meet the changing energy landscape and remains heavily dependent on a handful of aging coal power plants. With slowly but continually rising coal generation costs, Ameren's customers risk being saddled with increasingly less competitive rates.

Transitioning from fossil fuels and toward wind energy has three major benefits: 1) Businesses and large consumers with growing demands for renewable energy can be attracted to the region, creating jobs and economic benefits; 2) replacing coal generation with cheap and predictable wind generation can result in lower electricity costs for all customers; and 3) reductions in carbon and other forms of pollution can mitigate environmental liability and regulatory uncertainty.

Wind, in particular, presents an opportunity for lowering rates because of the drastic reductions in cost in recent years and because of the Midwest's unique geographic environment that is very favorable for wind. Even in liked-minded, conservative states surrounding Missouri, investor-owned utilities are rapidly adding clean resources to their fleets and retiring their aging (and increasingly expensive) coal plants.

In Missouri, an IRP must be submitted every three years to the Public Service Commission ("PSC"), the governmental entity charged with regulating investor-owned utilities. The IRP lays out the utility's 20-year plan for investing in new generation and infrastructure. The required objective of the resource planning process is to provide the public with energy services that are safe, reliable, and efficient, at just and reasonable rates, in compliance with all legal mandates, and in a manner that serves the public interest.[3] Investor-owned utilities work with regulators and other stakeholders on a consistent basis to gather input and feedback. While not legally binding, Ameren does have a responsibility to provide its customers with safe and reliable service, as well as a fiduciary duty to provide value to its shareholders. Ameren Missouri can live up to both of these obligations by using the IRP process to chart a cleaner path forward.

In this report, we: 1) summarize Ameren's current power mix and the risks it poses for the future; 2) lay out the potential for a clean energy transition that can benefit both customers and the utility; 3) review the examples of other similarly-situated utilities throughout the country; and 4) recommend the steps Ameren should take to transition to cleaner, cheaper, more reliable energy sources.

AMEREN'S POWER MIX AND ELECTRICITY RATES

Ameren Lags on Wind

Ameren has an obligation under Missouri's Renewable Energy Standard ("RES") to achieve 10 percent renewable energy by 2018 and 15 percent by 2021. The company is currently supplying about 5 percent renewable energy—most of which is from legacy hydropower generators—and has provided no plan for meeting its RES obligations over the long-term.[4] The small amount of wind energy the company currently supplies is through a contract that expires in 2024, at which point Ameren would revert to having zero wind supply and only marginal solar resources.

This is striking because the Midwest is home to some of the greatest wind resources on the planet. Figure 1 shows a wind resource map for the United States. Areas with annual average wind speeds around 6.5 meters per second and greater are generally considered to have a resource suitable for wind farms.[5] Much of northern and western Missouri meets this threshold. Tapping these resources could bring significant economic benefits

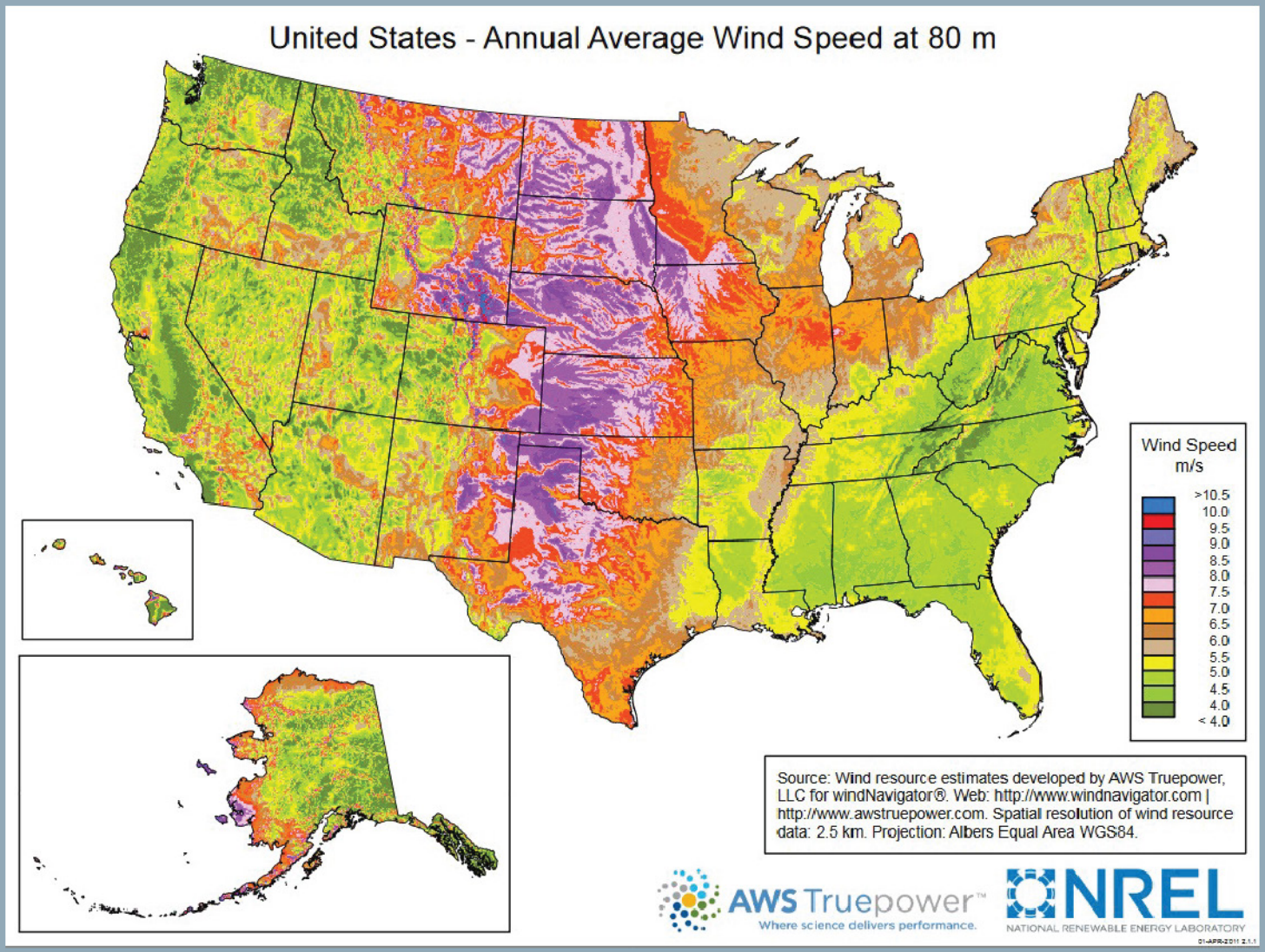


Figure 1 | U.S. Annual Average Wind Speed at 80 Meters

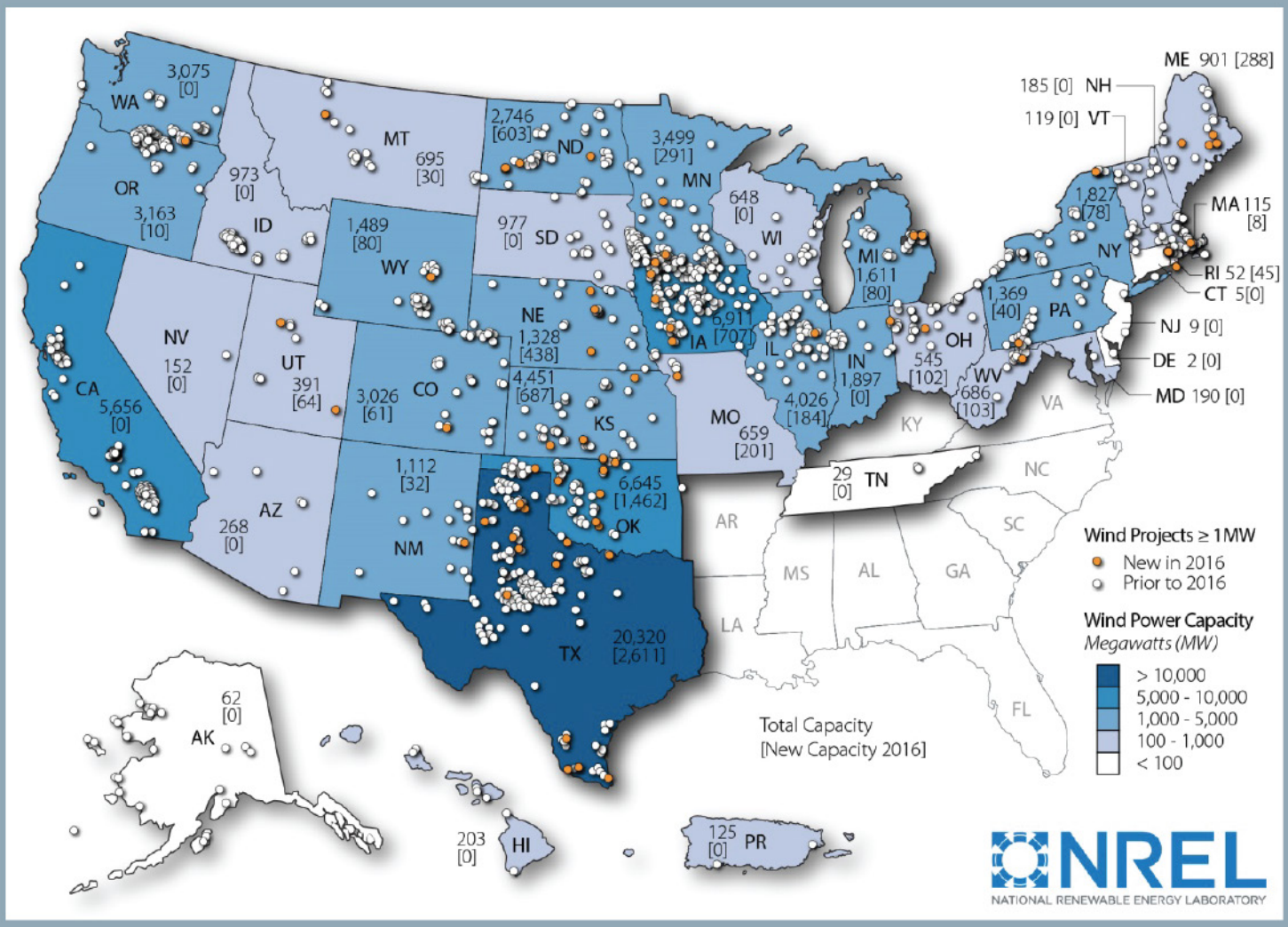


Figure 2 | *U.S. Wind Farms and Cumulative Capacity by State*

UTILITY	STATE(S)	Total Generating Capacity (MW)	Wind capacity currently owned/ purchased (MW)	Wind projects in development (MW)
Alliant Energy	IA/WI	7,389	600	1,000
Empire District	MO	1,480	255	0
KCPL	KS/MO	8,065	929	300
MidAmerican Energy	IA	9,389	4,009	2,000
Minnesota Power	MN	2,098	620	250
Omaha Public Power District	NE	3,355	812	160
Public Service Oklahoma (AEP)	OK	5,255	1,290	600
Southwestern Electric Power Co. (AEP)	AR/LA/TX	6,336	469	1,400
Westar	KS	4,874	1,768	0
Xcel Energy (NSP)	MN/ND/SD/WI	9,363	2,604	1,550
Xcel Energy (PSCo)	CO	6,648	2,566	600
Xcel Energy (SPS)	NM/TX	4,760	1,506	1,230
Ameren Missouri	MO	11,492	102	0

Figure 3 | *Wind Energy Use by Electric Utilities in Midwest and Plains*

Schedule JO-2

to the state, including spurring local investment, creating jobs, and expanding rural tax bases. Yet wind generation in Missouri lags far behind states like Illinois, Indiana, and Michigan that have similar resource potential (see Figure 2).[6]

Missouri also borders even windier states such as Iowa and Kansas. With appropriate transmission planning, Ameren could add wind generation from these or other nearby states to serve Missouri customers. The utility holding company AEP, for example, recently announced plans to build the largest wind farm in the United States, which will be located in Oklahoma's western panhandle and serve customers across four states, including non-windy Arkansas and Louisiana in addition to Oklahoma and Texas.[7]

In announcing the $4.5 billion investment, AEP's CEO Nicholas Akins explained, "This project is consistent with our strategy of investing in energy resources of the future, and it will save our customers money while providing economic benefits to communities."[8] AEP estimates the project will save its customers more than $7 billion over 25 years.

Other utilities in the middle and western parts of the country—including MidAmerican in Iowa,[9] Westar in Kansas,[10] and Xcel Energy in Colorado, Minnesota and the Dakotas[11] —are also transitioning to wind and far outpace Ameren. As Figure 3 shows, Ameren has the least amount of wind capacity of its closest peers and has zero wind projects in development.[12,13]

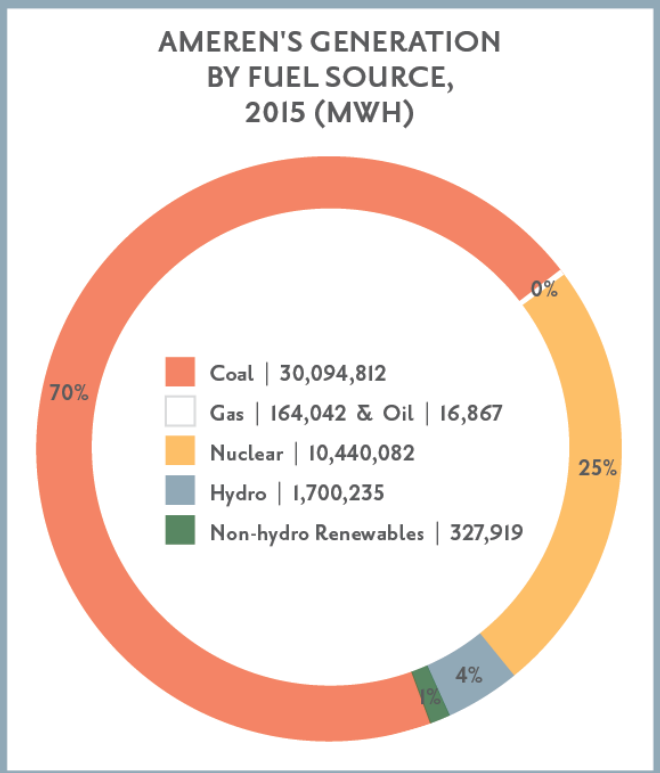


Figure 4 | *Ameren's Generation by Fuel Source, 2015 (MWh)*

Ameren is Heavily Reliant on Coal

Ameren's generation fleet remains among the least diversified in the nation. Failing both to diversify its assets and to adapt with changing times risks direct financial impact on the company as well as its customers.

Coal generation and nuclear output (from Ameren's single unit Callaway Energy Center) total about 95 percent of Ameren's mix (see Figure 4).[14] Ameren ranks as the twelfth largest coal generator of all U.S. utilities. Of the nation's 20 largest power producers, Ameren ranks as the second most coal dependent (see Figure 5).[15,16] This represents a stunning lack of portfolio diversity for a utility of Ameren's size and importance.

While generation mixes vary greatly across the United States (see Figure 6),[17] each region demonstrates far greater fuel diversity. Rapid change in the nation's fuel mix has been driven by a massive influx of wind, solar and gas generation that has become more economic than continuing to run legacy coal, nuclear, and gas steam generators.

Schedule JO-2

				Company Rankings Among 100 Largest Power Producers					
	Generation (MWh)			By Generation		By Total Emissions			
OWNER	Total	Coal	% from Coal	Total	Coal	SO2	NOx	CO2	Hg
Duke	217,660,843	76,702,725	35.2%	1	2	6	2	2	12
NextEra Energy	194,000,657	4,659,630	2.4%	2	53	51	21	10	49
Southern	185,909,900	62,640,702	33.7%	3	4	5	4	3	3
Exelon	180,032,937	208,813	0.1%	4	71	59	66	54	70
Tennessee Valley Authority	138,535,807	50,397,085	36.4%	5	7	3	7	7	7
AEP	137,800,140	95,413,466	69.2%	6	1	2	1	1	2
Entergy	130,443,218	8,936,490	6.9%	7	35	19	8	16	17
NRG	120,230,848	64,734,314	53.8%	8	3	1	6	4	4
Berkshire Hathaway Energy	116,157,574	59,015,752	50.8%	9	5	12	3	6	8
Calpine	109,780,918	-	0.0%	10	0	68	41	12	0
Dynegy	109,701,569	54,597,219	49.8%	11	6	8	11	5	23
Dominion	98,306,504	22,416,997	22.8%	12	17	29	22	14	22
FirstEnergy	86,464,896	49,258,091	57.0%	13	8	10	5	8	6
Xcel	73,504,981	41,710,610	56.7%	14	9	14	9	9	14
Talen Energy	69,649,204	24,898,664	35.7%	15	15	16	10	13	28
US Corps of Engineers	69,144,860	-	0.0%	16	0	0	0	0	0
Energy Future Holdings	62,503,772	41,689,054	66.7%	17	10	4	12	11	1
PSEG	56,152,089	5,571,415	9.9%	18	49	39	39	32	55
DTE Energy	42,785,264	30,933,978	72.3%	19	11	9	13	15	5
Ameren	42,416,038	30,094,812	71.0%	20	12	11	20	19	11

Figure 5 | *Ranking the Top 20 U.S. Power Producers*

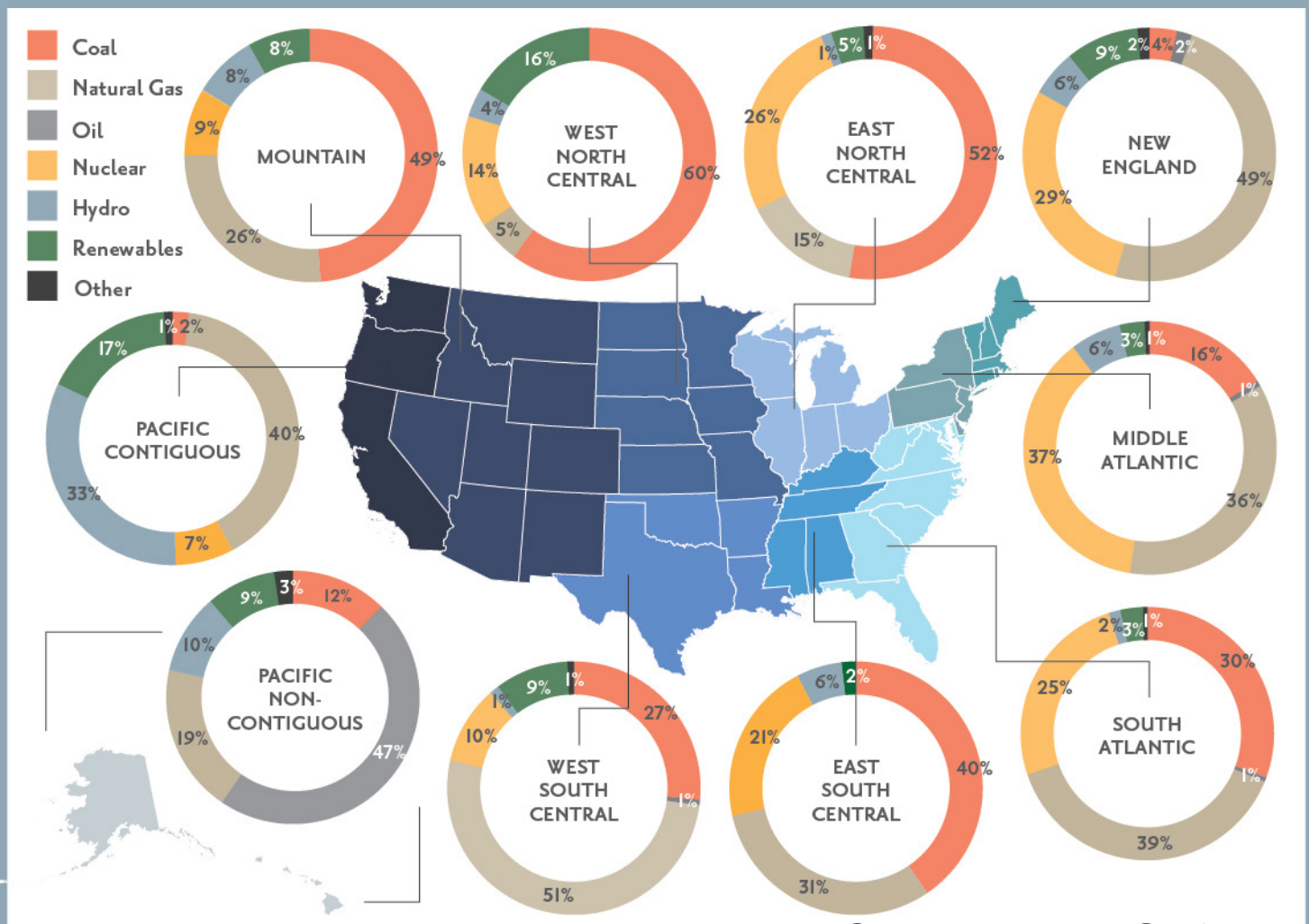


Figure 6 | *U.S. Electricity Generation by Fuel Source, 2015*

Ameren's Rates are Higher than its Regional Peers

Ameren frequently implies that transitioning to a cleaner fleet will entail significant costs for its customers, and that transitioning "responsibly" will take incremental action over decades.[18] This suggests that adding renewable energy is a luxury, but wind is now the cheapest form of new generation. Most utilities in the U.S. interior have already added significant levels of wind generation while managing to keep their rates competitive.

To illustrate this point, Figure 7 and Figure 8 display the average prices that households and businesses (respectively) are paying for electricity service from Ameren and its closest peers.[19] Ameren's residential rates are low on a national basis, but they are not providing a uniquely low-priced service when compared to other utilities in the U.S. interior (instead of those on the East or West coasts, where energy is typically more expensive). Nor are Ameren's peers somehow saddling their customers with high rates by aggressively pursuing wind additions. In the same vein, Ameren's commercial and industrial ("C&I") rates are far from the lowest in the region. Iowa's MidAmerican Energy, for example, has achieved some of the most competitive C&I rates in the nation while transitioning upwards of 40 percent of its generation to wind in recent years.

Note that these average price figures reflect the full amount that households and businesses are spending for their electricity, which is impacted by everything a utility does to supply electric service to its customers, such as maintaining transmission and distribution infrastructure, generator maintenance and upgrades, fuel costs, etc. Regardless, Ameren's customers are paying average or higher prices for electricity and since 2010 have seen steeper cost increases than customers of Ameren's peers. Many of Ameren's peers have been keeping stable, low-priced rates while also rapidly transitioning their fleets to cleaner technology.

Schedule JO-2

UTILITY	STATE	Residential Customers (2016)	2016	2015	2014	2013	2012	2011	2010	Percent Increase in 2016 from 2010
Alliant Energy	IA/WI	808,003	14.00	13.60	13.03	13.02	12.81	12.81	12.88	8.7%
Empire District	MO	143,554	12.96	12.56	12.12	11.76	11.59	11.18	9.94	30.4%
KCPL	KS/MO	750,556	12.67	11.97	11.60	11.31	10.93	10.56	9.91	27.9%
MidAmerican Energy	IA	574,953	10.23	9.75	9.21	8.92	8.83	8.40	8.37	22.3%
Minnesota Power	MN	121,836	10.20	8.86	9.21	9.25	9.18	9.38	9.66	5.6%
Omaha Public Power District	NE	323,784	11.47	11.07	10.68	10.68	10.12	9.37	9.22	24.4%
Public Service Oklahoma (AEP)	OK	470,006	8.62	9.07	8.88	8.43	8.01	8.49	7.95	8.5%
Southwestern Electric Power Co. (AEP)	AR/LA/TX	451,912	9.58	9.37	9.31	9.27	8.09	8.06	7.80	22.8%
Westar	KS	327,214	13.08	12.11	12.08	11.18	10.70	9.93	9.55	37.0%
Xcel Energy (NSP)	MN/ND/SD/WI	1,506,966	12.96	12.52	12.51	12.37	11.29	11.00	10.58	22.6%
Xcel Energy (PSCo)	CO	1,228,305	11.47	11.60	12.01	11.70	11.05	11.19	11.15	2.9%
Xcel Energy (SPS)	NM/TX	305,456	9.89	10.03	10.06	9.29	8.72	8.75	8.15	21.3%
Ameren Missouri	MO	1,047,640	10.73	11.34	10.38	10.53	9.69	9.17	8.15	31.6%

Figure 7 | *Average Price of Electricity for Residential Customers (nominal cents/kWh)*

UTILITY	STATE	C & I Customers (2016)	2016	2015	2014	2013	2012	2011	2010	Percent Increase in 2016 from 2010
Alliant Energy	IA/WI	146,251	8.65	8.29	8.02	7.96	7.60	7.70	7.97	8.5%
Empire District	MO	26,976	9.81	9.94	9.92	9.60	9.28	9.17	8.22	19.4%
KCPL	KS/MO	101,609	9.79	9.04	8.87	8.63	8.09	7.97	7.45	31.5%
MidAmerican Energy	IA	95,442	5.90	5.76	5.55	5.37	5.19	4.97	4.98	18.4%
Minnesota Power	MN	23,786	6.71	5.92	5.89	5.85	5.66	5.69	5.75	16.7%
Omaha Public Power District	NE	45,701	7.64	7.46	7.29	7.28	6.85	6.43	6.26	22.1%
Public Service Oklahoma (AEP)	OK	77,136	5.30	6.04	6.15	5.79	5.28	5.97	5.58	-5.0%
Southwestern Electric Power Co. (AEP)	AR/LA/TX	80,740	7.11	6.93	6.94	7.00	5.94	6.06	5.86	21.3%
Westar	KS	50,153	9.35	9.01	9.17	8.49	8.08	7.68	7.35	27.2%
Xcel Energy (NSP)	MN/ND/SD/WI	203,810	9.09	8.78	8.90	8.89	8.00	7.79	7.53	20.8%
Xcel Energy (PSCo)	CO	213,675	8.32	8.57	9.07	8.72	8.10	8.53	8.33	-0.1%
Xcel Energy (SPS)	NM/TX	84,027	5.25	5.47	6.01	5.53	5.01	5.30	5.19	1.2%
Ameren Missouri	MO	160,769	7.93	7.60	7.25	7.35	6.59	6.52	5.96	33.1%

Figure 8 | *Average Price of Electricity for Commercial and Industrial Customers (nominal cents/kWh)*

Schedule JO-2

THE BUSINESS AND ECONOMIC CASE FOR WIND

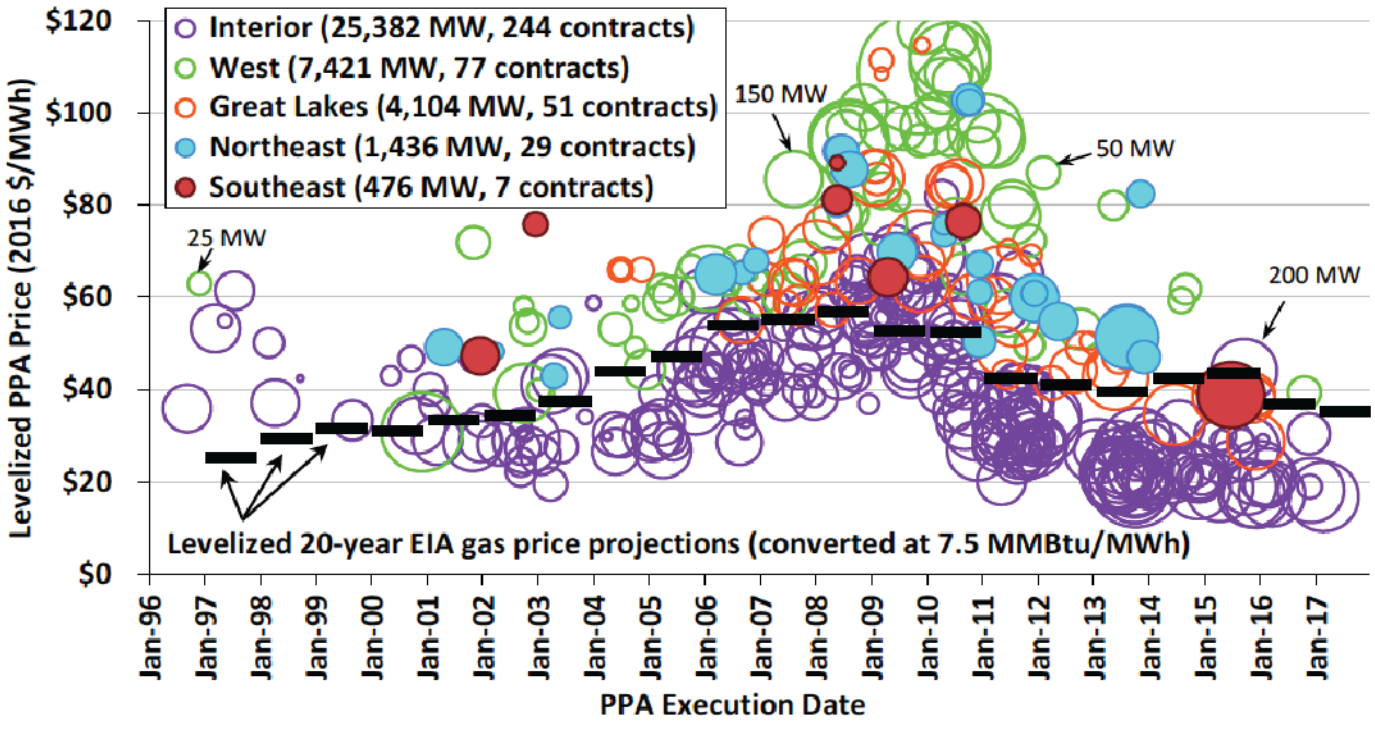
Wind Costs are Falling Dramatically

Wind generators are increasingly mature technology. Bigger, better turbines are enhancing project performance. Taller towers and increased blade lengths are among the important improvements that allow today's turbines to produce more energy from a wider range of wind speeds. These developments translate to higher capacity factors and ultimately result in lower project economics.

Wind turbine prices for recent orders are well below those seen even a few years ago. On an energy basis, wind projects across the U.S. interior are reportedly signing levelized Power Purchase Agreements ("PPAs") at below $20 per MWh levels (as shown in Figures 9 and 10).[20]

Pricing at that level is so low that new wind farms could potentially supply energy more affordably than what it costs to provide power from some of Ameren's coal units. While this pricing includes effects of the federal wind production tax credit, which is gradually rolling off, utilities regionally—except for Ameren—are rushing to lock in this exceptionally low-cost energy for their customers.

Wind Power Price Trends



Schedule JO-2

Longer term, due to continuing technological innovation, wind is expected to remain competitive even after subsidies roll off. Energy analysts now say that wind is or soon will be the lowest-cost source of energy on a levelized and unsubsidized basis (though solar costs are also dropping precipitously):

- Bloomberg New Energy Finance forecasts solar and wind to be the lowest-cost sources in the United States by 2023 and to dominate the future of electricity.[21]

- The financial advisory and asset management firm Lazard reports that renewables even without subsidies are now the cheapest source for new electricity generation in some locations in the U.S.[22]

- NextEra Energy Resources, the largest owner of wind capacity in the United States, anticipates wind power to be the lowest cost energy resource in the post-2020 period, ranging from $20-$30 per MWh.[23]

- A new report by the U.S. Department of Energy's National Renewable Energy Laboratory estimates that technological advances can drive unsubsidized levelized wind energy costs to an average of $23 per MWh by 2030.[24]

Ameren's 2016 IRP update had projected adding 600 MW of natural gas-fired combined cycle capacity in 2034. Since wind is now routinely being projected as the lowest cost source of new energy, Ameren should be looking first to add renewables to meet its future needs.

Wind Power Price Trends

Recent Wind Prices Are Hard to Beat: Competitive with Expected Future Cost of Burning Fuel in Natural Gas Plants

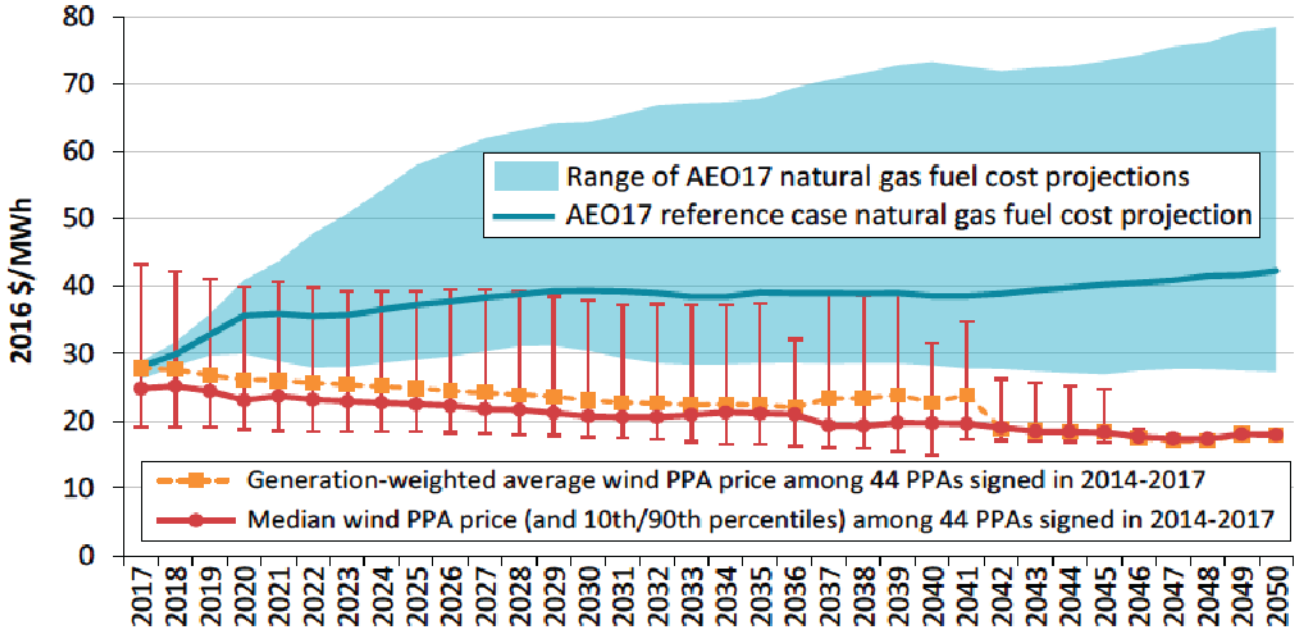


Figure 2: Wind Power and Gas Price Projections

Coal is More Expensive than Wind

The economics of coal-fired generators have been growing less favorable over the past several years. This is due largely to changing market fundamentals that are unlikely to reverse.

Ameren's coal fleet is not immune to these pressures. As Figure 11 shows, fuel costs alone appear to be in a range that likely makes coal more expensive than wind energy. It is critical to note that the amounts in Figure 11 are only average fuel expenses, whereas a generator's true marginal generation cost would also need to add in each unit's other variable expenses.[25] For coal units, this tends to add about another $5 per MWh on top of its fuel costs.[26] There is some plant-by-plant variation depending largely on the types of emissions/environmental controls as well as ash handling and disposal requirements.[27] In fact, many of the recently installed or planned pollution controls at Ameren's coal plants will further raise those units' variable operations and maintenance costs (including a projected increase of $2.20/MWh at the Labadie plant).[28] If wind farms or other forms of renewable energy can provide electricity at lower cost than its current generating fleet, Ameren has a responsibility to its customers to make the switch.

Ameren has paid more for delivered coal over the last several years, which is reflected in the price increases shown in Figure 11. Ameren also anticipates that coal prices will only get more expensive over time, according to its 2016 IRP update.[29]

The potential for fossil fuel price increases makes wind energy even more valuable. Since it has zero fuel cost, wind is an effective hedge that can help protect ratepayers from commodity price increases and volatility. This is particularly relevant given the heavy fossil fuel reliance of Ameren's current fleet.

Regardless, in addition to getting more expensive to operate, Ameren's generation facilities are also getting quite old. Figure 12 shows Ameren's coal and nuclear units by the year each generating unit was brought into service.[30] Rush Island 2, Ameren's newest coal unit, is now over 40 years old. Just like a well-used car, aging equipment requires additional maintenance and occasional upgrades to continue reliable operations. At some point, it is always more economical to transition and invest in something new.

COAL UNIT	2016	2015	2014	2013	2012	2011	2010
Labadie 1	$21.89	$21.09	$21.21	$20.44	$19.05	$15.29	$13.35
Labadie 2	$22.08	$21.16	$21.01	$19.97	$19.04	$15.83	$14.04
Labadie 3	$22.08	$21.29	$21.55	$20.63	$19.46	$15.58	$13.48
Labadie 4	$21.72	$21.19	$21.12	$19.96	$18.76	$15.22	$13.40
Meramec 3	$23.55	$25.58	$25.89	$25.44	$23.38	$22.49	$18.95
Meramec 4	$22.62	$22.36	$25.24	$24.59	$22.49	$21.61	$17.79
Sioux 1	$23.71	$24.14	$22.40	$21.81	$22.12	$22.01	$22.83
Sioux 2	$22.21	$21.39	$23.28	$22.66	$22.55	$21.72	$23.11
Rush Island 1	$22.11	$21.65	$23.03	$22.35	$21.32	$19.95	$18.06
Rush Island 2	$21.39	$20.68	$21.52	$19.74	$17.88	$17.61	$16.35

Figure 11 | *Generation Fuel [illegible] Coal Fleet (nominal $/MWh)*

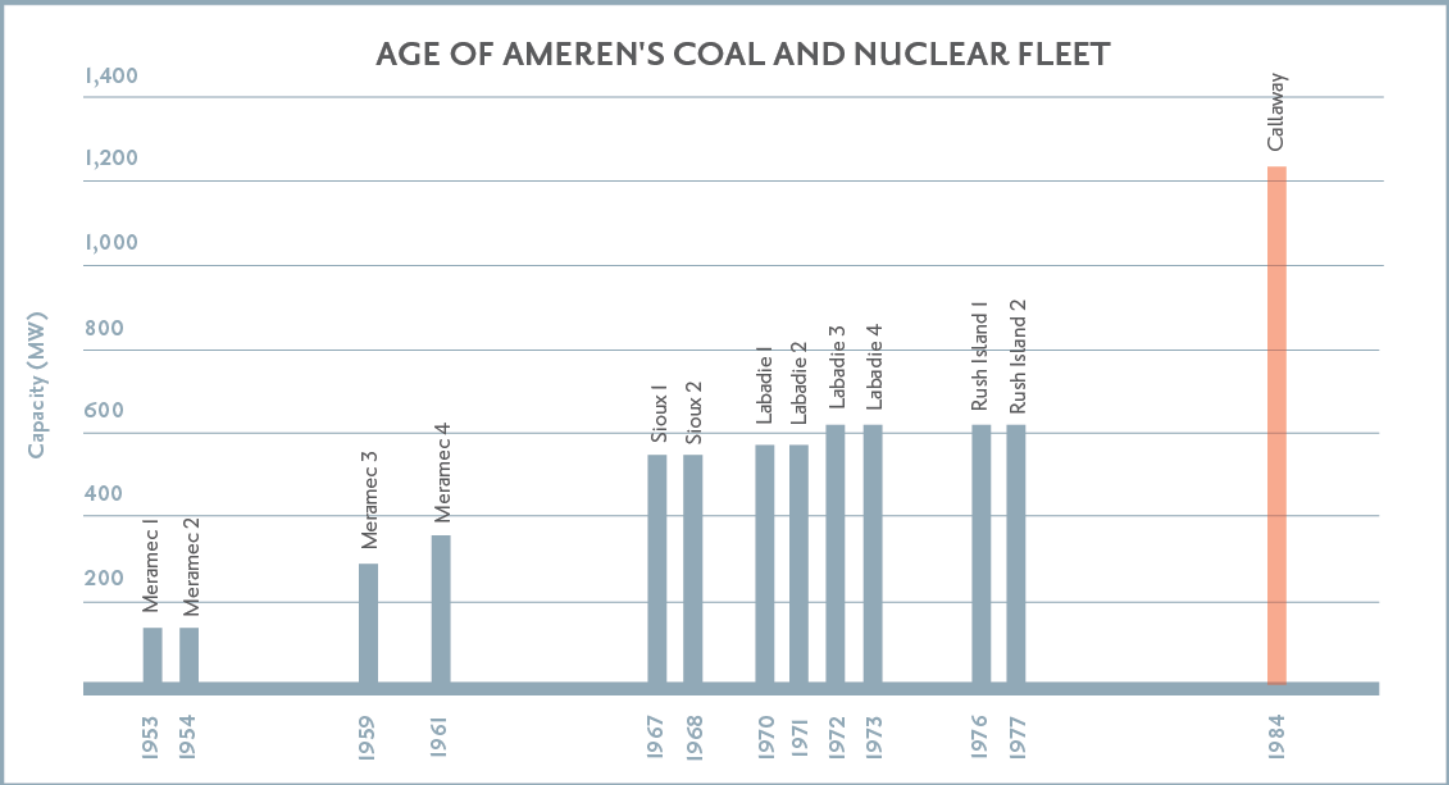


Figure 12 | *Age of Ameren's Coal and Nuclear Fleet*

Ameren's Heavy Dependence on Coal is Risky

Ameren's dependence on a single resource and a small number of generation units carries inherent risks. In the power sector, recent questions around fuel assurance and overreliance have mostly been associated with natural gas. However, rail lines share some of the concerns of pipelines, and fuel logistics can cause issues that are not unique to gas generators.[31]

Most of the coal used by Ameren comes from Wyoming's Powder River Basin (which produces about 45 percent of coal used nationwide, nearly all via the 103-mile Joint Line rail corridor). This transportation process has failed before. Indeed, coal rail service disruptions due to derailment, freezing, flooding, or other natural occurrence are quite common, and the risk is likely to increase with extreme weather patterns caused by climate change.[32]

Moreover, relying on a small number of very large power plants carries risk because every kind of electricity generator can and does break down occasionally. The average rate of technical failures for the U.S. coal fleet is much higher than for wind or solar photovoltaic generators.[33]

Reliance on "baseload" generators is also becoming an increasingly antiquated notion. The baseload term historically referred to plants that ran around-the-clock because they had the lowest variable operating costs. This concept is no longer helpful for resource planners because other generation technologies, including wind, can now frequently provide energy at more favorable economics.[34]

Increasing supply diversity can protect ratepayers by improving system flexibility, adaptability, and resiliency capabilities. For example, the grid-operator for the mid-Atlantic region recently concluded that its evolving resource mix (and diminishing dependence on coal) will create a portfolio that is more balanced and high-performing.[35] No technology is free from the risk of failure, but a more diverse and decentralized resource mix can minimize the threat and ultimately enhance grid reliability.

Schedule JO-2

Ameren's Customers are Demanding Greater Access to Renewable Energy

There is a tremendous demand for clean energy amongst Ameren's business and residential customers. This demand is currently going unmet because of a lack of state policies or utility programs allowing them to purchase renewable energy. By taking steps to meet this demand among its customers, Ameren could satisfy the twin aims of lowering its customers' bills and diversifying its generation portfolio.

Nowhere is the demand for more clean energy options clearer than among Ameren's large commercial and industrial customers. Businesses and large power consumers have a clear economic interest in reducing their bills over the long term

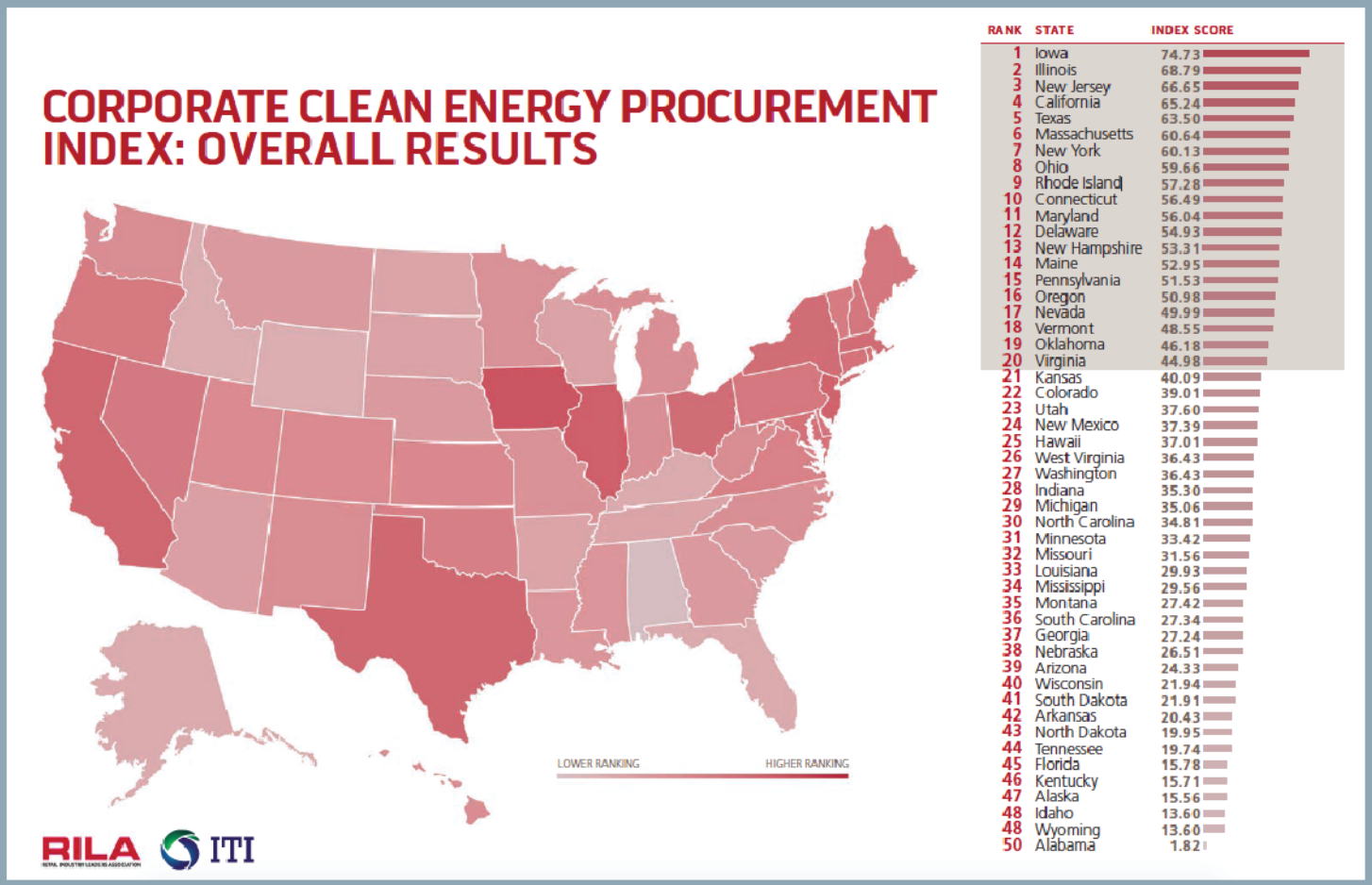
COMPANY	GOAL	DESCRIPTION
WalMart	100% renewable	Walmart is one of the largest employers in Missouri, with approximately 156 retail locations and four distribution centers across the state that employ more than 40,000 people. Walmart is committed to sourcing 100% of its electricity from renewable energy. The company aims to produce or procure 7,000 GWh of renewable energy globally by the end of 2020.[36]
General Motors	100% renewable by 2050	GM operates a major factory in Missouri, Wentzville Assembly, which provides approximately 4,500 jobs just outside of St. Louis. GM plans to meet the electricity needs of its 350 operations in 59 countries with 100% renewable energy by 2050.[37]
AB InBev	100% renewable by 2025	Anheuser-Busch was founded and is headquartered in St. Louis, Missouri. Today, the company is a wholly owned subsidiary of AB InBev, which also has its North American headquarters in St. Louis. AB InBev recently committed to transitioning its global operations to 100% renewable electricity and set a target to secure 100% of the company's purchased electricity from renewable sources by 2025.[38]
Nestlé Purina	100% renewable; reduce GHGs by 35% by 2020	Nestlé Purina Petcare is a subsidiary of Nestlé based in St. Louis, Missouri. Nestlé is committed to transitioning to 100% renewable electricity, to help deliver on its science-based target to reduce greenhouse gas emissions per tonne of product by 35% in its manufacturing operations by 2020 based on 2010 levels.[39]
Bank of America	100% renewable by 2020	Bank of America is a major Missouri employer. Bank of America has set a goal to become carbon neutral and purchase 100% renewable electricity by 2020.[40]
Procter & Gamble	30% by 2020; long-term goal of 100% renewable	One of the largest Procter & Gamble plants in the United States is in Cape Girardeau, Missouri, producing Bounty Paper Towels, Charmin Toilet Paper, Pampers Diapers, and Luvs Diapers. P&G has a short-term goal to source 30% of its energy from renewable sources by 2020 with a long-term goal to power its plants with 100% renewable energy.[41]
Unilever	100% renewable by 2030	Unilever operates a plant in Jefferson City, Missouri that recently celebrated its 50-year anniversary in 2016. The plant produces various Dove, Suave, Axe and Sunsik products. Unilever aims to be 'carbon positive' in its operations by 2030. To achieve this, the company is committed to sourcing 100% of total energy across its operations from renewables by 2030, and to sourcing all grid purchased electricity from renewables by 2020. [42]

Figure 13 | *Ameren's Corporate Customers' Renewable Energy Commitments*

and becoming insulated from fuel price volatility, and they have taken notice of falling wind and solar prices. As seen in Figure 13, many of Ameren's largest corporate customers have made public commitments to procure 100 percent of their energy needs from renewables in the near future. Other companies with a major presence in Missouri that support renewable energy include: Target, UPS, Home Depot, Ford Motor Company, Boeing, Lowe's, Monsanto, and Walgreens.

In addition to meeting the needs of companies already located in Ameren's territory, access to renewable energy has the potential to attract new businesses, thus bringing in new jobs and economic benefits to the region. Particularly for companies in the burgeoning tech sector, renewable energy is a central concern. Amazon recently invited cities to bid on an RFP to determine where the company will locate its second corporate headquarters (the so-called Amazon HQ2 RFP).[43] Amazon was the country's largest corporate purchaser of renewable energy in 2016, and the company clarified its intent to develop HQ2 with a particular eye on renewables and sustainability.[44] Similarly, Apple recently committed to invest $1.4 billion toward a data center project in Iowa; Apple C.E.O. Tim Cook said renewable energy was "paramount" to the decision: "For us, [renewable energy is] kind of a gate. If we couldn't do that, we wouldn't be here," Cook said.[45] If the St. Louis region were able to compete for these types of projects, it could bring significant amounts of new electricity load to Ameren's system, along with economic development and jobs.

Policies exist that would allow Ameren to offer renewable energy and corresponding benefits to its customers. Many Midwestern utilities have chosen to allow third-party PPAs, offer their customers



RANK	STATE	INDEX SCORE
1	Iowa	74.73
2	Illinois	68.79
3	New Jersey	66.65
4	California	65.24
5	Texas	63.50
6	Massachusetts	60.64
7	New York	60.13
8	Ohio	59.66
9	Rhode Island	57.28
10	Connecticut	56.49
11	Maryland	56.04
12	Delaware	54.93
13	New Hampshire	53.31
14	Maine	52.95
15	Pennsylvania	51.53
16	Oregon	50.98
17	Nevada	49.99
18	Vermont	48.55
19	Oklahoma	46.18
20	Virginia	44.98
21	Kansas	40.09
22	Colorado	39.01
23	Utah	37.60
24	New Mexico	37.39
25	Hawaii	37.01
26	West Virginia	36.43
27	Washington	36.43
28	Indiana	35.30
29	Michigan	35.06
30	North Carolina	34.81
31	Minnesota	33.42
32	Missouri	31.56
33	Louisiana	29.93
34	Mississippi	29.56
35	Montana	27.42
36	South Carolina	27.34
37	Georgia	27.24
38	Nebraska	26.51
39	Arizona	24.33
40	Wisconsin	21.94
41	South Dakota	21.91
42	Arkansas	20.43
43	North Dakota	19.95
44	Tennessee	19.74
45	Florida	15.78
46	Kentucky	15.71
47	Alaska	15.56
48	Idaho	13.60
48	Wyoming	13.60
50	Alabama	1.82

Figure 14 | *Corporate Clean Energy Procurement Index: Leadership Rankings*

"green tariffs," and other options. A 2017 report prepared by the Retail Industry Leaders Association ("RILA") and the Information Technology Industry Council ("ITI") ranked all 50 states in terms of how well they provide corporate access to renewable energy.[46] The report focused on three main criteria for evaluating states: 1) utility purchasing options (e.g. green tariffs); 2) third-party purchasing options (e.g. sleeved PPAs), and 3) onsite/direct deployment options.[47] While other states in the U.S. interior scored quite high in the index (Iowa: first, Illinois: second, Texas: fifth, Ohio: eighth, Oklahoma: 19th), Missouri came in at a dismal 32nd (see Figure 14).

As Missouri's largest utility and power provider, Ameren is in large part responsible for this low ranking. Unlike the Des Moines-based MidAmerican Energy, Ameren offers no meaningful way for its corporate customers to procure renewable energy in order to meet their goals and take advantage of the predictably low price point of renewables. Similarly, Ameren's power mix offers no enticement for the companies of tomorrow to locate in its territory. Without developing specific policies and programs to address the growing corporate renewable demand among its customers, Ameren will not be well positioned to attract new load to its system or to retain the large consumers it already has.

Ameren recently took its first major action to address this problem, announcing that it will file for approval of a green tariff program on Nov. 1. In its "Notice of Filing" with the Missouri PSC, Ameren stated that the new program "will allow for Ameren Missouri to enter into Power Purchase Agreements ("PPAs") on behalf of large customers who want to satisfy a large portion of their energy needs with renewable energy."[48] Ameren Missouri President Michael Moehn also commented, "Ameren Missouri fully supports the efforts of all of our customers, including local governments and businesses, seeking to receive more of their energy from renewable sources. We share the desire for renewable energy. That's why we're embracing new technologies and expanding service offerings that include a wide range of innovative and renewable energy solutions."[49]

Ameren's recent announcement is an encouraging sign for customers, but Ameren will need to move fast to avoid missing major opportunities. Ameren's green tariff announcement came just before Anheuser-Busch announced that it will meet nearly 50 percent of its energy needs through a wind deal in Oklahoma.[50] Ameren could have pursued a similar deal by agreeing to provide one of its largest, oldest, and most iconic customers with access to cheap, local renewable energy; such a deal could have been a boon for Ameren's public relations and its shareholders. Ameren should rush to claim similar opportunities as they present themselves in the future.

Shareholders are Demanding Utilities Transition to Clean Energy

Ameren's shareholders are urging the utility to embrace a cleaner future. Mercy Investment Services led a shareholder resolution in 2017 requesting Ameren produce a strategy for complying with climate change reductions consistent with a 2-degree Celsius goal.[51] This resolution, driven by Ameren's heavy reliance on coal, narrowly failed with 48 percent support. Shareholders also gave 46 percent support to another 2017 resolution focused on identifying and reducing coal-ash-related environmental and health hazards.[52]

These concerns are not likely to go away, as Wall Street is increasingly concerned with climate risk transparency. While activist shareholders have pushed publicly traded companies on climate change for years, these efforts have become mainstream after gaining the support of some of the world's largest institutional investment firms like Blackrock and Vanguard Group.[53]

Importantly, transitioning to clean energy need not constrain profits. Regulated utilities make money for their shareholders by earning an allowed rate of return on investments they make to serve their customers. Many utilities are now building wind farms because they realize it is a significant

Schedule JO-2

opportunity to add to their rate base. Not only is wind good for ratepayers and the environment, it also can increase a utility's bottom-line.[54]

In the past, Ameren saw direct financial incentive in keeping its old generation facilities up and running. The ongoing maintenance and upgrades in new pollution control technologies represent revenue opportunities for the company. Changing economic realities, however, are slowly rendering these legacy plants unnecessary. Utilities like Ameren will face revenue pressures if they cannot find new investments. Renewable assets offer such an opportunity.

Financial analysts are now beginning to question Ameren's plans. On the company's most recent quarterly earnings call, its executive team was asked by three separate analysts about whether and to what extent wind investments were being considered. For example, Michael Lapides from Goldman Sachs inquired:[55]

> *A quick question on Missouri. Warner [Warner Baxter, company Chairman, President and CEO], you commented a little bit about changing generation fleet and I'm just curious. You're one of the few utilities in the region that has not really, when you look at generation supply, benefited both by sizeable, in Missouri, transmission, growth that leads to a sizeable amount of wind generation entering your service territory and maybe replacing some fossil generation. Can you talk a little bit about whether you see that as a significant opportunity either via owning wind plants and rate base or in the need for incremental transmission in Missouri to be able to connect to the west where there's lots of great wind to resource?*

It is unusual for wind to receive this level of attention on a utility's earnings call. Ameren's leadership had not been asked a single question on wind or other potential renewables investments on their previous calls (dating at least since Q1 2014). But analysts covering the electric utility sector understand very well the evolving economics of competing generation technologies, where other utilities are finding significant new revenue opportunities, and relative corporate performance. The timing of the call also closely followed AEP's blockbuster announcement that it will be adding 2 GW of wind for its utilities in Arkansas, Louisiana, Oklahoma and Texas.[56]

The company's executive team responded on the call by saying Ameren is "going to transition our generation portfolio to a more diverse cleaner portfolio, but we'll do it in a responsible fashion," with more details to come in the upcoming IRP this October. With cleaner technologies having become more economic, the most responsible action is to adopt wind as fast as possible, just as Ameren's peers are doing.

MIDWEST AND PLAINS UTILITY EXECUTIVES UNDERSTAND THE VALUE OF WIND

Other utility companies in the Midwest and Great Plains have recently expressed eagerness to capitalize on opportunities to transition their fleets.[57] See below for recent statements from utility executives regarding the benefits of a clean energy transition:

Ben Fowke, CEO of Xcel Energy:

- "If I were talking to you 10 years ago, I don't think I'd be telling you that I think solar is competing with fossil. I wouldn't tell you that wind is beating fossil. I am telling you that now."
- "What's even more amazing is the prices. We're looking at [prices] in the low teens to low 20s [in dollars/MWh] — not starting prices, but levelized across the 25-year life of the project... That beats gas, even at today's prices."
- "I like to say we backed up the truck because the fuel of tomorrow was on sale today."[58]

Nicholas K. Akins, Chairman, President and CEO of AEP:

- "AEP is moving to a cleaner energy future, driven by new technologies and the expectations of our customers and shareholders. We are diversifying our generation mix to include more renewables, and we're also investing in a smarter, more efficient and resilient electricity grid to support these new resources and technologies. This project [investing $4.5 billion to build the nation's largest wind farm in Oklahoma's western panhandle] is consistent with our strategy of investing in the energy resources of the future, and it will save our customers money while providing economic benefits to communities."[59]
- "While it appears $4.5 billion is a big number, if you built a central-station generation facility like a coal unit or something like that, it would be as big or bigger, but much more risky."[60]

Bill Fehrman, CEO and President of MidAmerican Energy:

- "Our customers want more renewable energy, and we couldn't agree more. Once the project is complete, we will generate wind energy equal to 85 percent of our annual customer sales in Iowa, bringing us within striking distance of our 100 percent renewable vision."[61]
  (Note: MidAmerican Energy's average retail prices in Iowa are seventh lowest in the United States, approximately 38 percent below the national average.)

Schedule JO-2

Doug Kopp, President of Alliant Energy's Interstate Power and Light subsidiary:

- "The customers and communities we serve will benefit from this cost effective clean energy... Our wind projects will help keep energy costs stable over the long-term for customers."[62]

Ben Lipari, Director of Resource Development, Alliant Energy:

- "As other fuel costs will rise and fall ... wind and solar, renewables in general, will allow for very competitive costs for our customers in the future."[63]

Noel Rahn, Founder and CEO of Geronimo Energy:

- "I call wind 'oil above the ground.'"[64]

David Hudson, President, Xcel Energy - New Mexico, Texas:

- "The decision to add additional wind generation is purely in the economic interest of our customers. These new wind facilities will cost $1.6 billion to build, but will allow us to produce wind energy at a cost lower than energy produced at our coal and natural gas-fueled plants. These lower energy costs, in addition to savings from tax credits, add up to more than $2.8 billion in nominal customer savings over 30 years."[65]

MOVING FORWARD

Ameren has the opportunity to take advantage of favorable market conditions that favor wind energy over coal. Other utilities from this part of the country have already recognized this opportunity and achieved financial benefit for their customers and shareholders alike. Below are our recommendations for how Ameren Missouri should proceed:

- Ameren—either through its 2017 IRP process or via a standalone action—should immediately pursue a multi-gigawatt wind addition. Anything less represents incremental action that fails to properly diversify the company's generation mix or take advantage of favorable wind economics in a way that maximizes benefits for customers and Ameren shareholders.

- Ameren should strive to complete these key wind investments over the next three years. The timeliness of Ameren's wind investments is of vital importance. The current federal wind production tax credit steps down in 2017, 2018, and 2019, after which it will expire entirely. Ameren should act fast to secure the most advantageous pricing for its customers as the PTC phases out, and economic modeling of the PTC's phase out should be included in Ameren's IRP.

- Ameren's 2017 IRP should include proposals to close its oldest coal plants earlier than previously planned. Ameren already has announced future plans to close its Meramec and Sioux coal units, but these closures can, and must, be done much sooner. One only needs to look at the western part of the state where Great Plains Energy—the holding company for Kansas City Power & Light (KCPL) and KCPL Greater Missouri Operations—has laid out an aggressive coal and natural gas plant closure schedule over the next few years. Great Plains Energy proves a large-scale, coal-reliant utility can take expedient measures to limit coal-produced energy.

- Ameren's 2017 IRP should appropriately consider the value of wind investments in terms of the savings they can provide against the full incremental costs of maintaining the company's coal units, including the planned future environmental upgrades anticipated over the life of these coal units.

- Shareholders should demand that Ameren leadership articulate a plan that can capitalize on a major wind investment. Owning and rate-basing at least some portion of a multi-gigawatt wind buildout, as well as any necessary transmission upgrades, represents a unique organic growth opportunity for Ameren's owners.

With its upcoming IRP, Ameren can seize the occasion to lay out a plan for the future. Transitioning to renewables minimizes the costs associated with burning coal, reduces the regulatory liability that comes from compliance matters with the state and federal government, and meets market demands. Customers increasingly expect access to renewable energy, and will be making decisions whether to stay or to locate in Ameren territory based in no small part on the renewable policies available. Shareholders and investors are also paying attention to Ameren's investments in clean energy and overreliance on coal. Missouri's economy is counting on Ameren taking advantage of the economic benefits that accompany a transition away from fossil fuel generation and toward the increasingly cheap clean energy technologies of the future.

ENDNOTES

1. Note that this paper is not intended to address Ameren Illinois; Ameren does not own or operate the generation resources used to supply its Illinois subsidiary. Generation for Illinois customers (both Ameren Illinois and ComEd) is sourced via the Illinois Power Agency, which is also responsible for meeting that state's newly upgraded Renewable Portfolio Standard.
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12. The peer group used in Figures 3, 7, and 8 is a selection of the larger, vertically integrated utilities in Missouri and nearby states.
13. For Figure 3, note that 1 MW is approximately equal to the power used by 700 Missouri households. Total generating capacity figures are based on generator nameplate capacity data, include only owned generation assets [excludes power purchase agreements], and may also somewhat over or understate a utility's total generating capacity due to the allocation of some jointly-owned power plants. While Westar now has no wind in development, they just completed additions of 400 MW from the Kingman and Ninnescah Wind Energy Centers. Source: 2015 EIA Form 860 data and public announcements.
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Schedule JO-2

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Schedule JO-2

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Schedule JO-2

NOVEMBER 2018

LAZARD'S LEVELIZED COST OF ENERGY ANALYSIS—VERSION 12.0

LAZARD

Schedule JO-3

Introduction

Lazard's Levelized Cost of Energy ("LCOE") analysis addresses the following topics:

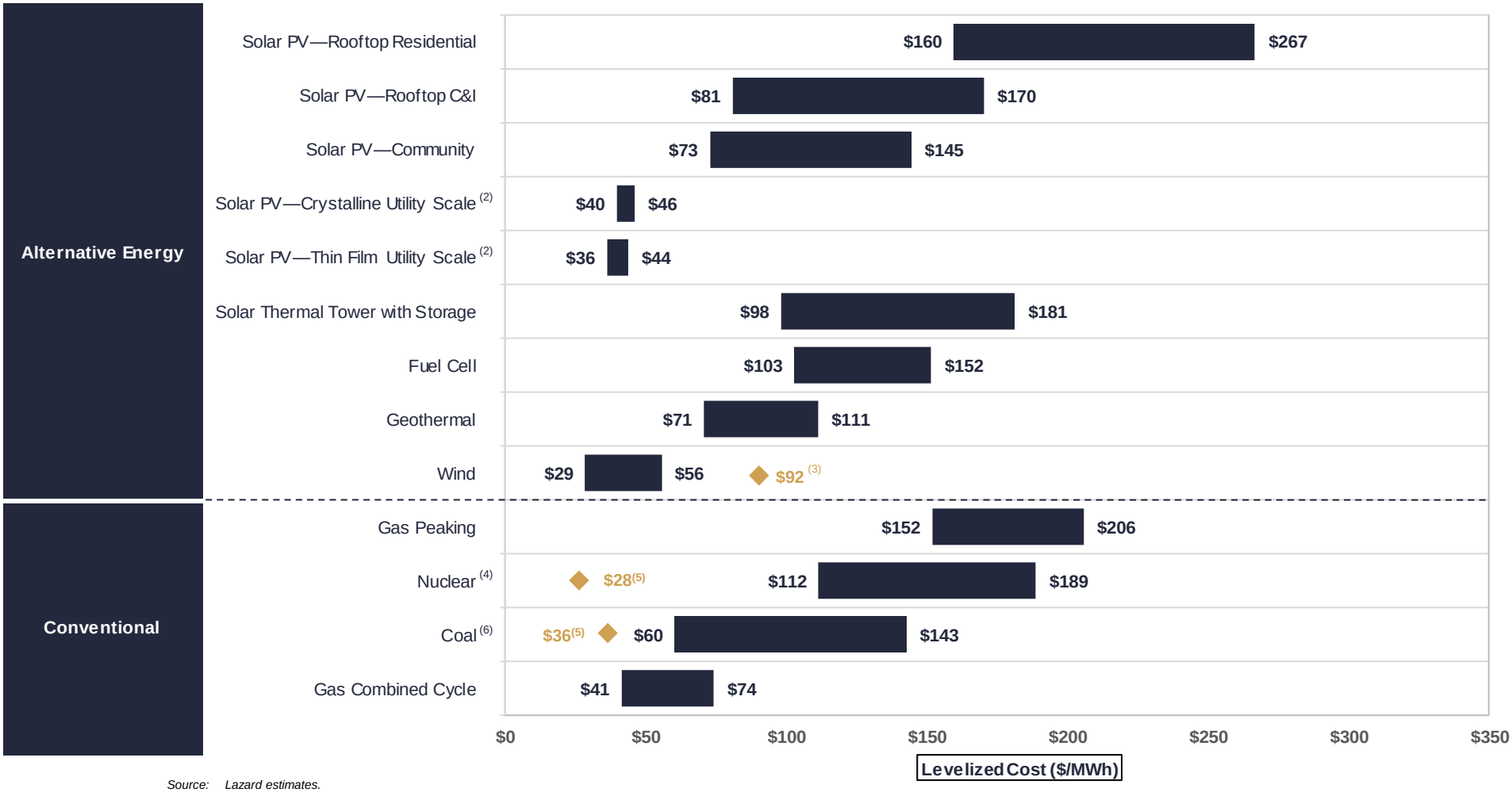
- **Comparative LCOE analysis for various generation technologies on a $/MWh basis, including sensitivities, as relevant, for U.S. federal tax subsidies, fuel prices and costs of capital**
- **Illustration of how the LCOE of wind and utility-scale solar compare to the marginal cost of selected conventional generation technologies**
- **Historical LCOE comparison of various utility-scale generation technologies**
- **Illustration of the historical LCOE declines for wind and utility-scale solar technologies**
- **Illustration of how the LCOE of utility-scale solar compares to the LCOE of gas peaking and how the LCOE of wind compares to the LCOE of gas combined cycle generation**
- **Comparison of assumed capital costs on a $/kW basis for various generation technologies**
- **Decomposition of the LCOE for various generation technologies by capital cost, fixed operations and maintenance expense, variable operations and maintenance expense and fuel cost, as relevant**
- **A methodological overview of Lazard's approach to our LCOE analysis**
- **Considerations regarding the usage characteristics and applicability of various generation technologies**
- **An illustrative comparison of the cost of carbon abatement of various Alternative Energy technologies relative to conventional generation**
- **Summary assumptions for Lazard's LCOE analysis**
- **Summary of Lazard's approach to comparing the LCOE for various conventional and Alternative Energy generation technologies**

Other factors would also have a potentially significant effect on the results contained herein, but have not been examined in the scope of this analysis. These additional factors, among others, could include: import tariffs; capacity value vs. energy value; stranded costs related to distributed generation or otherwise; network upgrade, transmission, congestion or other integration-related costs; significant permitting or other development costs, unless otherwise noted; and costs of complying with various environmental regulations (e.g., carbon emissions offsets or emissions control systems). This analysis also does not address potential social and environmental externalities, including, for example, the social costs and rate consequences for those who cannot afford distributed generation solutions, as well as the long-term residual and societal consequences of various conventional generation technologies that are difficult to measure (e.g., nuclear waste disposal, airborne pollutants, greenhouse gases, etc.)

Schedule JO-3

Levelized Cost of Energy Comparison—Unsubsidized Analysis

Certain Alternative Energy generation technologies are cost-competitive with conventional generation technologies under certain circumstances(1)



Source: *Lazard estimates.*

Note: Here and throughout this presentation, unless otherwise indicated, the analysis assumes 60% debt at 8% interest rate and 40% equity at 12% cost. Please see page titled "Levelized Cost of Energy Comparison—Sensitivity to Cost of Capital" for cost of capital sensitivities.

(1) Such observation does not take into account other factors that would also have a potentially significant effect on the results contained herein, but have not been examined in the scope of this analysis. These additional factors, among others, could include: import tariffs; capacity value vs. energy value; stranded costs related to distributed generation or otherwise; network upgrade, transmission, congestion or other integration-related costs; significant permitting or other development costs, unless otherwise noted; and costs of complying with various environmental regulations (e.g., carbon emissions offsets or emissions control systems). This analysis also does not address potential social and environmental externalities, including, for example, the social costs and rate consequences for those who cannot afford distribution generation solutions, as well as the long-term residual and societal consequences of various conventional generation technologies that are difficult to measure (e.g., nuclear waste disposal, airborne pollutants, greenhouse gases, etc.).

(2) Unless otherwise indicated herein, the low end represents a single-axis tracking system and the high end represents a fixed-tilt design.

(3) Represents the estimated implied midpoint of the LCOE of offshore wind, assuming a capital cost range of approximately $2.25 – $3.80 per watt.

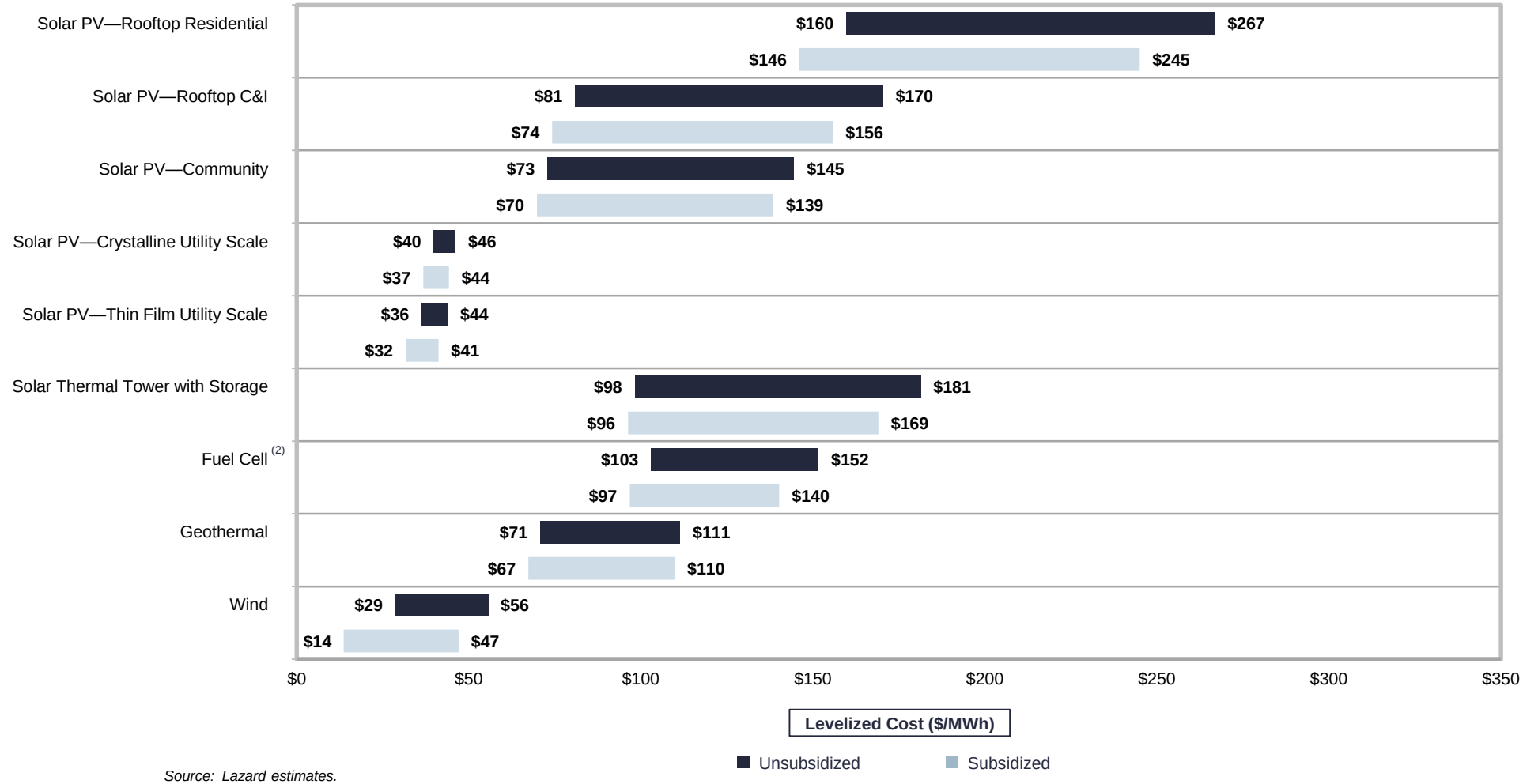
(4) Unless otherwise indicated, the analysis herein does not reflect decommissioning costs or the potential economic impacts of federal loan guarantees or other subsidies.

(5) Represents the midpoint of the marginal cost of operating fully depreciated coal and nuclear facilities, inclusive of decommissioning costs for nuclear facilities. Analysis assumes that the salvage value for a decommissioned coal plant is equivalent to the decommissioning and site restoration costs. Inputs are derived from a benchmark of operating, fully depreciated coal and nuclear assets across the U.S. Capacity factors, fuel, variable and fixed operating expenses are based on upper and lower quartile estimates derived from Lazard's research. Please see page titled "Levelized Cost of Energy Comparison—Alternative Energy versus Marginal Cost of Selected Existing Conventional Generation" for additional details.

(6) Unless otherwise indicated, the analysis herein reflects average of Northern Appalachian Upper Ohio River Barge and Pittsburgh Seam Rail coal. High end incorporates 90% carbon capture and compression. Does not include cost of transportation and storage.

Levelized Cost of Energy Comparison—Sensitivity to U.S. Federal Tax Subsidies(1)

Given the extension of the Investment Tax Credit ("ITC") and Production Tax Credit ("PTC") in December 2015 and resulting subsidy visibility, U.S. federal tax subsidies remain an important component of the economics of Alternative Energy generation technologies



Source: Lazard estimates.

Note: The sensitivity analysis presented on this page also includes sensitivities related to the U.S. Tax Cuts and Jobs Act ("TCJA") of 2017. The TCJA contains several provisions that impact the LCOE of various generation technologies (e.g., a reduced federal corporate income tax rate, an ability to elect immediate bonus depreciation, limitations on the deductibility of interest expense and restrictions on the utilization of past net operating losses). On balance, the TCJA reduced the LCOE of conventional generation technologies and marginally increased the LCOE for Alternative Energy technologies.

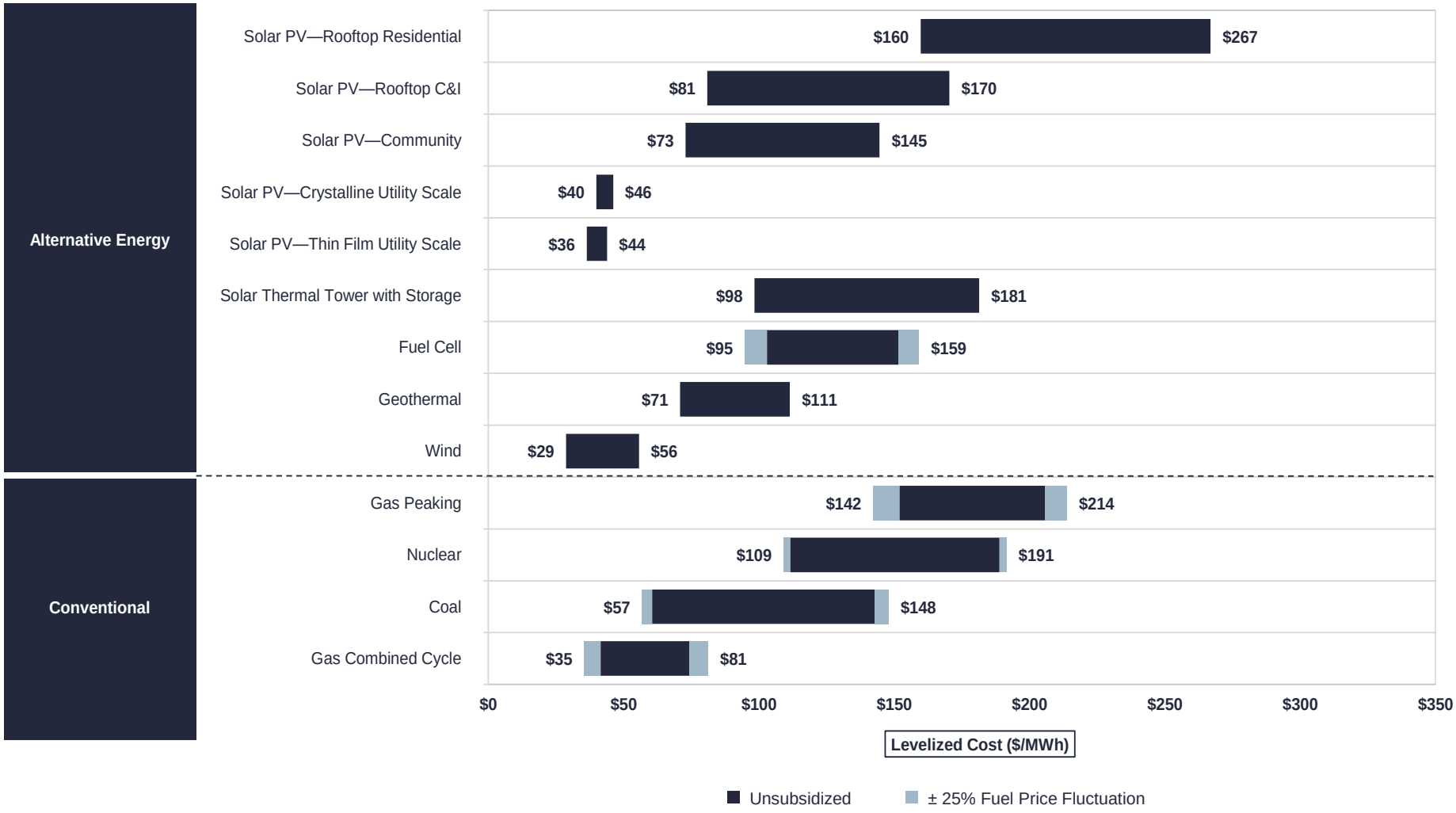
(1) The sensitivity analysis presented on this page assumes that projects qualify for the full ITC/PTC and have a capital structure that includes sponsor equity, tax equity and debt.

(2) The ITC for fuel cell technologies is capped at $1,500/0.5 kW of capacity.

Schedule JO-3

Levelized Cost of Energy Comparison—Sensitivity to Fuel Prices

Variations in fuel prices can materially affect the LCOE of conventional generation technologies, but direct comparisons against "competing" Alternative Energy generation technologies must take into account issues such as dispatch characteristics (e.g., baseload and/or dispatchable intermediate load vs. peaking or intermittent technologies)



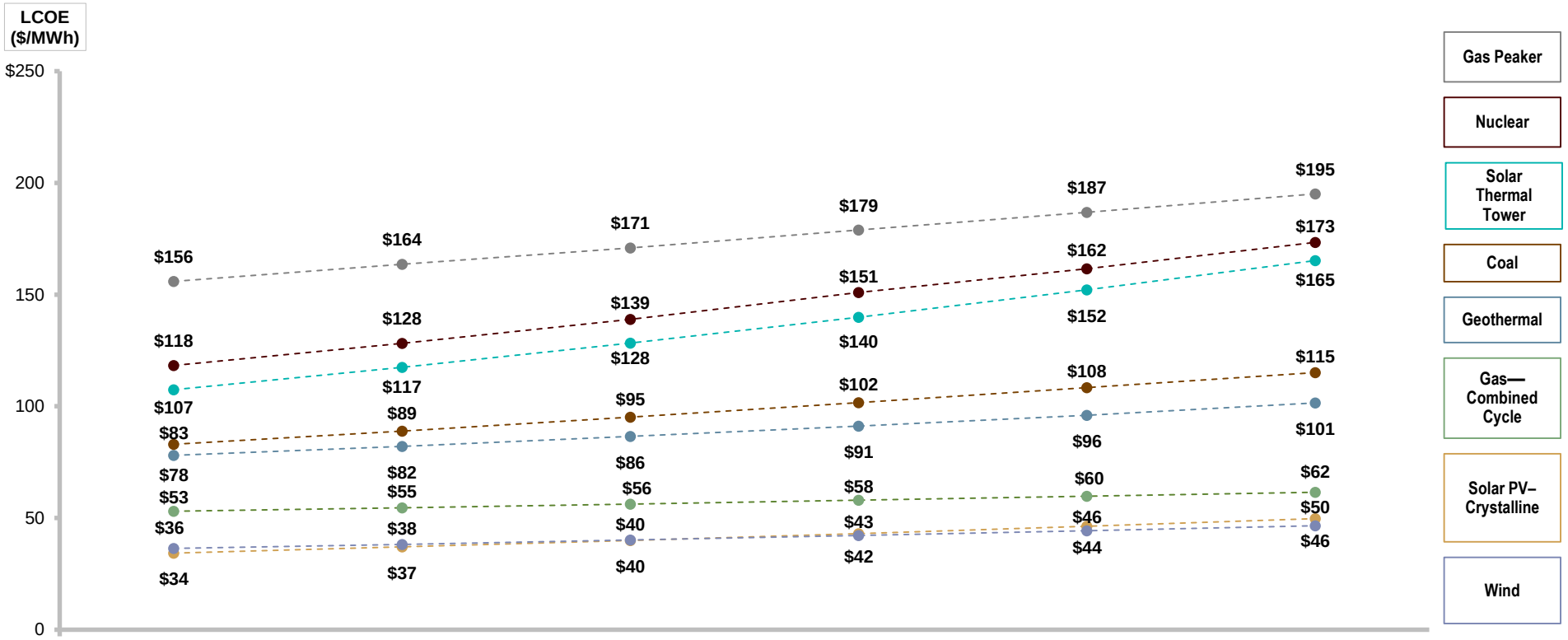
Source: Lazard estimates.

Schedule JO-3

Levelized Cost of Energy Comparison—Sensitivity to Cost of Capital

A key consideration for utility-scale generation technologies is the impact of the availability and cost of capital[1] on LCOE values; availability and cost of capital have a particularly significant impact on Alternative Energy generation technologies, whose costs reflect essentially the return on, and of, the capital investment required to build them

Midpoint of Unsubsidized LCOE[2]



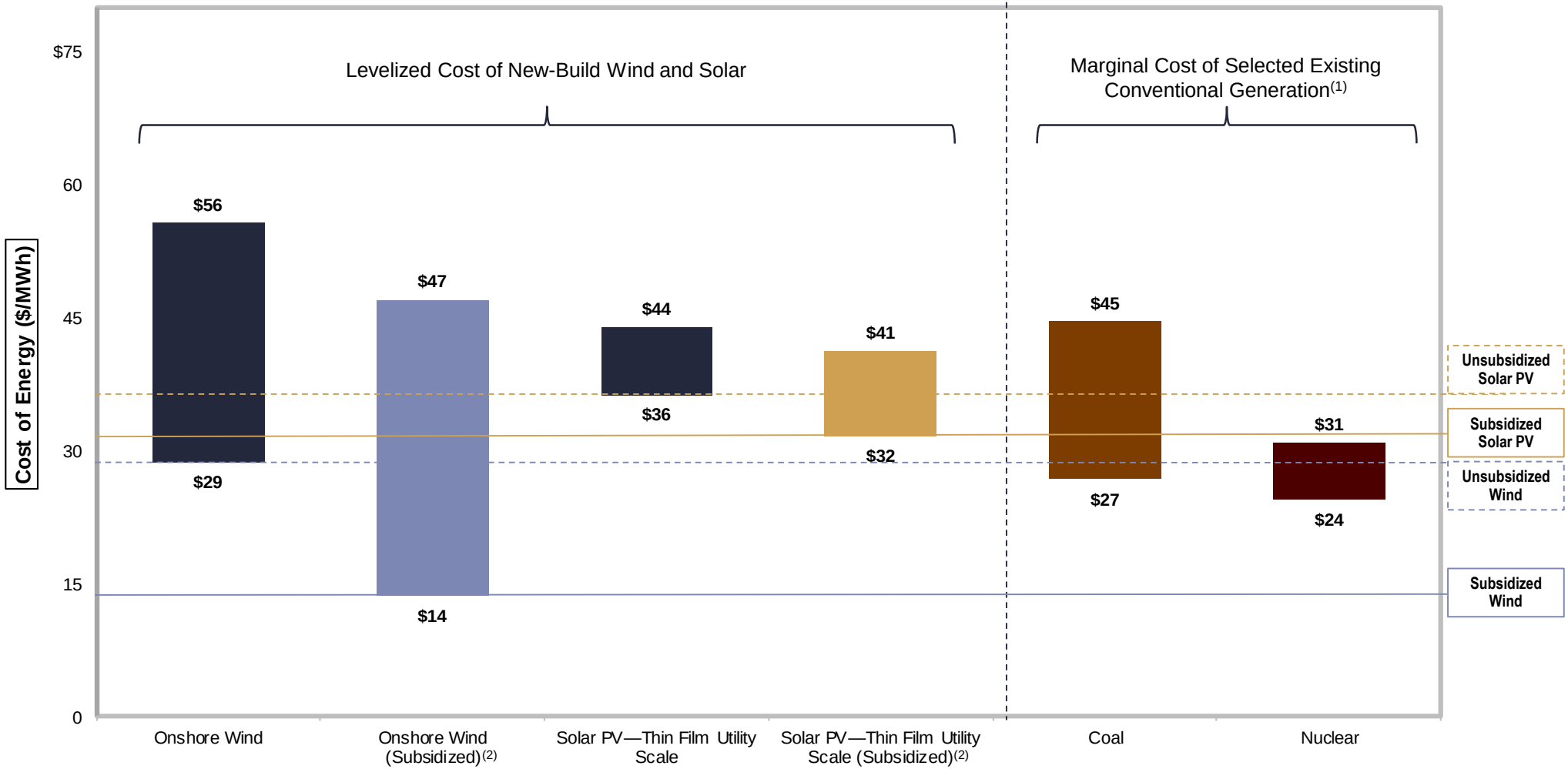
After-Tax IRR/WACC	5.4%	6.2%	6.9%	7.7%	8.4%	9.2%
Cost of Equity	9.0%	10.0%	11.0%	12.0%	13.0%	14.0%
Cost of Debt	5.0%	6.0%	7.0%	8.0%	9.0%	10.0%

Source: *Lazard estimates.*
Note: Analysis assumes 60% debt and 40% equity.
(1) Cost of capital as used herein indicates the cost of capital for the asset/plant and not the cost of capital of a particular investor/owner.
(2) Reflects the average of the high and low LCOE for each respective cost of capital assumption.

Schedule JO-3

Levelized Cost of Energy Comparison—Alternative Energy versus Marginal Cost of Selected Existing Conventional Generation

Certain Alternative Energy generation technologies, which became cost-competitive with conventional generation technologies several years ago, are, in some scenarios, approaching an LCOE that is at or below the marginal cost of existing conventional generation technologies



Source: Lazard estimates.

(1) Represents the marginal cost of operating, fully depreciated coal and nuclear facilities, inclusive of decommissioning costs for nuclear facilities. Analysis assumes that the salvage value for a decommissioned coal plant is equivalent to the decommissioning and site restoration costs. Inputs are derived from a benchmark of operating, fully depreciated coal and nuclear assets across the U.S. Capacity factors, fuel, variable and fixed operating expenses are based on upper and lower quartile estimates derived from Lazard's research.

(2) The subsidized analysis includes sensitivities related to the TCJA and U.S. federal tax subsidies. Please see page titled "Levelized Cost of Energy Comparison—Sensitivity to U.S. Federal Tax Subsidies" for additional details.

Schedule JO-3

Levelized Cost of Energy Comparison—Historical Utility-Scale Generation Comparison

Lazard's unsubsidized LCOE analysis indicates significant historical cost declines for utility-scale Alternative Energy generation technologies driven by, among other factors, decreasing supply chain costs, improving technologies and increased competition

Selected Historical Mean Unsubsidized LCOE Values(1)

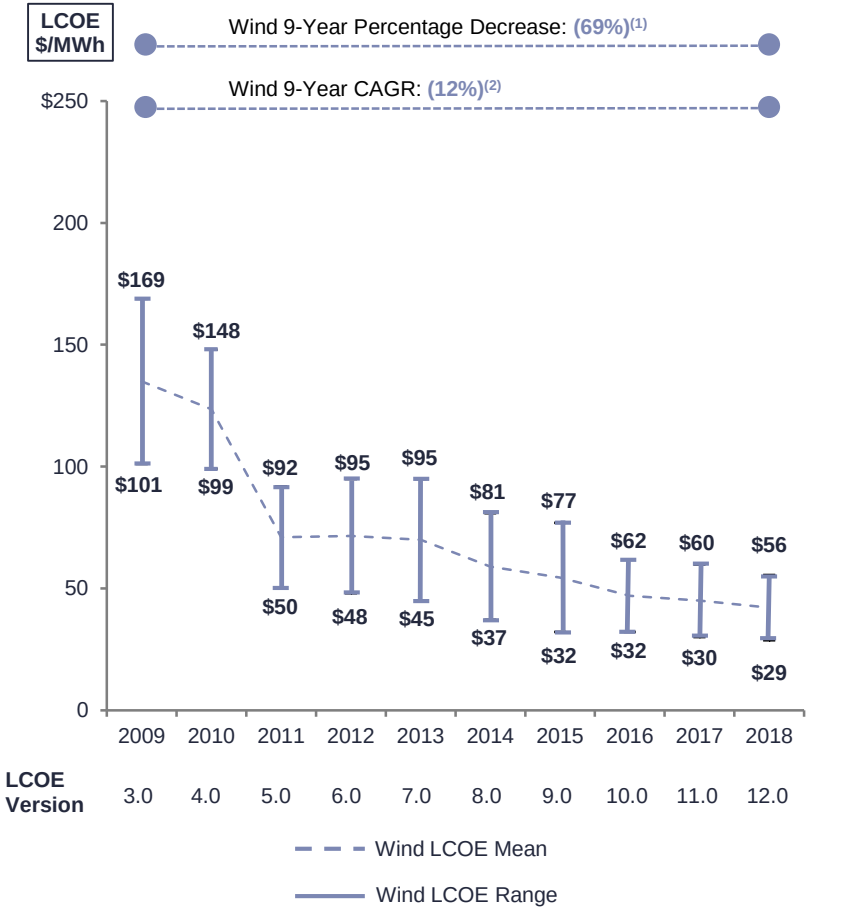
Source: Lazard estimates.

(1) Reflects the average of the high and low LCOE for each respective technology in each respective year. Percentages represent the total decrease in the average LCOE since Lazard's LCOE—Version 3.0.

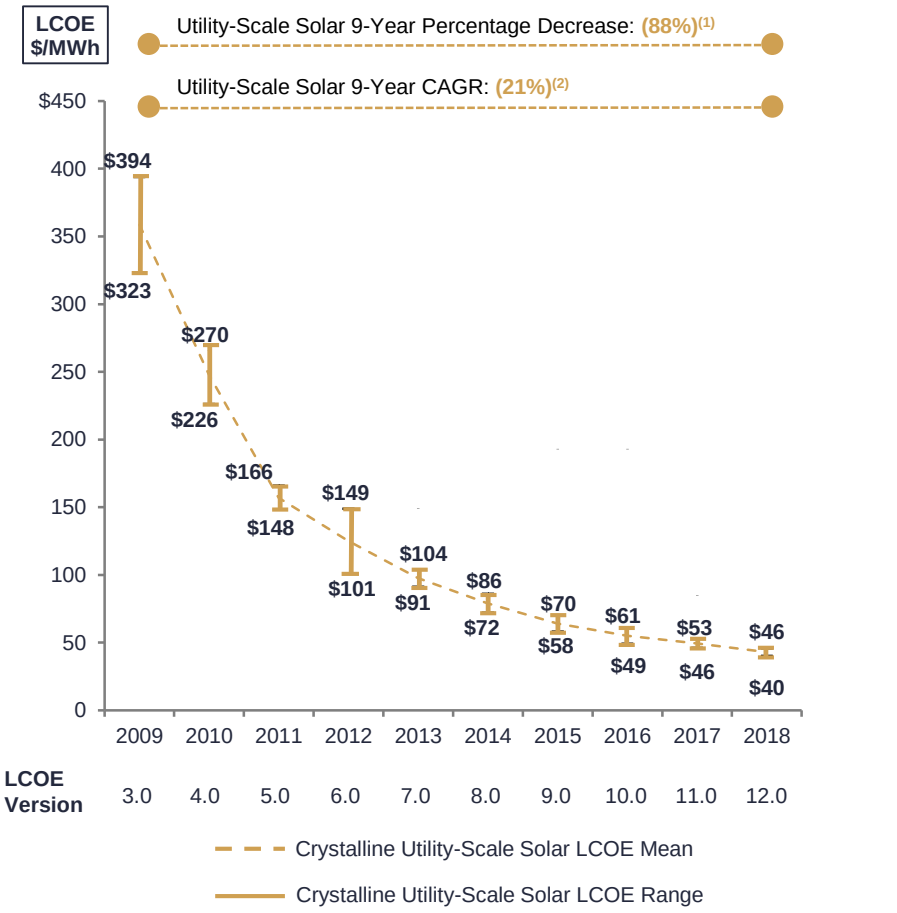
Levelized Cost of Energy Comparison—Historical Alternative Energy LCOE Declines

In light of material declines in the pricing of system components (e.g., panels, inverters, turbines, etc.) and improvements in efficiency, among other factors, wind and utility-scale solar PV have seen dramatic historical LCOE declines; however, over the past several years the rate of such LCOE declines have started to flatten

Unsubsidized Wind LCOE



Unsubsidized Solar PV LCOE



Source: Lazard estimates.

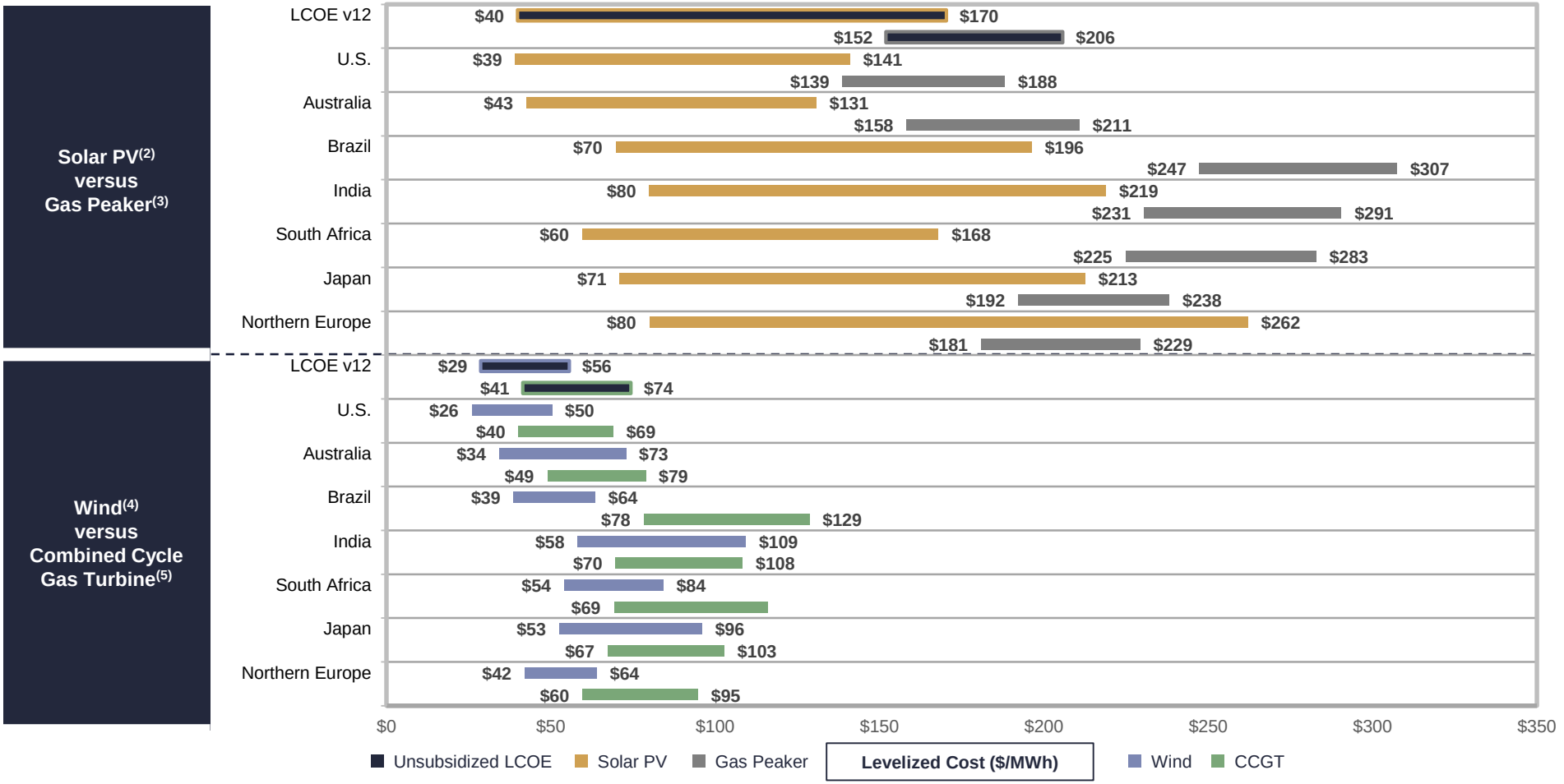
(1) Represents the average percentage decrease of the high end and low end of the LCOE range.

(2) Represents the average compounded annual rate of decline of the high end and low end of the LCOE range.

Schedule JO-3

Solar PV versus Peaking and Wind versus CCGT—Global Markets(1)

Solar PV and wind have become an increasingly attractive resource relative to conventional generation technologies with similar generation profiles; without storage, however, these resources lack the dispatch characteristics of such conventional generation technologies



Source: Lazard estimates.

(1) Equity IRRs are assumed to be 10% for the U.S., 12% for Australia, Japan and Northern Europe and 18% for Brazil, India and South Africa. Cost of debt is assumed to be 6% for the U.S., 8% for Australia, Japan and Northern Europe, 14.5% for Brazil, 13% for India and 11.5% for South Africa.

(2) Low end assumes crystalline utility-scale solar with a single-axis tracker. High end assumes rooftop C&I solar. Solar projects assume illustrative capacity factors of 21% – 28% for the U.S., 26% – 30% for Australia, 26% – 28% for Brazil, 22% – 23% for India, 27% – 29% for South Africa, 16% – 18% for Japan and 13% – 16% for Northern Europe.

(3) Assumes natural gas prices of $3.45 for the U.S., $4.00 for Australia, $8.00 for Brazil, $7.00 for India, South Africa and Japan and $6.00 for Northern Europe (all in U.S. $ per MMBtu). Assumes a capacity factor of 10% for all geographies.

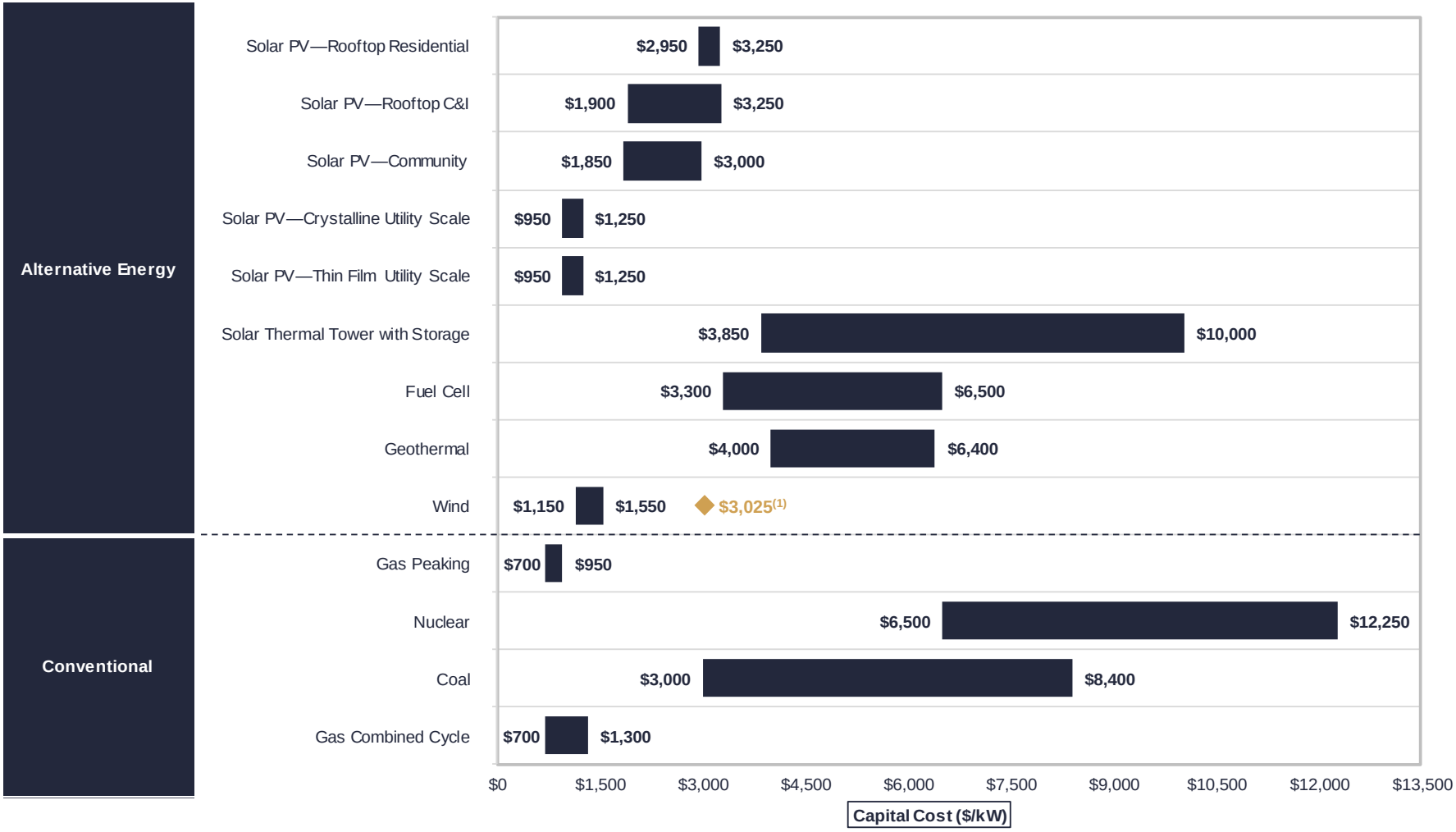
(4) Wind projects assume illustrative capacity factors of 38% – 55% for the U.S., 29% – 46% for Australia, 45% – 55% for Brazil, 25% – 35% for India, 31% – 36% for South Africa, 22% – 30% for Japan and 33% – 38% for Northern Europe.

(5) Assumes natural gas prices of $3.45 for the U.S., $4.00 for Australia, $8.00 for Brazil, $7.00 for India, South Africa and Japan and $6.00 for Northern Europe (all in U.S. $ per MMBtu). Assumes capacity factors of 43% – 80% on the high and low ends, respectively, for all geographies.

Schedule JO-3

Capital Cost Comparison

While capital costs for a number of Alternative Energy generation technologies are currently in excess of some conventional generation technologies, declining costs for many Alternative Energy generation technologies, coupled with uncertain long-term fuel costs for conventional generation technologies, are working to close formerly wide gaps in LCOE values

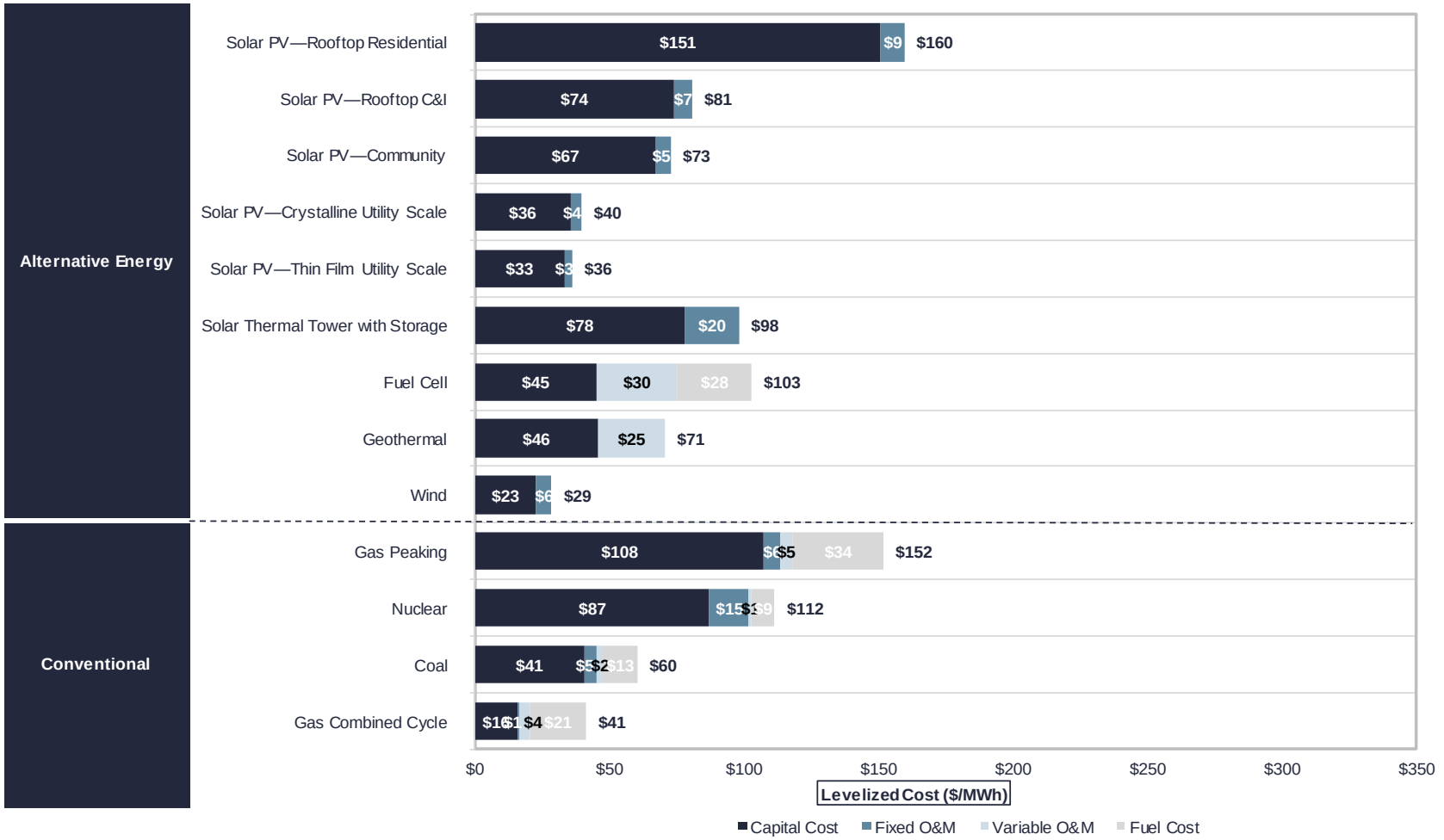


Source: Lazard estimates.
(1) Represents the estimated midpoint of the total capital cost for offshore wind.

Schedule JO-3

Levelized Cost of Energy Components—Low End

Certain Alternative Energy generation technologies are already cost-competitive with conventional generation technologies; a key factor regarding the long-term competitiveness of Alternative Energy generation technologies is the ability of technological development and increased production volumes to materially lower operating expenses and capital costs for Alternative Energy generation technologies

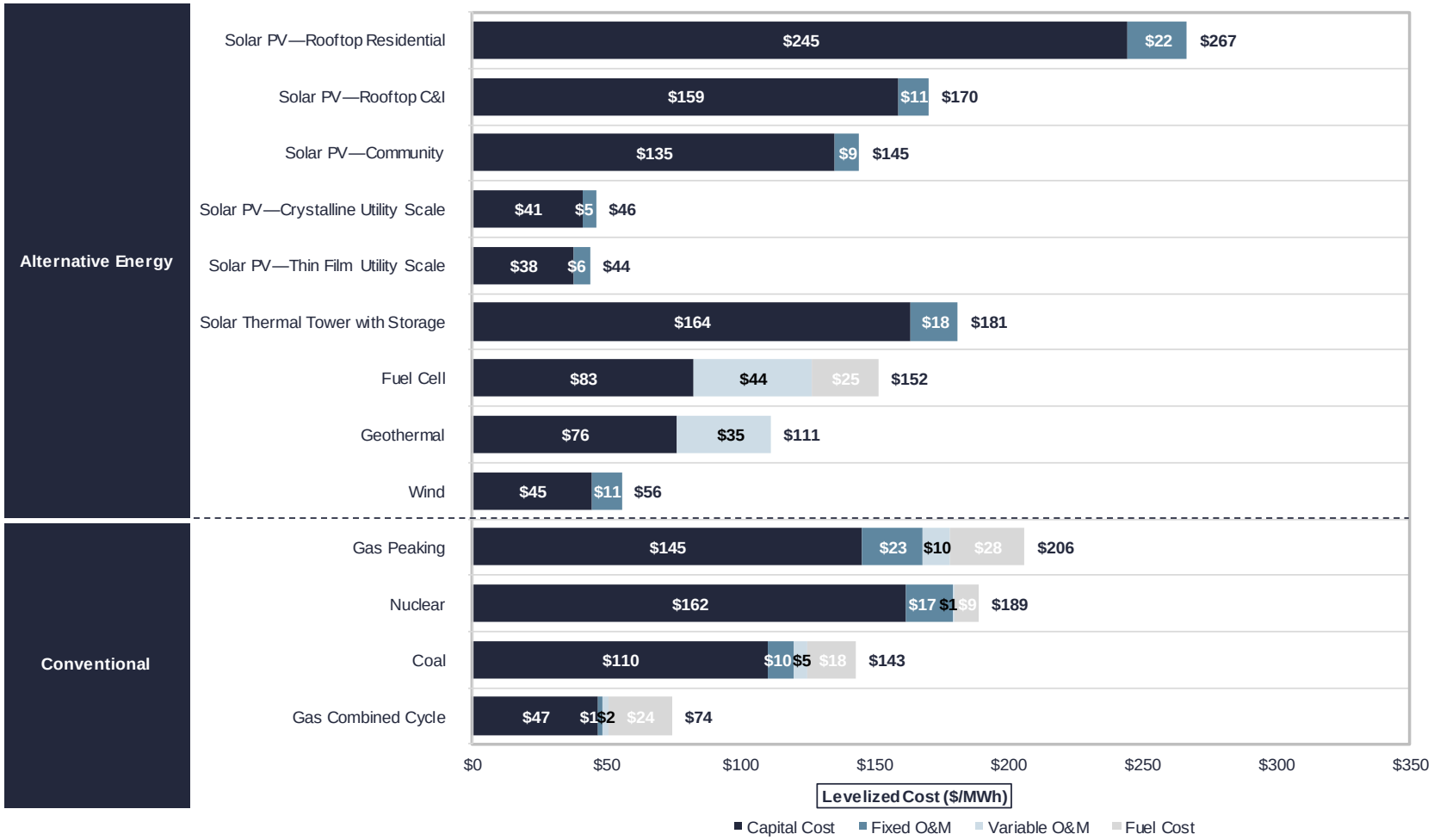


Source: Lazard estimates.

Schedule JO-3

Levelized Cost of Energy Components—High End

Certain Alternative Energy generation technologies are already cost-competitive with conventional generation technologies; a key factor regarding the long-term competitiveness of Alternative Energy generation technologies is the ability of technological development and increased production volumes to materially lower operating expenses and capital costs for Alternative Energy generation technologies



Source: Lazard estimates.

Schedule JO-3

Levelized Cost of Energy Comparison—Methodology

($ in millions, unless otherwise noted)

Lazard's LCOE analysis consists of creating a power plant model representing an illustrative project for each relevant technology and solving for the $/MWh figure that results in a levered IRR equal to the assumed cost of equity (see appendix for detailed assumptions by technology)

Unsubsidized Wind — High Case Sample Illustrative Calculations

Year [1]		*0*	*1*	*2*	*3*	*4*	*5*	*20*
Capacity (MW)	(A)		150	150	150	150	150	150
Capacity Factor	(B)		38%	38%	38%	38%	38%	38%
Total Generation ('000 MWh)	(A) x (B) = (C)*		499	499	499	499	499	499
Levelized Energy Cost ($/MWh)	***(D)***		***$55.6***	***$55.6***	***$55.6***	***$55.6***	***$55.6***	***$55.6***
Total Revenues	**(C) x (D) = (E)***		**$27.8**	**$27.8**	**$27.8**	**$27.8**	**$27.8**	**$27.8**
Total Fuel Cost	(F)		--	--	--	--	--	--
Total O&M	(G)*		5.5	5.6	5.7	5.9	6.0	8.4
Total Operating Costs	**(F) + (G) = (H)**		**$5.5**	**$5.6**	**$5.7**	**$5.9**	**$6.0**	$8.4
EBITDA	**(E) - (H) = (I)**		**$22.3**	**$22.2**	**$22.0**	**$21.9**	**$21.8**	**$19.4**
Debt Outstanding - Beginning of Period	(J)		$139.5	$136.7	$133.7	$130.5	$127.0	$24.8
Debt - Interest Expense	(K)		(11.2)	(10.9)	(10.7)	(10.4)	(10.2)	(2.0)
Debt - Principal Payment	(L)		(2.8)	(3.0)	(3.2)	(3.5)	(3.8)	(11.9)
Levelized Debt Service	(K) + (L) = (M)		($13.9)	($13.9)	($13.9)	($13.9)	($13.9)	($13.9)
EBITDA	**(I)**		$22.3	$22.2	$22.0	$21.9	$21.8	$19.4
Depreciation (MACRS)	(N)		(46.5)	(74.4)	(44.6)	(26.8)	(26.8)	--
Interest Expense	(K)		(11.2)	(10.9)	(10.7)	(10.4)	(10.2)	(2.0)
Taxable Income	**(I) + (N) + (K) = (O)**		**($35.4)**	**($63.2)**	**($33.3)**	**($15.3)**	**($15.2)**	**$17.4**
Tax Benefit (Liability) [2]	**(O) x (tax rate) = (P)**		**$14.2**	**$25.3**	**$13.3**	**$6.1**	**$6.1**	**($7.0)**
After-Tax Net Equity Cash Flow	**(I) + (M) + (P) = (Q)**	**($93.0)**[3]	**$22.5**	**$33.5**	**$21.4**	**$14.1**	**$13.9**	**($1.5)**
IRR For Equity Investors		**12.0%**						

Key Assumptions [4]	
Capacity (MW)	150
Capacity Factor	38%
Fuel Cost ($/MMBtu)	$0.00
Heat Rate (Btu/kWh)	0
Fixed O&M ($/kW-year)	$36.5
Variable O&M ($/MWh)	$0.0
O&M Escalation Rate	2.25%
Capital Structure	
Debt	60.0%
Cost of Debt	8.0%
Equity	40.0%
Cost of Equity	12.0%
Taxes and Tax Incentives:	
Combined Tax Rate	40%
Economic Life (years) [5]	20
MACRS Depreciation (Year Schedule)	5
Capex	
EPC Costs ($/kW)	$1,550
Additional Owner's Costs ($/kW)	$0
Transmission Costs ($/kW)	$0
Total Capital Costs ($/kW)	$1,550
Total Capex ($mm)	$233

Source: *Lazard estimates.*
Note: Wind—High LCOE case presented for illustrative purposes only.
* Denotes unit conversion.
(1) Assumes half-year convention for discounting purposes.
(2) Assumes full monetization of tax benefits or losses immediately.
(3) Reflects initial cash outflow from equity investors.
(4) Reflects a "key" subset of all assumptions for methodology illustration purposes only. Does not reflect all assumptions.
(5) Economic life sets debt amortization schedule. For comparison purposes, all technologies calculate LCOE on a 20-year IRR basis.

Technology-dependent

Levelized

Schedule JO-3

Energy Resources—Matrix of Applications

While the LCOE for Alternative Energy generation technologies is, in some cases, competitive with conventional generation technologies, direct comparisons must take into account issues such as location (e.g., centralized vs. distributed) and dispatch characteristics (e.g., baseload and/or dispatchable intermediate load vs. peaking or intermittent technologies)

- **This analysis does not take into account potential social and environmental externalities or reliability-related considerations**

		Carbon Neutral/ REC Potential	Location			Dispatch			
			Distributed	Centralized	Geography	Intermittent	Peaking	Load-Following	Base-Load
Alternative Energy	Solar PV(1)	✓	✓	✓	Universal(2)	✓	✓		
	Solar Thermal	✓		✓	Varies	✓	✓	✓	
	Fuel Cell	✗	✓		Universal				✓
	Geothermal	✓		✓	Varies				✓
	Onshore Wind	✓		✓	Varies	✓			
Conventional	Gas Peaking	✗	✓	✓	Universal		✓	✓	
	Nuclear	✓		✓	Rural				✓
	Coal	✗(3)		✓	Co-located or rural				✓
	Gas Combined Cycle	✗		✓	Universal			✓	✓

Source: Lazard estimates.

(1) Represents the full range of solar PV technologies; low end represents thin film utility-scale solar single-axis tracking, high end represents the high end of rooftop residential solar.

(2) Qualification for RPS requirements varies by location.

(3) For the purposes of this analysis, carbon neutrality also considers the emissions produced during plant construction and fuel extraction.

Schedule JO-3

Cost of Carbon Abatement Comparison

As policymakers consider ways to limit carbon emissions, Lazard's LCOE analysis provides insight into the implicit "costs of carbon avoidance", as measured by the abatement value offered by Alternative Energy generation technologies. This analysis suggests that policies designed to promote wind and utility-scale solar development could be a particularly cost-effective means of limiting carbon emissions; providing an implied value of carbon abatement of $26 – $34/Ton vs. Coal and $10 – $25/Ton vs. Gas Combined Cycle

- **These observations do not take into account potential social and environmental externalities or reliability or grid-related considerations**

		Conventional Generation			Alternative Energy Generation			
	Units	Coal	Gas Combined Cycle	Nuclear	Wind	Solar PV Rooftop	Solar PV Utility Scale	Solar Thermal with Storage
Capital Investment/KW of Capacity [1]	$/kW	$3,000	$700	$6,500	$1,150	$2,950	$950	$3,850
Total Capital Investment	**$mm**	**1,800**	**490**	**4,030**	**1,162**	**8,673**	**1,558**	**5,044**
Facility Output	MW	600	700	620	1,010	2,940	1,640	1,310
Capacity Factor	%	93%	80%	90%	55%	19%	34%	43%
Effective Facility Output	**MW**	**558**	**558**	**558**	**558**	**558**	**558**	**558**
MWh/Year Produced [2]	GWh/yr	4,888	4,888	4,888	4,888	4,888	4,888	4,888
Levelized Cost of Energy	$/MWh	$60	$41	$112	$29	$160	$36	$98
Total Cost of Energy Produced	**$mm/yr**	**$296** (2)	**$203**	**$546**	**$140**	**$781**	**$178** (1)	**$480**
CO_2 Equivalent Emissions	Tons/MWh	0.92	0.51	—	—	—	—	—
Carbon Emitted	mm Tons/yr	4.51	2.50	—	—	—	—	—
Difference in Carbon Emissions	mm Tons/yr							
vs. Coal		—	2.01	4.51	4.51	4.51	4.51 (3)	4.51
vs. Gas		—	—	2.50	2.50	2.50	2.50	2.50
Difference in Total Energy Cost	$mm/yr							
vs. Coal		—	($93)	$250	($155)	$485	($118) (4)	$185
vs. Gas		—	—	$343	($63)	$578	($25)	$278
Implied Abatement Value/(Cost)	$/Ton							
vs. Coal		—	$46	($55)	$34	($108)	$26 (5)	($41)
vs. Gas		—	—	($137)	$25	($231)	$10	($111)

: Favorable vs. Coal/Gas : Unfavorable vs. Coal/Gas

Implied Carbon Abatement Value Calculation (Solar vs. Coal)—Methodology

(4) Difference in Total Energy Cost (Solar vs. Coal) = (1) – (2)
= $178 mm/yr (Solar) – $296 mm/yr (Coal) = ($118) mm/yr

(5) Implied Carbon Abatement Value (Solar vs. Coal) = (4) ÷ (3)
= $118 mm/yr ÷ 4.51 mm Tons/yr = $26/Ton

Source: Lazard estimates.
(1) Inputs for each of the various technologies are those associated with the low end LCOE.
(2) All facilities illustratively sized to produce 4,888 GWh/yr.

Schedule JO-3

Levelized Cost of Energy—Key Assumptions

		Solar PV				
	Units	Rooftop—Residential	Rooftop—C&I	Community	Utility Scale—Crystalline [2]	Utility Scale—Thin Film [2]
Net Facility Output	MW	0.005	1	5	50	50
Total Capital Cost [1]	$/kW	$2,950 – $3,250	$1,900 – $3,250	$1,850 – $3,000	$1,250 – $950	$1,250 – $950
Fixed O&M	$/kW-yr	$14.50 – $25.00	$15.00 – $20.00	$12.00 – $16.00	$12.00 – $9.00	$12.00 – $9.00
Variable O&M	$/MWh	—	—	—	—	—
Heat Rate	Btu/kWh	—	—	—	—	—
Capacity Factor	%	19% – 13%	25% – 20%	25% – 20%	32% – 21%	34% – 23%
Fuel Price	$/MMBtu	—	—	—	—	—
Construction Time	Months	3	3	4 – 6	9	9
Facility Life	Years	25	25	30	30	30
Levelized Cost of Energy	$/MWh	$160 – $267	$81 – $170	$73 – $145	$40 – $46	$36 – $44

Source: Lazard estimates.

(1) Includes capitalized financing costs during construction for generation types with over 24 months construction time.

(2) Left column represents the assumptions used to calculate the low end LCOE for single-axis tracking. Right column represents the assumptions used to calculate the high end LCOE for fixed-tilt design. Assumes 50 MW system in high insolation jurisdiction (e.g., Southwest U.S.).

Schedule JO-3

Levelized Cost of Energy—Key Assumptions (cont'd)

	Units	Solar Thermal Tower with Storage	Fuel Cell	Geothermal	Wind—Onshore	Wind—Offshore
Net Facility Output	MW	135 – 110	2.4	20 – 50	150	210 – 385
Total Capital Cost [(1)]	$/kW	$3,850 – $10,000	$3,300 – $6,500	$4,000 – $6,400	$1,150 – $1,550	$2,250 – $3,800
Fixed O&M	$/kW-yr	$75.00 – $80.00	—	—	$28.00 – $36.50	$80.00 – $110.00
Variable O&M	$/MWh	—	$30.00 – $44.00	$25.00 – $35.00	—	—
Heat Rate	Btu/kWh	—	8,027 – 7,260	—	—	—
Capacity Factor	%	43% – 52%	95%	90% – 85%	55% – 38%	55% – 45%
Fuel Price	$/MMBtu	—	3.45	—	—	—
Construction Time	Months	36	3	36	12	12
Facility Life	Years	35	20	25	20	20
Levelized Cost of Energy	$/MWh	$98 – $181	$103 – $152	$71 – $111	$29 – $56	$62 – $121

Source: Lazard estimates.

(1) Includes capitalized financing costs during construction for generation types with over 24 months construction time.

Levelized Cost of Energy—Key Assumptions (cont'd)

	Units	Gas Peaking	Nuclear	Coal	Gas Combined Cycle
Net Facility Output	MW	241 – 50	2,200	600	550
Total Capital Cost [(1)]	$/kW	$700 – $950	$6,500 – $12,250	$3,000 – $8,400	$700 – $1,300
Fixed O&M	$/kW-yr	$5.00 – $20.00	$115.00 – $135.00	$40.00 – $80.00	$6.00 – $5.50
Variable O&M	$/MWh	$4.70 – $10.00	$0.75 – $0.75	$2.00 – $5.00	$3.50 – $2.00
Heat Rate	Btu/kWh	9,804 – 8,000	10,450 – 10,450	8,750 – 12,000	6,133 – 6,900
Capacity Factor	%	10%	90%	93%	80%
Fuel Price	$/MMBtu	$3.45 – $3.45	$0.85 – $0.85	$1.45 – $1.45	$3.45 – $3.45
Construction Time	Months	12 – 18	69 – 69	60 – 66	24 – 24
Facility Life	Years	20	40	40	20
Levelized Cost of Energy	$/MWh	$152 – $206	$112 – $189	$60 – $143	$41 – $74

Source: Lazard estimates.

(1) Includes capitalized financing costs during construction for generation types with over 24 months construction time.

Summary Considerations

Lazard has conducted this analysis comparing the LCOE for various conventional and Alternative Energy generation technologies in order to understand which Alternative Energy generation technologies may be cost-competitive with conventional generation technologies, either now or in the future, and under various operating assumptions, as well as to understand which technologies are best suited for various applications based on locational requirements, dispatch characteristics and other factors. We find that Alternative Energy technologies are complementary to conventional generation technologies, and believe that their use will be increasingly prevalent for a variety of reasons, including environmental and social consequences of various conventional generation technologies, RPS requirements, carbon regulations, continually improving economics as underlying technologies improve and production volumes increase and government subsidies in certain regions.

In this analysis, Lazard's approach was to determine the LCOE, on a $/MWh basis, that would provide an after-tax IRR to equity holders equal to an assumed cost of equity capital. Certain assumptions (e.g., required debt and equity returns, capital structure, etc.) were identical for all technologies in order to isolate the effects of key differentiated inputs such as investment costs, capacity factors, operating costs, fuel costs (where relevant) and other important metrics on the LCOE. These inputs were originally developed with a leading consulting and engineering firm to the Power & Energy Industry, augmented with Lazard's commercial knowledge where relevant. This analysis (as well as previous versions) has benefited from additional input from a wide variety of Industry participants.

Lazard has not manipulated capital costs or capital structure for various technologies, as the goal of the study was to compare the current state of various generation technologies, rather than the benefits of financial engineering. The results contained in this study would be altered by different assumptions regarding capital structure (e.g., increased use of leverage) or capital costs (e.g., a willingness to accept lower returns than those assumed herein).

Key sensitivities examined included fuel costs and tax subsidies. Other factors would also have a potentially significant effect on the results contained herein, but have not been examined in the scope of this current analysis. These additional factors, among others, could include: import tariffs; capacity value vs. energy value; stranded costs related to distributed generation or otherwise; network upgrade, transmission, congestion or other integration-related costs; significant permitting or other development costs, unless otherwise noted; and costs of complying with various environmental regulations (e.g., carbon emissions offsets or emissions control systems). This analysis also does not address potential social and environmental externalities, including, for example, the social costs and rate consequences for those who cannot afford distribution generation solutions, as well as the long-term residual and societal consequences of various conventional generation technologies that are difficult to measure (e.g., nuclear waste disposal, airborne pollutants, greenhouse gases, etc.).

Schedule JO-3