Exhibit No. 301

MIEC – Exhibit 301
Maurice Brubaker
Surrebuttal Testimony
File No. EA-2022-0245

Issue: Revenue Solutions Program
Witness: Maurice Brubaker
Type of Exhibit: Surrebuttal Testimony
Sponsoring Parties: Missouri Industrial Energy Consumers
Case Nos.: EA-2022-0245
Date Testimony Prepared: January 18, 2023

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 a Certificate of Convenience and Necessity for a Solar Facility, Approval of a Subscription-Based Renewable Energy Program, and Authorization to Establish Tracking Mechanism	)	**Case No. EA-2022-0245**

Surrebuttal Testimony and Schedule of

Maurice Brubaker

On behalf of

Missouri Industrial Energy Consumers

January 18, 2023

BRUBAKER & ASSOCIATES, INC.

Project 11363

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 a Certificate of Convenience and Necessity for a Solar Facility, Approval of a Subscription-Based Renewable Energy Program, and Authorization to Establish Tracking Mechanism	)	**Case No. EA-2022-0245**

STATE OF MISSOURI)
) **SS**
COUNTY OF ST. LOUIS)

Affidavit of Maurice Brubaker

Maurice Brubaker, being first duly sworn, on his oath states:

1. My name is Maurice Brubaker. I am a consultant with Brubaker & Associates, Inc., having its principal place of business at 16690 Swingley Ridge Road, Suite 140, Chesterfield, Missouri 63017. We have been retained by the Missouri Industrial Energy Consumers in this proceeding on their behalf.

2. Attached hereto and made a part hereof for all purposes is my surrebuttal testimony and schedules which were prepared in written form for introduction into evidence in the Missouri Public Service Commission, Case No. EA-2022-0245.

3. I hereby swear and affirm that the testimony and schedules are true and correct and they show the matters and things that they purport to show.

Maurice Brubaker

Subscribed and sworn to before me this 18th day of January, 2023.

TAMMY S. KLOSSNER
Notary Public - Notary Seal
STATE OF MISSOURI
St. Charles County
My Commission Expires: Mar. 18, 2023
Commission # 15024862

Tammy S Klossner
Notary Public

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 a Certificate of Convenience and Necessity for a Solar Facility, Approval of a Subscription-Based Renewable Energy Program, and Authorization to Establish Tracking Mechanism	)	**Case No. EA-2022-0245**

Surrebuttal Testimony of Maurice Brubaker

Q PLEASE STATE YOUR NAME AND BUSINESS ADDRESS.

A Maurice Brubaker. My business address is 16690 Swingley Ridge Road, Suite 140, Chesterfield, MO 63017.

Q WHAT IS YOUR OCCUPATION?

A I am a consultant in the field of public utility regulation and President of Brubaker & Associates, Inc., energy, economic and regulatory consultants.

Q ARE YOU THE SAME MAURICE BRUBAKER WHO FILED REBUTTAL TESTIMONY IN THIS PROCEEDING ON DECEMBER 21, 2022?

A Yes, I am.

Q ON WHOSE BEHALF ARE YOU APPEARING IN THIS PROCEEDING?

A This testimony is presented on behalf of the Missouri Industrial Energy Consumers ("MIEC"), a non-profit company that represents the interests of industrial customers in Missouri utility matters.

Q PLEASE SUMMARIZE YOUR TESTIMONY AND RECOMMENDATIONS.

A My testimony responds to the testimony of various witnesses on behalf of the Staff of the Missouri Public Service Commission ("Staff") who assert that, even if the Boomtown facility is viable, that acquisition of the facility and the development of the project is premature based on Ameren Missouri's ("AMO") needs.

In addition, I address Staff's lack of appreciation for the benefits that the Renewable Solutions Program ("RSP") provides to the AMO system and non-subscribers. I also present examples of Renewable Purchase Programs sponsored by electric utilities in other states, which demonstrates that without the RSP, AMO would not be providing its customers with comparable opportunities to participate and help expand the use of renewables through customer programs.

Q WHAT SCHEDULES ARE YOU SPONSORING?

A
- Schedule MEB-2: The Solar Energy Industries Association's ("SEIA") US Solar Market Insight, Executive Summary, Q4 2022
- Schedule MEB-3: Survey of Renewable Energy Programs

Solar Capacity Need

Q DOES STAFF SAY THAT THE BOOMTOWN SOLAR PROJECT SHOULD NOT BE PURSUED AT THIS TIME?

A Yes. Several Staff witnesses[1] make that specific recommendation.

[1]For example, please see the rebuttal testimony of Staff witness Luebbert at page 5, and the rebuttal testimony of Staff witness Stahlman at pages 8 and 10.

Q WHAT IS THE BASIS FOR THAT RECOMMENDATION?

A The basis seems to be that Staff does not believe that AMO has a need for additional Renewable Energy Credits ("REC") or capacity and energy in the near term.

Q DO YOU AGREE WITH THAT FRAME OF REFERENCE?

A No. That point of view in Staff's recommendation seems to be based on the mistaken notion that it's easy to find renewable projects and to acquire and execute on the contracting and construction in a short span of time. This is wrong. As Ameren witness Arora noted at page 14-15 of his direct testimony, full cycle development of a renewable project often takes as many as 8 years. It is not like ordering an automobile – it's not an off the shelf standard product that can be had whenever desired. Developing renewable projects is time consuming and very complex. Even if a project is optioned, it may be the case that failure to timely execute on the option allows other interested parties to acquire the site/solar panels and other equipment, and permits.

There is significant competition in the market place for sites and the equipment to construct renewable facilities. This is only becoming a bigger problem as we go through time because of the increased demand on the part of many utilities and individual purchases for these scarce resources. Failure to act when sites and equipment are available may result in a foregone opportunity and a workable schedule may not be recoverable at a later time.

Q HOW MANY MEGAWATTS OF RENEWABLE CAPACITY HAS AMEREN MISSOURI SET FORTH IN ITS LATEST INTEGRATED RESOURCE PLAN?

A According to the direct testimony of AMO witness Arora, the Company needs 2,800 MW of new renewable resources by 2030 (page 27), and 5,400 MW of new renewable generation by 2039 (page 7).

Q PLEASE OUTLINE YOUR EXPERIENCE WITH DEVELOPMENT OF RENEWABLE RESOURCES IN THE MIDCONTINENT INDEPENDENT SYSTEM OPERATOR ("MISO") TERRITORY?

A Over the last 6 years, I have represented customers in utility proceedings involving the development, certification, and related cost recovery for over 9,000 MW of renewable resources within the MISO footprint.

Q CAN YOU SHARE ANY INSTANCES OF PROJECTS BEING OPTIONED OR PARTIALLY DEVELOPED ONLY TO FACE SETBACKS, ADDITIONAL TIME DELAYS, AND PERHAPS LOSS OF PROJECT AVAILABILITY?

A Yes. One example is a current proceeding in Iowa involving MidAmerican Energy Company (Iowa Utilities Board, Docket No. RPU-2022-0001) and its request for certification of 2,042 MW of wind resources and 50 MW of solar resources. MidAmerican Energy Company has reported that as time went by it lost the ability to contract for one of its best sites, a site for ___ MW of wind resources because a competing interest was able to provide the developer with a more timely and attractive contract.

Another example involves Interstate Power and Light Company ("IPL") in Iowa (Iowa Utilities Board, Docket No. RPU-2021-0003) and its effort to certify 400 MW of

solar capacity. In that certification proceeding, IPL was able to secure interconnection capability for 200 MW of solar power that was made available because of the retirement of IPL generation capacity. However, IPL has not been able to secure locations for an additional 200 MW of solar capacity, even though it has an ability to acquire the solar panels and supporting facilities. This demonstrates that there is a considerable risk of not being able to find adequate sites because of competition, unsatisfactory interconnection capability, local siting laws, and other factors. IPL filed its case with the Iowa Utilities Board in late 2021, and still has not been able to secure arrangements for this 200 MW of solar capacity.

Q DO YOU HAVE ANY OTHER EXAMPLES?

A Yes. Another recent example involves Entergy Louisiana, LLC ("ELL") in LPSC Docket No U-36190 in which ELL seeks to certify 475 MW of solar capacity. ELL was successful in negotiating acquisition agreements with developers and (it thought) obtain necessary local siting authority and meet other requirements. However, during the course of the certification proceeding before the Louisiana Public Service Commission, the local authority for the site involving 150 MW of solar adopted some new rules which meant that ELL has to go back to the negotiating table to see if it can resurrect this project.

Q WHAT IS THE LESSON HERE?

A The lesson is that there is substantial competition for sites for renewable resources, which means that if they are not available now they'll be even less available or more difficult to acquire in the future. It is important to take steps to secure needed sites and

capacity when they are available, rather than speculate on future availability and bear the risk of those sites becoming unavailable.

Q IN GENERAL, HOW WOULD YOU DESCRIBE THE CURRENT STATE OF THE SOLAR INDUSTRY?

A The solar industry has been temporarily disrupted by events such as the import tariff and other issues which have resulted in a general shortage of solar panels.

Q IS THIS A PERMANENT OR TEMPORARY SITUATION?

A In my opinion, and in the opinion of most knowledgeable industry personnel, this is temporary and will be rectified. Import issues, and the recent passage of the Inflation Reduction Act ("IRA") that greatly liberalizes the availability of tax credits for solar resources is expected to return the industry to a state of growth more comparable to what was experienced before these recent disruptions. It seems that the disruption is mainly a supply-side issue, and not a demand-side issue; in other words, the demand for solar resources remains high and is expected to increase over time.

Q DO YOU HAVE ANY AUTHORITATIVE REFERENCES TO SUPPORT THAT POINT OF VIEW?

A Yes. First, it is almost impossible these days to pick up any industry publications, or even such general market publications as *The Wall Street Journa*l, and not understand that there are considerable pressures on utilities and other energy consumers to migrate their portfolios away from fossil resources and toward renewable resources.

As an example, I have included as Schedule MEB-2 the Executive Summary of a December 2022 publication entitled "Solar Market Insight" by Wood Mackenzie and

SEIA. Wood Mackenzie is a well-respected consulting agency with substantial presence in the renewable space and SEIA is, as the name implies, an organization composed of solar industry interests. The December 2022 "Quarterly Executive Summary" published by Wood Mackenzie and SEIA is a good source of trends in the industry,.

To highlight just a couple of passages, the following appears on page 7 of the publication:

> "After 2022, we expect the solar industry to return to growth. In 2023, some projects that were delayed this year should obtain module supply and come online. And by 2024, the real impacts of the IRA will begin to come to fruition. From 2023-2027, Wood Mackenzie forecasts 21% average annual growth across all solar segments."

Also, as set forth on page 13, where Mackenzie and SEIA express the following:

> "Utility PV
>
> - 2,460 MW_{dc} installed in Q3 2022
> - 150 GW_{dc} of utility-scale solar will be added between 2022 and 2027
>
> Supply chain issues continued to constrain utility-scale deployments in Q3 2022. 2.5 GW_{dc} were installed during the third quarter, bringing the 2022 total to 7.4 GW_{dc} – barely two-thirds of the volume installed at this time last year. Another 4.5 GW_{dc} of newly contracted capacity was signed this quarter, the majority of which will come online between 2024-2025. This brings the total pipeline to 90 GW_{dc}, a slight increase compared to last quarter. There are currently 30 GW_{dc} of projects under construction, though module shipment delays are stalling progress."

Q WOULD AN ALLEVIATION OF SUPPLY CHAIN SHORTAGES FOR SOLAR PANELS ALSO RESULT IN MORE SOLAR FARM SITES BECOMING AVAILABLE?

A No. Solar panels and physical sites for their placement are entirely different markets. Many factors will influence site availability and cost, but improved availability of solar panels could increase the number of developers looking for sites and therefore make

site acquisition more difficult and costly. If anything, this underscores the importance of executing now on available site acquisition opportunities.

Renewable Solutions Program

Q IS THE RSP PROGRAM A BENEFIT TO NON-SUBSCRIBING CUSTOMERS?

A Yes. As shown in the supplemental direct testimony of AMO witness Forsberg (page 6), the presence of the RSP reduces the cost of solar resources to non-subscribing customers. As Mr. Wills explains at page 10 of his direct testimony, the fixed charge to subscribing customers is somewhat more than the cost of the Boomtown Solar Facility, and the obligation to pay that subscription fee is a 15-year obligation.[2] This is an offset to the cost of the Boomtown Solar Project and reduces the amount that non-subscribing customers must pay to have the benefit of the resource.

Q WHAT ARE SOME OF THE BENEFITS OF THE PROJECT TO NON-SUBSCRIBING CUSTOMERS?

A The full capacity of the Boomtown Solar Facility is available as a credit to AMO, which can reduce the amount of other capacity that AMO has to acquire. In addition, the output of the facility can be sold into MISO, and the proceeds from those sales are to the benefit of the non-subscribing customers.

[2]The obligation can be sold or transferred to other customers under certain limited circumstances.

Q IS THE EXISTENCE OF A TARIFF WHEREBY CUSTOMERS CAN ACQUIRE RECS PREVALENT IN THE INDUSTRY?

A Yes. Many utilities operate such programs. Schedule MEB-3 is a summary recently prepared which highlights some of the key programs and features in other locations. This is not comprehensive because other utilities have other programs and some utilities have more than one program. However, it does indicate a significant prevalence of such programs.

Q WHAT IS THE BENEFIT OF HAVING THE CUSTOMER'S UTILITY PARTICIPATE IN A PROGRAM OF THIS NATURE?

A There are several. First, having a program keyed to a solar resource that the utility system needs anyway and having it tariffed, greatly reduces the complexity of the contracting process compared to other alternatives.

One alternative is for a utility customer to enter into a contract with a developer or other resource owner in some other geographical location and execute a "Contract for Differences" whereby the customer effectively agrees to pay a fixed price to the developer in return for receiving the market revenues from liquidating the output of the renewable facility in the market. This is less of a resource acquisition than a hedge, which some corporations may not be allowed to undertake based on corporate risk management protocols or perhaps because of regulatory barriers.

Another option would be for the customer to construct a renewable resource on its property, so that it's behind the meter. This requires capital which most utility customers would rather invest in their businesses and purchase their requirements from the utility, so everybody does what they do best. Another issue, sometimes the decisive one, is the lack of availability of land to site a meaningful amount of renewable

resources. So, in many instances, it may not be possible either because of lack of availability of adequate land or local siting requirements. These other options are available, but they are not as "customer-friendly" as the options like that offered by the RSP. The RSP is basically a win-win proposition for the subscribing customer and the non-subscribing customer.

Q DOES THIS CONCLUDE YOUR SURREBUTTAL TESTIMONY?

A Yes, it does.

Solar Energy Industries Association®

Wood Mackenzie
A Verisk Business

December 2022

US Solar Market Insight

Executive summary

Q4 2022

About the report

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US Solar Market Insight® is a quarterly publication of Wood Mackenzie and the SEIA®. Each quarter, we collect granular data on the US solar market from nearly 200 utilities, state agencies, installers, and manufacturers. This data provides the backbone of this US Solar Market Insight® report, in which we identify and analyze trends in US solar demand, manufacturing and pricing by state and market segment over the next five to ten years. All forecasts are from Wood Mackenzie, Limited; SEIA does not predict future pricing, bid terms, costs, deployment or supply. The report includes all 50 states, Washington, D.C., and Puerto Rico. Detailed data and forecasts are contained within the full version of the report.

References and Contact

- References, data, charts, and analysis from this executive summary should be attributed to "Wood Mackenzie/SEIA US Solar Market Insight®."
- Media inquiries should be directed to Wood Mackenzie's PR team (WoodmacPR@woodmac.com) and Morgan Lyons (mlyons@seia.org) at SEIA.
- All figures are sourced from Wood Mackenzie. For more detail on methodology and sources, access the full report at www.woodmac.com/research/products/power-and-renewables/us-solar-market-insight/.

Note on US Solar Market Insight report title: The report title is based on the quarter in which the report is released, not the most recent quarter of installation figures.

Contents

1. Key figures

- In Q3 2022, the US solar market installed 4.6 GW_{dc} of solar capacity, a 17% decrease from Q3 2021 and a 2% decrease from Q2 2022. The industry continues to be supply-constrained, most recently from import detentions.
- Solar accounted for 45% of all new electricity-generating capacity added to the US grid through the third quarter, more than any other electricity source.
- The residential segment had a historic quarter with 1.57 GW_{dc} installed, a 43% increase over Q3 2021 and a 16% increase over Q2 2022. California made up 36% of this total as installers continue to push to sell residential solar before changes to current net metering rates.
- There were 340 MW_{dc} of commercial solar installed, up 3% year-over-year and down 10% quarter-over-quarter. Community solar developers installed 212 MW_{dc}, down 17% both year-over-year and quarter-over-quarter.
- The industry deployed 2.5 GW_{dc} of utility-scale solar in Q3 2022, a 36% decrease from Q3 2021 and a 9% decrease from Q2 2022. The low installation figures are the result of previous project delays and continued supply chain constraints.
- Total 2022 installations are expected to land at 18.6 GW_{dc} – a slight increase from our previous outlook, but still a 23% decrease from 2021. Utility-scale solar installations are expected to decline 40% from 2021 with only 10.3 GW_{dc} installed.
- Wood Mackenzie expects the industry to remain supply-constrained through at least the second half of next year. Equipment importers are still contending with detainments as they seek to provide the documentation needed for compliance with the Uyghur Forced Labor Prevention Act (UFLPA).
- Once supply chain relief arrives, the true impacts of the Inflation Reduction Act will manifest in our outlooks. Beginning in 2024, annual installations of solar will consistently reach 30-40 GW_{dc}.
- On December 2nd, the Department of Commerce issued a preliminary affirmative ruling in the anticircumvention case initiated earlier this year. While the ruling was not issued in time to allow for incorporation into our forecasts, new tariffs present a downside risk to our outlook.

2. Introduction

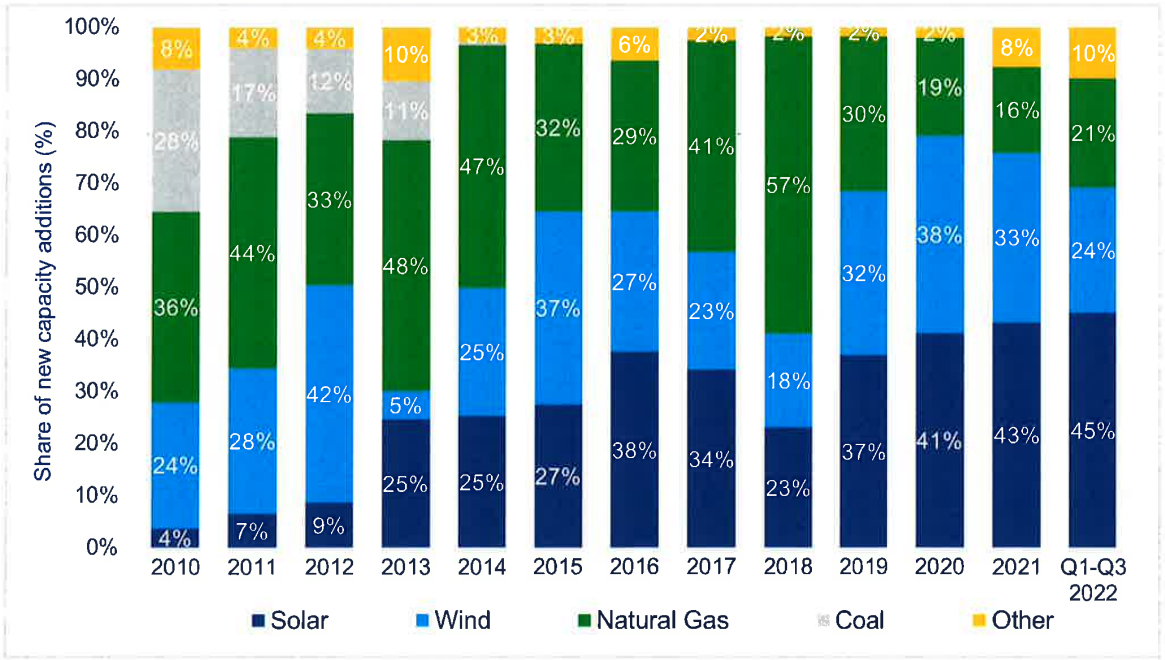
The US solar industry installed 4.6 gigawatts-direct current (GW_{dc}) of capacity in the third quarter of 2022, a 17% decrease from Q3 2021 and a 2% decrease from Q2 2022.

Commercial, community, and utility-scale solar were all down quarter-over-quarter – an unsurprising outcome given the nearly ubiquitous project delays from supply chain constraints. These segments installed 340 MW_{dc}, 212 MW_{dc}, and 2.5 GW_{dc}, respectively. If utility-scale solar reaches our 2022 forecast of 10.3 GW_{dc}, it will reflect a 40% drop from 2021 volumes.

The trend for residential solar looks quite different. Quarterly installs set another record at 1,568 MW_{dc}. The fundamentals for residential solar are strong – customers crave energy independence and savings from a solar system, particularly as retail power prices increase. Record volumes in California are also driving this growth, as the industry rushes to capture sales before the state shifts to a new net metering policy. More analysis of California market trends and their impact on the residential sector can be found in the full report.

Overall, solar PV accounted for 45% of all new electricity-generating capacity additions through the third quarter.

New US electricity-generating capacity additions, 2010 – Q1-Q3 2022



Source: Wood Mackenzie, US Energy Information Administration (for all other technologies)

An industry waits

After a year of starts and stops, the US solar industry once again finds itself waiting on the outcomes of several key policy issues. The first, and most pressing, is how US Customs and Border Protection (CBP) will manage the approval process under the UFLPA and the release of hundreds of solar equipment shipments still being detained.

The UFLPA took effect on June 21st, with detentions beginning shortly thereafter, but even after several months, CBP has not made major releases of equipment. As mentioned in last quarter's report, the requirements to demonstrate compliance with the UFLPA are more rigorous than those for the Withhold Release Order (WRO) issued last fall. Last quarter, importers were working with CBP on the required documentation and were expecting near-term releases as some manufacturers had started to file admissibility packages.

Unfortunately, little has changed since then. It is proving more difficult than expected to provide traceability for the sourcing of quartzite used in solar equipment. There are many questions around the required documentation that is needed to demonstrate compliance with the UFLPA. Furthermore, the CBP is still releasing detentions from last fall's WRO, a sign that UFLPA releases could take just as long. We still expect supply chain relief to arrive in the second half of 2023, but the exact timing is uncertain.

The solar industry is also waiting on guidance from the US Department of Treasury on how to qualify for the various tax credits and adders within the Inflation Reduction Act (IRA). These incentives will undoubtedly provide upside for solar project development, but without more specifics from the US government, it's difficult to assess which projects will qualify for various adders. The overwhelming sentiment from developers this quarter was that it's too soon to know how the bonus adders will impact their business.

Treasury collected public comments on various aspects of the IRA tax credits, which were due on November 4th. While there's no firm deadline for all Treasury guidance, most is expected sometime in the first quarter of 2023. Given this uncertainty, Wood Mackenzie has assumed most projects will earn the 30% ITC or $26/MWh PTC. In the medium-term, the availability of bonus adders will certainly provide upside to our outlooks after supply chain issues have been resolved.

California moves to net billing for distributed solar

Uncertainty around supply chain constraints and IRA qualifications aside, the distributed solar industry received some clarity for the segment's largest market. The California Public Utilities Commission (CPUC) issued the highly anticipated revision of its Proposed Decision (PD) for the next generation of net metering tariffs ("NEM 3.0"). November's PD makes several substantial changes to the first proposal from December 2021.

The November PD maintains several elements of the previous proposal (a shift to a "net billing" structure instead of "net metering" and compensating exports at the avoided cost

rate) but eliminates others (the Grid Participation Charge and Market Transition Credit). On balance, the new PD certainly elongates current payback periods for solar and solar-plus-storage, but not by as much as the previous proposal. Therefore, we still expect market contraction in both the residential and non-residential markets.

Importantly, if the November PD is finalized in its current form, the largest distributed solar market will no longer compensate solar exports at a customer's retail rate. More details on the PD and its impact can be found in the full report.

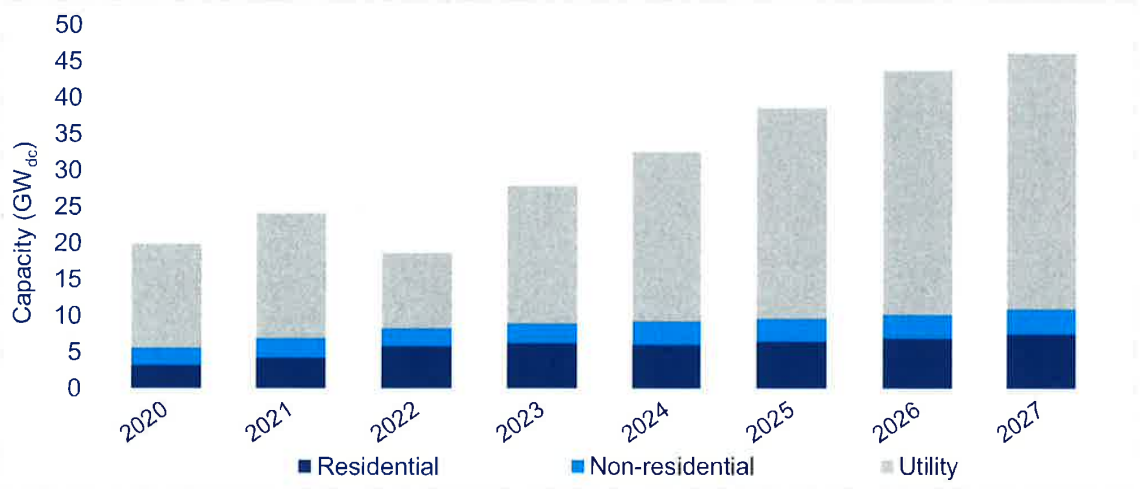
Average annual growth of 21% expected after 2022

After 2022, we expect the solar industry to return to growth. In 2023, some projects that were delayed this year should obtain module supply and come online. And by 2024, the real impacts of the IRA will begin to come to fruition. From 2023-2027, Wood Mackenzie forecasts 21% average annual growth across all solar segments.

It is worth noting that on December 2nd, the Department of Commerce (DOC) issued an affirmative preliminary determination on the anticircumvention case that was initiated earlier this year. This means that by early June 2024, new antidumping and countervailing duties (AD/CVD) could be applied to solar cells and module imports from certain companies with facilities in the four named Southeast Asian countries. The tariff rates will vary between producers.

In this report, our outlook does not include additional AD/CVD tariffs stemming from this case. New tariffs present downside risk to our forecasts, but it's too early to tell the extent of the impacts. We will be incorporating the impacts into future outlooks upon further investigation.

US solar PV installations and forecasts by segment, 2020-2027



Source: Wood Mackenzie

State solar PV installation rankings, Q1-Q3 2022

State	Rank			Installations (MW_{dc})		
	2020	2021	Q1-Q3 2022	2020	2021	Q1-Q3 2022
California	1	2	1	3,917	3,648	3,187
Texas	2	1	2	3,426	6,063	2,325
Florida	3	3	3	2,826	1,668	1,578
New York	8	9	4			
Nevada	15	10	5			
Illinois	13	7	6			
Arizona	9	13	7			
New Jersey	12	17	8			
Georgia	7	5	9			
Wisconsin	19	15	10			
North Carolina	5	8	11			
Tennessee	49	44	12			
Iowa	22	25	13			
New Mexico	16	31	14			
Michigan	27	14	15			
South Carolina	6	26	16			
Utah	11	16	17			
Maine	29	20	18			
Oregon	20	21	19			
Massachusetts	10	11	20			
Virginia	4	4	21			
Colorado	14	12	22			
Mississippi	31	50	23			
Pennsylvania	17	28	24			
Puerto Rico	34	29	25			
Maryland	26	27	26			
Hawaii	28	33	27			

Underlying data available in the full report

Source: Wood Mackenzie

State solar PV installation rankings, Q1-Q3 2022

State	Rank			Installations (MW_{dc})		
	2020	2021	Q1-Q3 2022	2020	2021	Q1-Q3 2022
Ohio	18	18	28			
Connecticut	24	22	29			
Missouri	33	32	30			
Washington	36	35	31			
Indiana	32	6	32			
Rhode Island	25	24	33			
Minnesota	21	30	34			
Arkansas	23	23	35			
Idaho	41	36	36			
New Hampshire	39	37	37			
Washington DC	35	34	38			
Vermont	42	39	39			
Oklahoma	40	42	40			
Louisiana	30	41	41			
Kansas	37	40	42			
Kentucky	46	43	43			
Delaware	44	38	44			
Montana	45	47	45			
Nebraska	43	45	46			
West Virginia	48	46	47			
Wyoming	38	48	48			
Alaska	47	49	49			
South Dakota	50	52	50			
North Dakota	52	51	51			
Alabama	51	19	52			

Underlying data available in the full report

Source: Wood Mackenzie

3. Market segment outlooks

3.1. Residential PV

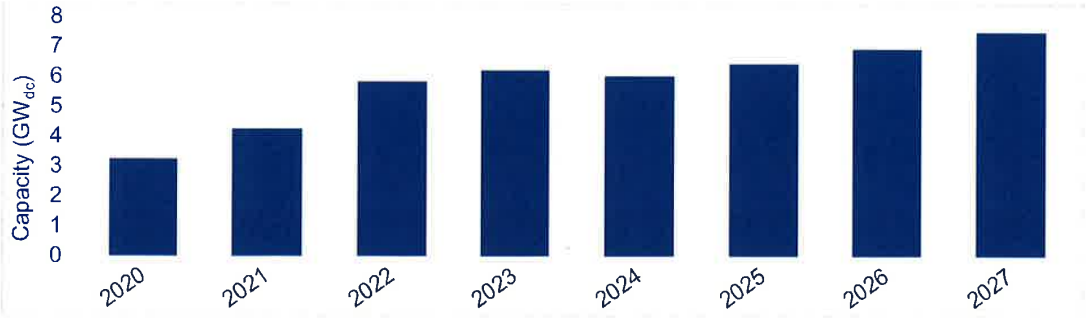
- 1,568 MW_{dc} installed in Q3 2022
- Up 43% from Q3 2021
- Up 16% from Q2 2022

More than 1,500 MW_{dc} were installed in the residential solar market in one quarter for the first time in Q3 2022. Nineteen states set quarterly records in Q3, with California (571 MW_{dc}), Florida (150 MW_{dc}), and Texas (130 MW_{dc}) again installing the most capacity. California alone surpassed 500 MW_{dc} for the first time. Although some installers continue to face challenges (supply constraints, interest rate increases, permitting and utility interconnection delays), recent retail rate inflation is a significant driver of growth.

Many installers indicate that module supply normalized in Q3 and they were able to secure modules for Q4 installations. However, as a result of supply chain issues from early 2022, coupled with strong demand, installers are still working through lingering customer backlogs. Permitting and utility interconnection delays in certain markets exacerbated these backlogs, with reports of some inspection times exceeding six months.

As a result of these trends, we have increased our residential outlook for 2022 to 37% year-over-year growth. We expect high retail rates and California demand pull-in to result in record installations as installers make progress on their backlogs. The release of the Revised PD in California fundamentally changes the shape of our long-term residential solar outlook. With implementation expected in April of next year, we expect high levels of installations through Q3 2023 as customers who submit an interconnection application before the deadline will qualify under NEM 2.0. 2024 will be the first full year of impacts from the new NEM 3.0 policy, contracting the California market by 39% and causing a 3% contraction in the national market. The residential solar industry also awaits guidance on implementation of the ITC adders, which may shake up the product landscape and provide a boost to third-party owned (TPO) projects.

Residential solar installations and forecast, 2020-2027



Source: Wood Mackenzie

3.2. Commercial PV

- 340 MW_{dc} installed in Q3 2022
- Up 3% from Q3 2021, down 10% from Q2 2022

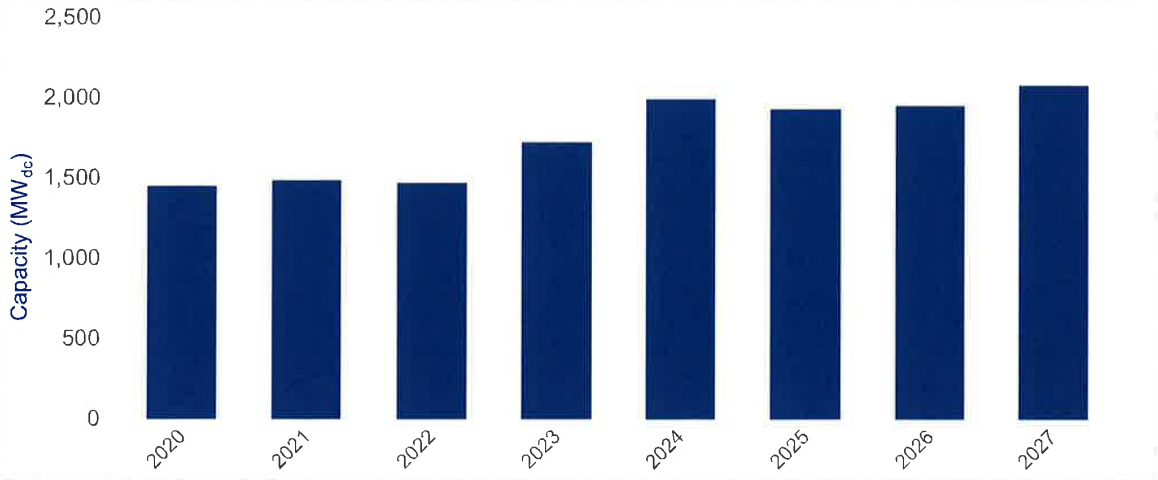
Note on market segmentation: Commercial solar encompasses distributed solar projects with commercial, industrial, agricultural, school, government or nonprofit offtakers, including remotely net-metered projects. This excludes community solar (covered in the following section).

Commercial solar volumes fell quarter-over-quarter as project delays from earlier in the year manifested. However, installation volumes did not contract as much as originally anticipated. Surprisingly, installations through the third quarter roughly match those of 2021. While there are some state-specific dynamics that partially explain this, it is still clear that 2022 volumes have been suppressed due to the supply chain constraints of the last year. Overall, we expect 2022 to be flat compared to 2021.

Next year will be a better year for the sector, with 17% growth expected. However, this represents a lower growth forecast than we were expecting last quarter, due to both the increase in projects expected to come online before the end of 2022, as well as reductions to a few states, including New Jersey and New York.

As mentioned in the Introduction, our forecasts do not incorporate any impacts from the ITC or PTC adders. Thus far, the low-income and energy communities adders are the most appealing to the commercial solar industry. The adders provide upside to our outlook, with commercial solar growing at an average annual rate of 7% through 2027. While there are still many challenges to commercial solar project execution, the IRA tailwinds should help sustain modest growth.

Commercial solar installations and forecast, 2020-2027



Source: Wood Mackenzie

3.3. Community solar PV

- 212 MW_{dc} installed in Q3 2022
- Down 17% from Q3 2021, down 17% from Q2 2022

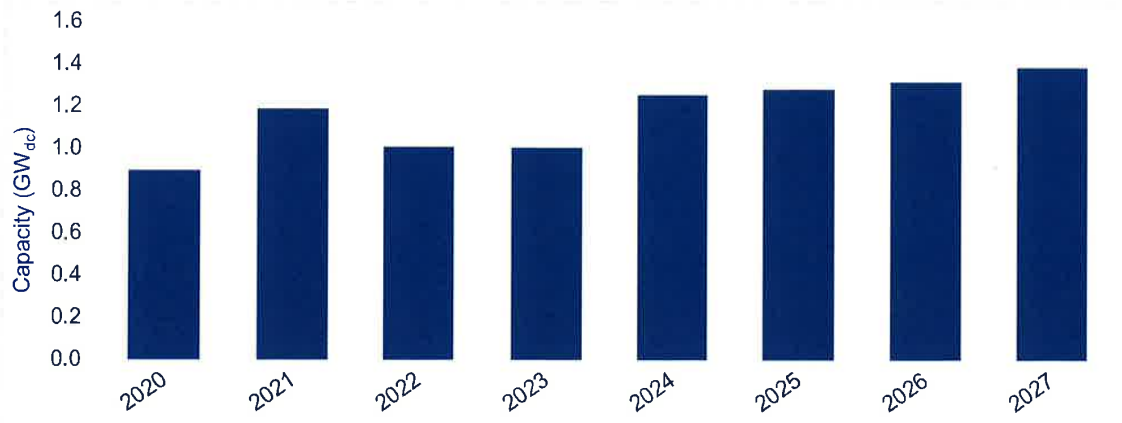
Note on market segmentation: Community solar projects are part of formal programs where multiple customers can subscribe to the power produced by a local solar project and receive credits on their utility bills.

Community solar installations declined in Q3 2022 for the second consecutive quarter. Low installation volumes in three key states—Maine, Massachusetts, and Maryland—contributed to most of the national decline. Interconnection backlogs and siting constraints continue to be the major obstacles hindering growth in these states. Additionally, the last several quarters of nation-wide supply chain constraints are extending project timelines into 2023 and beyond, limiting near-term installations.

Despite these challenges, our expectations for community solar in 2022 have increased by 8% compared to our previous outlook. This increase is driven primarily by significant growth in New York. The project pipeline in the state continues to come online at a very healthy pace, leading us to increase the forecast for 2022 by 21% compared to the previous outlook. Third quarter installation volumes in New York accounted for more than 60% of the national market.

Beginning this quarter, we have added a community solar forecast for California due to the passage of legislation requiring a state-wide community solar program. Although policy makers have not finalized many details of the program, we estimate it will result in an additional 570 MW_{dc} between 2024 and 2027. We attribute growth in our national five-year forecast to favorable conditions resulting from the IRA, as well as state policy initiatives in both mature and emerging community solar markets.

Community solar installations and forecast, 2020-2027



Source: Wood Mackenzie

3.4. Utility PV

- 2,460 MW_{dc} installed in Q3 2022
- 150 GW_{dc} of utility-scale solar will be added between 2022 and 2027

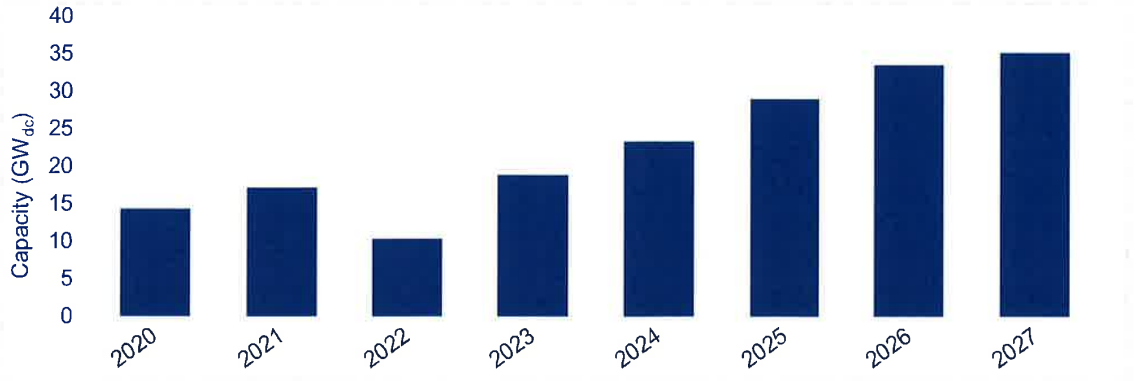
Supply chain issues continued to constrain utility-scale deployments in Q3 2022. 2.5 GW_{dc} were installed during the third quarter, bringing the 2022 total to 7.4 GW_{dc} – barely two-thirds of the volume installed at this time last year. Another 4.5 GW_{dc} of newly contracted capacity was signed this quarter, the majority of which will come online between 2024-2025. This brings the total pipeline to 90 GW_{dc}, a slight increase compared to last quarter. There are currently 30 GW_{dc} of projects under construction, though module shipment delays are stalling progress.

Industry players are cautiously optimistic as they begin to navigate newly available tax credit adders and financing options included in the IRA. Due to uncertainty around specific adder requirements, Wood Mackenzie assumes that utility-scale projects will earn the 30% ITC or the $26/MWh PTC, with most opting for the latter. The IRA's impacts are not expected to fully materialize until 2024-2025, while the near-term pipeline remains vulnerable to delays and cancellations.

As mentioned in the Introduction, UFLPA enforcement has caused widespread module detentions as the industry has scrambled to develop quartzite sourcing documentation. Because polysilicon sourced outside of China comprises a small share of the current market, the inability to demonstrate traceability of the quartzite will continue to threaten US module supply.

Wood Mackenzie anticipates another 2.8 GW_{dc} of utility-scale solar will come online this year, increasing the 2022 outlook to 10.3 GW_{dc}. After this year, IRA-driven demand and supply normalization will boost the utility-scale sector to 150 GW_{dc} of installations through the forecast period.

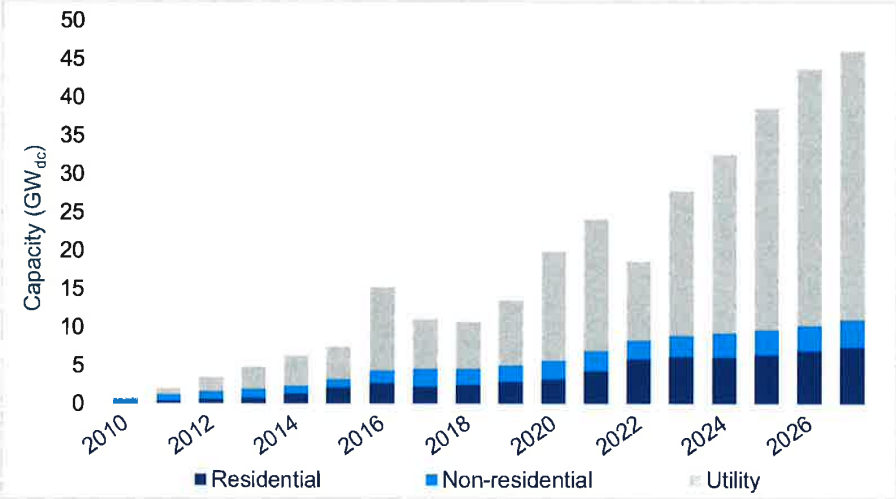
Utility solar installations and forecast, 2020-2027



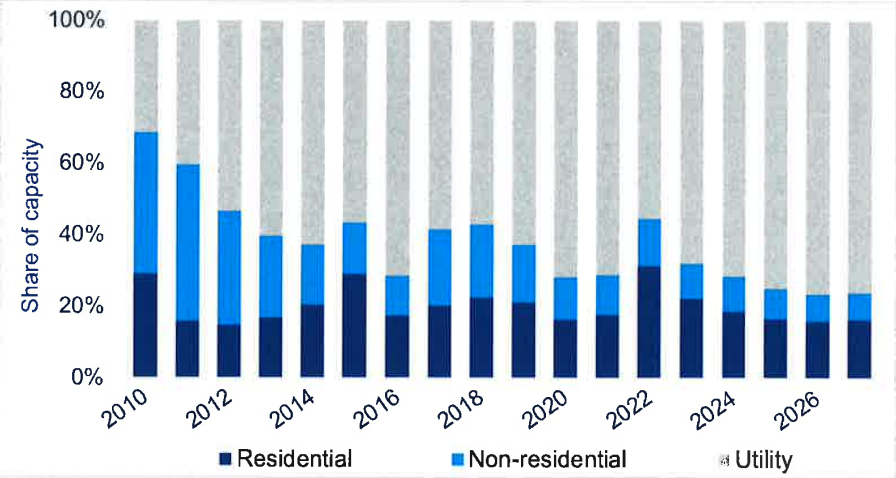
Source: Wood Mackenzie

4. US solar PV forecasts

US PV installation historical data and forecast, 2010-2027



US PV share of capacity (historical and forecast), 2010-2027



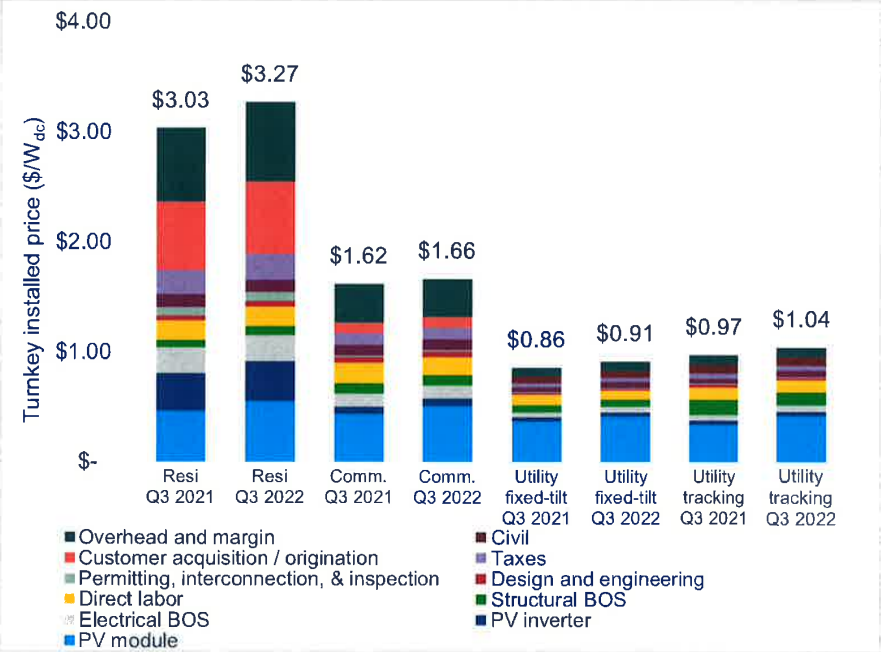
Source: Wood Mackenzie; Note that non-residential solar is broken out into commercial solar and community solar in the full data accompanying the US Solar Market Insight report.

5. National solar PV system pricing

Note: Wood Mackenzie has updated the reporting methodology for modeled prices to be consistent with US solar system pricing reports. Therefore, figures shown below may not match those published in earlier editions of the US Solar Market Insight report.

Wood Mackenzie employs a bottom-up modeling methodology to capture, track and report national average PV system pricing by segment for systems installed each quarter. The methodology is based on the tracked wholesale pricing of major solar components and data collected from industry interviews. Wood Mackenzie assumes all product is procured and delivered in the same year as the installation except modules for the utility segment, which are procured one year prior to commercial operation.

Modeled US national average system prices by market segment, Q3 2021 and Q3 2022



Source: Wood Mackenzie

System pricing increased by 8% for residential solar and by 3% for commercial solar compared to Q3 2021, as the impacts of the anticircumvention case and UFLPA continue to create a high pricing environment for modules. Pricing for utility-scale systems was also up by 6% for fixed-tilt and 7% for tracker systems compared to last year. Module pricing continues to climb on the heels of rising polysilicon prices. Equipment pricing and labor costs are also high, due to rising inflation, keeping system prices high across all segments.

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For more information on US Solar Market Insight™ and to download this quarter's free Executive Summary, visit **www.woodmac.com/research/products/power-and-renewables/us-solar-market-insight/** or **www.seia.org/cs/research/solarinsight**.

The US Solar Market Insight™ is also available as a part of Wood Mackenzie's **US Utility Solar** and **US Distributed Solar Services**. In addition to this report, the services include analysis of the competitive landscape and additional market data and insights.

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SURVEY OF RENEWABLE ENERGY PROGRAMS

Utility	Program Name	Program Size / Limits	Facility Ownership	Cost Recovery	Bill Impact	Energy Pricing	RECs
Appalachian Power Company	Wind, Water and Sunlight Rider (See page 128 of the Standard 1 document) FAQ	Available to customers that take firm service from the Company. Customers can purchase renewable energy to cover 100% of their energy needs.	A customer's energy needs and associated RECs come from the Company's renewable energy generation portfolio (wind, hydro and potentially solar).	Program costs are limited to program participants.	Customers remain on their current rate schedule but pay a Balancing Charge and Renewable Energy Premium instead of the Fuel Factor, non-renewable G-RACs, and the generation component of their rate schedule. Prices are provided in the tariff. Source / calculation of pricing is not stated but the Company states they are subject to periodic revision to reflect current market conditions.	Balancing Charge and Renewable Energy Premium charges are provided in the tariff. Source / calculation of pricing is not stated.	RECs are retained or retired on the customer's behalf.

SURVEY OF RENEWABLE ENERGY PROGRAMS

Utility	Program Name	Program Size / Limits	Facility Ownership	Cost Recovery	Bill Impact	Energy Pricing	RECs
Appalachian Power Company	Voluntary Wind Service / Schedule VWS (See page 97 of the Standard 1 document) FAQ	The program is available to customers with a demand greater than 0.5 MW. Customers are required to execute a services agreement with the Company. Total capacity is limited based on the amount of energy available from the generating facilities.	Generation comes from the Virginia-allocated output purchased via a PPA with two wind facilities. The Company will purchase additional energy from other wind generation facilities if required and if the output is available.	Program costs are limited to program participants.	Customers avoid the generation-based Base Rate Energy Charge and the Fuel Factor Rider. Instead, customers are subject to an energy rate for the renewable energy.	Customers pay an energy rate that is determined through a services agreement with the Company.	RECs are retired on the customer's behalf.

SURVEY OF RENEWABLE ENERGY PROGRAMS

Utility	Program Name	Program Size / Limits	Facility Ownership	Cost Recovery	Bill Impact	Energy Pricing	RECs
Appalachian Power Company	Renewable Energy Credit Rider (REC) (See page 127 of the Standard 1 document) FAQ	Each program allows customers to purchase RECs. A former RPR rider allowed customers to purchase RECs associated with with the Summersville Hydro project. Customers purchase 100 kWh blocks or an amount equal to the customer's total monthly energy consumption.	The Company purchases RECs and purchases power from the Summersville Hydro project.	Program costs are limited to program participants.	In addition to the monthly charges determined according to the Company's rate schedule, the customer purchases RECs at the rate in the tariff.	REC prices are provided in the tariff. Source / calculation of pricing is not stated. REC and RPR have different prices. REC rider RECs are currently $0.0010 per kWh.	RECs are retired on the customer's behalf.
Consumers Energy Company Michigan	Green Generation Program (See Section 10.2 or page 75) Homepage	The program is limited to 100% of a customer's annual usage. The program was open to all full-service customers but is currently closed to new customers.	Generation comes from Consumers' renewable resource portfolio. RFPs are issued for additional generation if needed.	Program costs are limited to the program participants. The program is also funded from the $5 million per year from the Midland Cogeneration Venture revenues.	No impact on a customer's bill beyond the additional program charges.	REC prices are provided in the tariff. Source / calculation of pricing is not stated.	RECs are retired annually in an amount equal to the generation associated with customer participation.

SURVEY OF RENEWABLE ENERGY PROGRAMS

Utility	Program Name	Program Size / Limits	Facility Ownership	Cost Recovery	Bill Impact	Energy Pricing	RECs
Consumers Energy Company Michigan	Voluntary Large Customer Renewable Energy Pilot (LC-REP) Program (See Section 10.6 or page 93) Application	Customers can match up to 100% of their annual energy use with renewable energy. Customers must have an annual aggregated maximum demand of at least 1 MW.	Under Option A, Consumers Energy will supply the renewable energy from designated renewable facilities. Renewable energy designated for use in the program is not used by the Company for compliance with the state's statutory renewable energy portfolio requirements. Under Option B, the customer provides their own Renewable Energy Resource.	Program costs are limited to program participants.	Customers receive energy and capacity credits which can be paid via a bill credit or direct payment. The amount of energy billed at standard rates does not change. Customers who receive at least 50% of their monthly energy under the program are exempt from the renewable energy surcharge.	The energy credit is based the MISO settled Day Ahead and Real Time LMP related payments for the renewable energy at the assigned load node for the facility. The capacity credit is based on the value of the auction clearing price in the annual MISO capacity auction for the planning period.	Consumers will either retire the RECs or transfer them to the customer.

SURVEY OF RENEWABLE ENERGY PROGRAMS

Utility	Program Name	Program Size / Limits	Facility Ownership	Cost Recovery	Bill Impact	Energy Pricing	RECs
Consumers Energy Company Michigan	Pilot Solar Program / Solar Gardens (See Section C10.5 or page 89) Homepage	The pilot is limited to 10 MW. Customers can purchase 0.5 kW subscriptions and are limited to 100% of their annual usage. The program is open to residential, general service secondary, general service primary, and energy intensive rate classes.	Consumers can own the renewable facility or can satisfy subscriptions through a PPA.	Program costs and costs of the solar generation are limited to program participants.	Subscriptions provide a Solar Energy Credit. The amount of energy billed at standard rates does not change. Customers that receive at least 50% of their average monthly energy through this program will be exempt from paying the Company's Renewable Energy surcharge.	Customers pay the cost of the service and receive Solar Energy Credits.	Consumers own and will retire the RECs.

SURVEY OF RENEWABLE ENERGY PROGRAMS

Utility	Program Name	Program Size / Limits	Facility Ownership	Cost Recovery	Bill Impact	Energy Pricing	RECs
Dominion Energy	Schedule RG – Renewable Generation Homepage	The program is open to large, non-residential customers. Customers must purchase renewable generation from a project with a size of no less than 1 MW in nameplate capacity. Customers cannot purchase more than 100% of their annual usage. Customers can aggregate accounts to participate in Schedule RG. The program is capped at 50 customers.	Dominion will sign a PPA with renewable energy generators to procure the renewable energy.	Program costs are limited to program participants.	Customers are billed at their current rate and receive a Schedule RG settlement charge or credit for each renewable facility as described in the customer's Schedule RG Agreement.	Customers sign a Customer Agreement with Dominion for the purchase of the renewable energy and renewable energy attributes.	RECs are retired on the customer's behalf.

SURVEY OF RENEWABLE ENERGY PROGRAMS

Utility	Program Name	Program Size / Limits	Facility Ownership	Cost Recovery	Bill Impact	Energy Pricing	RECs
Dominion Energy	Schedule RF - Environmental Attributes Purchases Homepage	The program is open to non-residential customers. Customers must purchase a minimum of 2,000 Environmental Attributes. Customers can purchase RECs for up to 100% of their energy usage. Enrollment is open until May 31, 2023.	RECs will come from newly constructed renewable energy facilities owned by Dominion or from facilities that Dominion has a PPA with.	Program costs are limited to program participants	No impact on a customer's bill beyond the additional program charges (Schedule RF Charge).	Customers enter into a Renewable Facilities Agreement with Dominion.	Customers purchase the Renewable Attributes.

SURVEY OF RENEWABLE ENERGY PROGRAMS

Utility	Program Name	Program Size / Limits	Facility Ownership	Cost Recovery	Bill Impact	Energy Pricing	RECs
Dominion Energy	Rider VCS - Virginia Community Solar Pilot Program Homepage	The rider is open to residential and non-residential customers. Residential customers can purchase one to five 100 kWh blocks or 100% of their monthly usage. Non-residential customers can purchase one to ten 100 kWh blocks or 100% of their monthly usage if they are a small non-residential customer. The rider is open until all blocks are fully subscribed.	Dominion will execute power purchase agreements with a portfolio of community-based solar facilities to support the Rider. Dominion is soliciting bids for renewable energy from solar facilities up to 2 MW or less in size.	Program costs are limited to program participants.	No impact on a customer's bill beyond the additional program charges (VCS Net Rate).	The VCS Net Rate is the sum of the VCS Charge and the VCS Adjustment. The VCS Charge equals 6.42¢ per kWh and is based on the Company's purchased power costs for the output of the portfolio of community-based solar facilities supporting this Rider. The VCS Adjustment is based on the energy and capacity market value of power delivered to the electrical grid equal to the output of the portfolio of community-based solar facilities.	RECs and other Environmental Attributes associated with Rider VCS are retired on behalf of the customer.

SURVEY OF RENEWABLE ENERGY PROGRAMS

Utility	Program Name	Program Size / Limits	Facility Ownership	Cost Recovery	Bill Impact	Energy Pricing	RECs
Duke Energy Carolinas	Green Source Rider (Rider GS)	The Rider is available for customers on the Optional Power Service, Time of Use rate who displace all or a portion of their new load added after June 30, 2012. The new load must be at least 1,000 kW. The Rider has an aggregate cap of 1 million MWh.	Duke Energy will procure renewable energy on the customer's behalf. Renewable energy will come from PPAs with suppliers or from Duke's own renewable generation.	Program costs are limited to program participants.	Customers are billed the applicable time of use rate plus the total cost of the renewable energy and RECs during the previous billing period, determined on an hourly basis. Customers also pay an additional admin charge of $500 and 0.02 cents per kWh of renewable energy.	Customers pay the total costs of the renewable energy and RECs, as determined on an hourly basis. Bill credits are applied at a rate equal to the avoided capacity and energy during the hours the renewable energy was produced by the Company or supplied to the Company. Credits are capped at the total costs of the renewable energy and RECs.	RECs are retired on the customer's behalf.

SURVEY OF RENEWABLE ENERGY PROGRAMS

Utility	Program Name	Program Size / Limits	Facility Ownership	Cost Recovery	Bill Impact	Energy Pricing	RECs
Duke Energy Carolinas	Green Source Advantage (Rider GSA) Homepage	The program is limited to a combined 600 MW of renewable energy between Duke Energy Carolinas and Duke Energy Progress. Customers must have an annual peak of 1 MW at one location or an aggregated annual peak of 5 MW across multiple locations. The program is limited to the Univ. of NC system, military, and nonresidential customers. Customers can procure up to 125% of their annual peak.	Must be new renewable energy facilities located in the Duke Energy Carolinas service territory. Customers will direct Duke to procure renewable energy that will be used to supply all customers. Facilities can be utility owned or independently owned.	Program costs are limited to program participants.	In addition to the amount billed under the customer's primary rate schedule, customers receive a bill credit and pay a product charge.	Customers are billed their normal rate plus 1) the GSA Product Charge, 2) the GSA Bill Credit, and 3) an admin charge. The GSA Product Charge is equal to the fixed rate for energy specified by the supplier. The GSA Bill Credit is either 1) the avoided cost bill credit (the calculated fixed levelized avoided energy and capacity rate), or 2) the hourly rate bill credit (the expected marginal production cost plus the marginal capacity cost during hours with generation constraint).	Customers own the RECs.

SURVEY OF RENEWABLE ENERGY PROGRAMS

Utility	Program Name	Program Size / Limits	Facility Ownership	Cost Recovery	Bill Impact	Energy Pricing	RECs
Duke Energy Carolinas	Renewable Advantage Rider	Customers can purchase blocks of renewable energy on a month to month basis. The program's size is limited to the number RECs available under the rider.	Duke Energy will procure renewable energy on the customer's behalf from a combination of different Renewable Energy Resources that fosters a blend of renewable energy.	Program costs are limited to program participants.	No impact on a customer's bill beyond the additional program charges.	REC prices are provided in the tariff. Source / calculation of pricing is not stated.	RECs are retired on the customer's behalf.

SURVEY OF RENEWABLE ENERGY PROGRAMS

Utility	Program Name	Program Size / Limits	Facility Ownership	Cost Recovery	Bill Impact	Energy Pricing	RECs
Duke Energy Carolinas	Shared Solar Rider Homepage	The Rider is open to residential and nonresidential customers. Each solar generation site will be limited to 5 MW and no subscriber can use over 40% of the site's capacity. The total of all sites cannot exceed 20 MW. A customer cannot subscribe for more than 100% of its annual demand. Customers must be within the county with the solar site or adjacent. Customers may get Commission approval if located more than 75 miles away.	Duke will manage the site selection and the Company will use either dedicated company resources or PPAs for the Rider.	Program costs are limited to program participants.	Customers pay a subscription that includes a Shared Solar Credit for each subscribed block and a monthly subscription charge that is the number of blocks times a fixed rate per block that is specific to the generation site.	The monthly subscription cost per Shared Solar Block will be unique to each site and be designed to recover the estimated revenue requirement of the generation over the 20-year generating asset life and related ongoing program cost. The monthly Shared Solar Credit will be variable based on the actual production of the solar facility and is based on the fixed 20-year long term avoided cost rate.	RECs are retired on the customer's behalf. Customers have the option to purchase the RECs from Duke Energy.

SURVEY OF RENEWABLE ENERGY PROGRAMS

Utility	Program Name	Program Size / Limits	Facility Ownership	Cost Recovery	Bill Impact	Energy Pricing	RECs
Entergy Louisiana	Geaux Green Option ("GGO) Rider (Approved. Not available until program resources are available)	The Rider is open to all rate schedules and the minimum subscription is 2 kW. Non-residential customers that subscribe to more than 500 kW of capacity under this rider are subject to an ESA with Entergy. The total capacity available under the rider is defined in the tariff and is currently 475 MW.	Entergy will procure renewable energy on the customer's behalf from designated facilities. Entergy current purchases power from three solar facilities and has a build-own-transfer agreement with a fourth solar facility.	Program costs are limited to program participants.	Customers are billed their normal rate plus an additional amount that is the sum of a GGO charge and an energy credit. The energy credit is the subscribed energy times the MISO settlement rate. The GGO charge can be calculated using a capacity or energy rate included in the tariff. There is also rate for low income customers.	The monthly subscription pricing is specified in the tariff. Customers can pay either a capacity charge based on the customer's subscribed capacity or an energy charge based on the customer's share of the facility's output. Prices are current $7.91/kW-month for the capacity charge option and $0.039288/kWh for the energy charge option.	RECs are retired on the customer's behalf.

SURVEY OF RENEWABLE ENERGY PROGRAMS

Utility	Program Name	Program Size / Limits	Facility Ownership	Cost Recovery	Bill Impact	Energy Pricing	RECs
Evergy Kansas	Direct Renewable Participation Service	The program is limited to customers with an average monthly demand above 0.5 MW and who take service under a rate schedule subject to the Retail Energy Cost Adjustment surcharge. The program is limited by the amount of renewable generating capacity.	Evergy has a 20-year PPA with the 225 MW Soldier Creed Wind Farm and other PPAs with smaller wind farms	Program costs are limited to program participants.	Energy purchased under the tariff is subject to the Renewable Participation Charge instead of the Retail Energy Cost Adjustment surcharge. All other charges are billed at standard rates.	The program rate is equal to the actual PPA price plus the estimated transmission and other program costs. The current price for the Soldier Creek Wind Farm is 1.8 cents per kWh for a 20 year term.	Customers receive the RECs.
Evergy Kansas	Solar kWh Service and Solar kW Service Homepage	Customers can subscribe, in 1 kW increments, to a portion of a Evergy solar garden by paying a fixed (for the life of the solar garden) $/kW or $/kWh rate.	At the program's inception, Evergy (then Westar) stated it would purchase approximately 80% of the solar energy from a 1.2 MW facility for the program. A large food manufacturer purchases 20%.	The rates charged to the initial participants cover 100% of the direct costs of the project.	Subscriptions directly offset utility supplied power and reduce the amount of energy billed at standard rates. Customers with a demand component on their bill will have the kW billing demand reduced by 15% of the subscribed capacity.	Customers pay a solar rate based on the NPV of the standard tariff rate, escalated by 4% over 20 years, plus a PPA rate.	RECs are retired on the customer's behalf.

SURVEY OF RENEWABLE ENERGY PROGRAMS

Utility	Program Name	Program Size / Limits	Facility Ownership	Cost Recovery	Bill Impact	Energy Pricing	RECs
Evergy Missouri Metro	Renewable Energy Rider	The Rider is open to non-residential customers with a monthly peak demand above 200 kW.	The Company will combine subscription requirements and execute a purchase power agreement with a renewable resource.	Program costs are recovered as part of the Subscription Charge.	In addition to the amount billed under the customer's primary rate schedule, customers pay a Subscription Charge and receive a Renewable Adjustment that is a charge or credit based on the sale of the renewable energy into the wholesale market.	The Final Market Price for the output of the renewable facility in a given month is the accumulated charges and market revenues from selling the energy in the wholesale market at the nearest node.	RECs are tracked by the Company and transferred to the customer annually or at the customer's request. The Company will also retire RECs on behalf of the customer if requested.
Georgia Power	Commercial and Industrial Renewable Energy Development Initiative (C&I REDI)	Available to C&I customers with an annual peak demand of 3 MW or more and who participate in the C&I REDI Notice of Intent process. Subscriptions are limited to 100% of a customer's annual load. Contract terms are between 10 and 30 years. The program is limited to 200 MW of subscriptions.	The renewable energy portfolio is procured through a RFP process.	Program costs are recovered through the CIR Portfolio Price and are limited to program participants.	Subscriptions provide a bill credit that is used to offset the CIR Portfolio Price. The amount of energy billed at standard rates does not change. Customers also pay a $5,000 fee to apply.	Customers purchase a subscription at the CIR Portfolio Price and receive hourly credits based on the customer's share of the renewable energy portfolio. The CIR Portfolio Price is a fixed per kWh price based on a levelized supply cost of the renewable portfolio, including administrative fees.	RECs are retired on the customer's behalf.

SURVEY OF RENEWABLE ENERGY PROGRAMS

Utility	Program Name	Program Size / Limits	Facility Ownership	Cost Recovery	Bill Impact	Energy Pricing	RECs
Georgia Power	Simple Solar Homepage	The program is open to all customers and allows customers to purchase solar RECs that cover 50% or 100% of the customer's monthly usage. A large volume purchase option covers REC purchases with a minimum of 50 MWh. The program is limited by the number of RECs for purchase.	Georgia Power will purchase RECs that meet the criteria approved by the Georgia Public Service Commission.	Program costs are recovered through the REC price reported in the tariff.	No impact on a customer's bill beyond the additional program charges.	The REC purchase price (currently 1¢ per kWh) includes the solar REC cost, plus program marketing and administration expenses including customer education, program promotion, REC tracking and certification.	Georgia Power will purchase and retire the RECs on the customer's behalf.

SURVEY OF RENEWABLE ENERGY PROGRAMS

Utility	Program Name	Program Size / Limits	Facility Ownership	Cost Recovery	Bill Impact	Energy Pricing	RECs
Kentucky Power	Renewable Power Option Rider (RPO) (See page 162) Homepage	The program is open to most rate classes and includes two options. Option A allows customers to purchase RECs at the rates stated in the tariff. Option B is for customers who contract bilaterally with the Company and wish to directly purchase the electrical output and all associated environmental attributes from a renewable energy generator. Option B is limited to customers in the IGS and CS-IRP rate classes with an aggregated demand of 1 MW.	The Company will procure the RECs. Ownership of the generation is not stated.	Program costs are limited to program participants.	Under Option A, in addition to the customer's primary rate schedule, the customer will purchase RECs for the rates listed in the tariff. Under Option B, rates will be established through a written agreement with the Company and will reflect a combination of the firm service rates and the cost of the renewable energy resource being directly contracted for by the customer.	REC prices are provided in the tariff. Source / calculation of pricing is not stated. Prices are listed by type of renewable facility.	All RECs purchased under Option A will be retained or retired on the customer's behalf.

SURVEY OF RENEWABLE ENERGY PROGRAMS

Utility	Program Name	Program Size / Limits	Facility Ownership	Cost Recovery	Bill Impact	Energy Pricing	RECs
Madison Gas & Electric	Green Power Tomorrow / Renewable Energy Program (See page 91) Homepage	Schedule RWE-1 is open to residential customers. Schedule BWE-1 is open to commercial and industrial customers. Customers can offset up to 100% of their usage with renewable generation.	Most of the renewable generation comes from MGE's wind farms in Wisconsin and Iowa. A small amount comes from local solar arrays.	Program costs are limited to program participants. Generation under this program is above the amount required by the Public Service Commission of Wisconsin.	Customers are charged an extra $0.01 per kW for the energy they take under the program. The energy purchased under this rider is exempt from fuel cost surcharges and credits. The additional charge is in addition to the customer's standard applicable tariff rate.	Renewable energy prices (currently $0.01 per kW) are provided in the tariff. The price is subject to periodic review by the Public Service Commission of Wisconsin. It is based on the difference between the cost of renewable resources supplying the program and the average cost of all energy supplied to the grid in the region.	REC status not stated.

SURVEY OF RENEWABLE ENERGY PROGRAMS

Utility	Program Name	Program Size / Limits	Facility Ownership	Cost Recovery	Bill Impact	Energy Pricing	RECs
Madison Gas & Electric	Shared Solar (See page 93) Homepage	Service is available to select rate schedules and customers can designate the lesser of 50% of their annual energy usage or 100% of the customer's minimum available monthly energy usage. Customers must execute a service agreement with the Company. Currently there are 21,893 shares available where one share is defined as the amount of solar capacity that, at the time of construction, will on average produce 325 kWh annually.	MGE owns the facilities through a partnership with the City of Middleton.	Program costs are limited to program participants.	Participants pay a one-time, up-front fee to reserve a portion of the electricity produced and pay an ongoing rate. The customer's existing rate applies with one modification, the solar energy supplied under the program for the subscribed share of the project will replace an equal amount of kWh for which the customer would otherwise be billed.	Customers pay a shared solar power kWh rate that is approved by the Public Service Commission of Wisconsin. The rate is locked in for the entire term of the customer's participation. Customers that receive service under schedule Cg-4 that are also served on this schedule will not be charged the Transmission Service charge or the Grid Electricity Service charge included in this schedule.	All RECs associated with energy produced by the Middleton Shared Solar Project and purchased by customers participating in the program will be retired annually.

SURVEY OF RENEWABLE ENERGY PROGRAMS

Utility	Program Name	Program Size / Limits	Facility Ownership	Cost Recovery	Bill Impact	Energy Pricing	RECs
MidAmerican Energy	Green Advantage 2019 Order	MidAmerican allows large customers to elect to have their pro-rata share of renewable energy certificates retired on their behalf so they can claim credit toward their own corporate sustainability goals. MidAmerican provided customers 51.4% of their energy from renewable sources in 2019.	MidAmerican owns a majority of its generation, with a small amount coming from PPAs. All PPAs entered into by MidAmerican include the renewable attributes of the generation.	Costs for the renewable generation are recovered through rates from all customers.	The program is available at no charge.	Pricing for the 51.4% (in 2019) of renewable energy is included in rates.	RECs are retired on behalf of MidAmerican's customers.
MidAmerican Energy	Renewable Advantage (See page 342) Homepage	The program allows customers to make voluntary contributions to the development of alternate energy.	Renewable generation funded by the program can be utility owned or purchased energy. The program funded the development of a 0.5 MW wind turbine and several solar installations.	Program costs are limited to program participants.	No impact on a customer's bill beyond the additional program charges.	No energy is purchased under the program.	MidAmerican will retire any RECs through the Green Advantage program.

SURVEY OF RENEWABLE ENERGY PROGRAMS

Utility	Program Name	Program Size / Limits	Facility Ownership	Cost Recovery	Bill Impact	Energy Pricing	RECs
Northern States Power Company (Xcel Minnesota)	Voluntary Renewable Connect pilot program (See page 178)	Customers can purchase 100 kWh blocks but are limited to 100% of their annual usage.	NSP uses PPAs to satisfy the program. 50 MW is from a wind farm and 25 MW is from a solar facility. NSP does not own the facilities	Program costs are limited to the program participants.	Customers receive a bill credit to offset fuel costs that would have otherwise been paid.	The Renewable Connect cost is based on a partially levelized delivered cost of the resources, adjusted for other credits, charges, and program expenses.	RECs are retired on the customer's behalf.

SURVEY OF RENEWABLE ENERGY PROGRAMS

Utility	Program Name	Program Size / Limits	Facility Ownership	Cost Recovery	Bill Impact	Energy Pricing	RECs
Northern States Power Company (Xcel Minnesota)	Voluntary Renewable Adjustment / Windsource Program (See page 162) FAQ	The program is open to all Minnesota retail metered electric customers. Customers can purchase a specific number of 100 kWh blocks or the customer's entire usage. The minimum subscription period is one year for residential customers and three years for non-residential customers. After the minimum period, customers may continue to subscribe on a month to month basis.	Wind energy purchased by Xcel under the program is from Minnesota wind farms.	Program costs are limited to program participants.	No impact on a customer's bill beyond the additional program charges.	The Voluntary Renewable Adjustment is calculated by dividing the recoverable program expenses and annual tracker balance by the forecasted renewable energy for a designated recovery period. The recoverable program expenses include renewable energy purchases, marketing, other costs, and true up of tracker balance or this program. The Adjustment may be revised annually with approval of the Minnesota Public Utilities Commission. The Adjustment is not subject to the Fuel Clause Rider.	REC status not stated. Windsource is Green-e Energy certified, and meets the environmental and consumer-protection standards set forth by the nonprofit Center for Resource Solutions.

SURVEY OF RENEWABLE ENERGY PROGRAMS

Utility	Program Name	Program Size / Limits	Facility Ownership	Cost Recovery	Bill Impact	Energy Pricing	RECs
Northern States Power Company (Xcel Minnesota)	Solar Rewards Community (See page 76) Homepage	A customer cannot exceed 120% of their annual consumption and no customer can subscribe to more than 40% of a solar garden. The program is open to residential, commercial, and industrial customers.	The program uses independent developers who contract to provide power to NSP. NSP purchases the solar generation through bill credits to customers. Customers contract with the independent developers.	The cost of solar generation is contracted between the customer and the independent solar developer. NSP does not own the facilities.	Subscriptions provide a bill credit. The amount of energy billed at standard rates does not change.	The bill credit, or value-of-solar rate, is approved by the Commission and is designed to reflect the value of solar generation to the utility, its customers, and society. The Commission approves a 25-year bill credit rate each year that is applicable to all solar applications approved under the program that year.	The solar developer owns the RECs. Solar developers can sell RECs to NSP for the customer receiving an Enhanced Bill Credit.

SURVEY OF RENEWABLE ENERGY PROGRAMS

Utility	Program Name	Program Size / Limits	Facility Ownership	Cost Recovery	Bill Impact	Energy Pricing	RECs
NV Energy (North and South NV Service Territories)	Schedule NGR – GreenEnergy Rider	The program is open to all customers. Any customer can contract for 50% or 100% of their monthly electric energy from an existing renewable resource. Non-residential customers may enter into a special contract to receive energy from a dedicated, contracted or utility owned New Renewable Resource.	NV Energy will purchase the renewable energy.	Program costs are limited to program participants.	No impact on a customer's bill beyond the additional program charges which is either the NGR Existing Renewable Resource Rate or the NGR New Renewable Resource Rate.	The NGR Existing Renewable Resource Rate reflects the weighted average of existing renewable resources that are owned by or under contract with the Utility and is equal to the present value of the difference between the levelized cost of energy plus applicable costs to fully integrate the resources and the Utility's long-term avoided cost approved in the most recent Integrated Resource Plan. The NGR New Renewable Resource Rate will reflect all of the costs associated with a specific renewable energy facility dedicated to the Customer.	NV Energy will first retire RECs in compliance with Nevada's Renewable Portfolio Standard (RPS). Then, NV Energy will retire the difference between the amount of energy purchased under this schedule and the RPS.

SURVEY OF RENEWABLE ENERGY PROGRAMS

Utility	Program Name	Program Size / Limits	Facility Ownership	Cost Recovery	Bill Impact	Energy Pricing	RECs
Oklahoma Gas & Electric	Utility Solar Pilot Program (USP) Homepage	Customers can subscribe, in 10% increments, up to 50% of their annual usage to solar energy produced by OG&E. Customers must be on the applicable time-of-use rate schedule. Subscriptions above 50 MWh for a customer are at OG&E's discretion. The program is open to all retail customers.	OG&E owns the solar facilities.	OG&E recovers the costs of the facility from program participants.	Subscriptions directly offset the time differential energy charges of the utility supplied power.	The solar price is based on a levelized revenue requirement. The current price is $0.0982 per kWh.	OG&E will retire RECs associated with the subscribers' usage of solar energy under the pilot, on behalf of subscribers.

SURVEY OF RENEWABLE ENERGY PROGRAMS

Utility	Program Name	Program Size / Limits	Facility Ownership	Cost Recovery	Bill Impact	Energy Pricing	RECs
Oklahoma Gas & Electric	Green Power Wind Rider Homepage	Customers can purchase 100 kWh blocks of wind energy. The maximum kWh per month varies by rate classes, ranging from 2 MWh for residential to 16 MWh for the Power and Light class. OG&E reserves the right to limit the amount of energy provided to individual customers. The program is limited to 1.39 million blocks. The University of Oklahoma is subject to different costs and terms.	OG&E owns the wind resources.	Program costs are limited to program participants. Subscribers pay for related educational, advertising, and ancillary expenses.	Subscribers pay a wind selection charge. The charge is in addition to the applicable standard pricing. Subscriptions are exempt from the Fuel Cost Adjustment (FCA) but all energy sales over the subscription are subject to the FCA.	Block prices are provided in the tariff. Source / calculation of pricing is not stated. The current price for each 100 kWh block is $3.90.	REC status not stated.
Oklahoma Gas & Electric	Renewable Energy Program (REP)	The program is limited to the available amount of renewable energy, which is posted in the tariff.	RECs are sourced from either OG&E owned or contracted resources or OG&E may purchase RECs from a clearing house.	Program costs are limited to program participants.	No impact on a customer's bill beyond the additional program charges.	REC prices are provided in the tariff. Source / calculation of pricing is not stated.	Participants benefit from the RECs but they cannot be resold.

SURVEY OF RENEWABLE ENERGY PROGRAMS

Utility	Program Name	Program Size / Limits	Facility Ownership	Cost Recovery	Bill Impact	Energy Pricing	RECs
Omaha Public Power District	Green Sponsorship Rate Rider (See page 97)	Available to customers under rate schedules 232, 240, 245, 250, or 261 that will purchase at least 10 million kWh of energy annually from the District. Customers can purchase environmental attributes for amounts more than 10 million kWh but less than the customer's annual usage. Customers will sign a Green Sponsorship Sales Agreement (GSSA) with the District.	Environmental attributes will come from facilities owned by the District or procured by the District through a PPA.	Program costs are limited to program participants.	No impact on a customer's bill beyond the additional program charges.	The monthly GSP charge will be the kWh times the AWP (all costs associated with the additional renewable resources) less the kWh times the SPP$ (the average monthly net of all revenues and costs assessed by the SPP integrated market at the contracted renewable facility divided by the total kWh).	Environmental attributes cannot be resold or reassigned without the permission of the District.

SURVEY OF RENEWABLE ENERGY PROGRAMS

Utility	Program Name	Program Size / Limits	Facility Ownership	Cost Recovery	Bill Impact	Energy Pricing	RECs
Omaha Public Power District	Community Solar (See page 100) Homepage	The program is open to all retail customers. Customers can subscribe to solar in 100 kWh shares via a Community Solar Service Agreement. Participation is limited to the aggregated amount of generation available from the community solar PPAs.	Solar energy comes from community solar PPAs.	Program costs are limited to program participants.	No impact on a customer's bill beyond the additional program charges.	The Community Solar Charge is the market based value of solar times the subscription level. The market based value of solar is the interconnected costs of the community solar PPA less the actual hourly community solar production from the prior year valued at the corresponding SPP day ahead hourly prices less the accredited capacity assigned by SPP to the community solar facilities valued at the annual levelized value of the District's next marginal generation capacity.	REC status not stated.

SURVEY OF RENEWABLE ENERGY PROGRAMS

Utility	Program Name	Program Size / Limits	Facility Ownership	Cost Recovery	Bill Impact	Energy Pricing	RECs
PNM	Green Energy Rider	The program is open to customers with a minimum demand of 10 MW, 75% load factor, and all other requirements of Schedule 36B. The customer enters into a special service contract with PNM (that is approved by the New Mexico Public Regulation Commission) where PNM procures at least 10 MW of additional renewable resources on behalf of the customer. The customer must not have previously received electric utility service from PNM.	PNM will acquire new renewable resources for the customer. New resources can be utility owned or acquired through a PPA.	Program costs are limited to program participants.	Rates are established in the special service contract and cover the Company's entire cost of the renewable resources and alternative capacity projects.	If the new resources are acquired through a PPA, the customer will pay PNM the full cost of the PPA. If the new resources are owned by PNM, the customer will pay monthly rates based on the Company's full cost of service revenue requirement for those renewable resources, including a return on the investment equal to the Company's weighted average cost of capital, and operation and maintenance expenses, including fuel, or such other pricing structures.	REC status not stated.

SURVEY OF RENEWABLE ENERGY PROGRAMS

Utility	Program Name	Program Size / Limits	Facility Ownership	Cost Recovery	Bill Impact	Energy Pricing	RECs
PNM	Voluntary Renewable Energy Program Homepage	The program is open to all permanent retail customers under select rate schedules. No contract is required. Customers can purchase 100 kWh blocks of renewable energy or set a percent up to 80% of their annual usage.	The program uses 22,000 solar panels from PNM's facility in Los Lunas plus wind purchased from the New Mexico Wind Energy Center near Fort Sumner.	Program costs are limited to program participants.	No impact on a customer's bill beyond the additional program charges.	Customers pay the renewable energy premium stated in the tariff (currently $0.017 per kWh). Source / calculation of pricing is not stated.	PNM will retire the RECs.

SURVEY OF RENEWABLE ENERGY PROGRAMS

Utility	Program Name	Program Size / Limits	Facility Ownership	Cost Recovery	Bill Impact	Energy Pricing	RECs
Puget Sound Energy	Voluntary Long Term Renewable Energy Purchase Rider	Customers must have a minimum aggregated load of 10 million kWh per year and contract for 100% of the load at all meters under the contract for renewable energy. Customers can choose which service addresses to subscribe to the program. The customer must enter into a services agreement with the Company. The program is limited to an aggregated load of 75 MW.	Puget will procure the renewable energy for the customer.	Program costs are limited to program participants.	In addition to the customer's existing rate schedule, the customer will receive a credit for the energy related power cost component of the customer's existing energy charge and pay a resource option energy charge.	The resource option energy charge is listed in Section 9 of the tariff. Prices vary by resource mix and contract term.	RECs are either retired on the customer's behalf or the customer must retire the credits.

SURVEY OF RENEWABLE ENERGY PROGRAMS

Utility	Program Name	Program Size / Limits	Facility Ownership	Cost Recovery	Bill Impact	Energy Pricing	RECs
Puget Sound Energy	Green Energy Option Purchase Rider / Large Volume Green Energy Purchase Rider	Customers have the option to support the purchase of RECs through a solar only rate or a blended-renewables rate. The minimum purchase for solar is one 150 kW block. The minimum purchase for blended-renewables is two 200 kWh blocks. The large volume option is limited to renewable energy purchases of 1 million kWh or more per year.	RECs come from Puget's resources or will be purchased provided Puget can secure evidence that the green energy attributes will be available to the Company for purchase by its customers.	Program costs are limited to program participants.	No impact on a customer's bill beyond the additional program charges.	Block prices are provided in the tariff. Source / calculation of pricing is not stated.	RECs are retired on the customer's behalf.
Rocky Mountain Power Utah	Renewable Energy Rider (Schedule 70) Bulk Purchase Option (Schedule 72)	Customers purchase 200 kWh blocks of renewable energy. RMP matches purchases to renewable generation.	RMP does not own the renewable facilities. Renewables purchases are in addition to RMP's IRP.	Program costs are limited to program participants.	No impact on a customer's bill beyond the additional program charges.	Block prices are provided in the tariff. Source / calculation of pricing is not stated, but rates designed to cover program costs. The current change is $1.95 per block (200 kWh).	RECs are retired on the customer's behalf.

SURVEY OF RENEWABLE ENERGY PROGRAMS

Utility	Program Name	Program Size / Limits	Facility Ownership	Cost Recovery	Bill Impact	Energy Pricing	RECs
Rocky Mountain Power Utah	Subscriber Solar Homepage	Customers purchase 1 kW blocks. Residential and small commercial customers can purchase any amount of blocks but are limited to 100% of their annual usage. Commercial and industrial customers are limited to 2 MW (or 100% of annual usage, if lower). The program is currently limited to 20 MW.	RMP owns the output of a 20 MW solar facility.	Program costs and costs of the solar generation are limited to program participants.	Solar blocks directly offset utility supplied power and reduce the amount of energy billed at standard rates.	Pricing based on the forecasted cost of the solar program. Customers pay a solar generation charge and a solar delivery charge. The generation charge is fixed for the length of a customer's contract. The delivery changes over time to reflect non-generation costs.	RMP owns the RECs, which will be retired on behalf of the subscriber or may be deposited in a Western Renewable Energy Generation Information System account.
Rocky Mountain Power Utah	Service From Renewable Energy Facilities (Schedule 32) 5,000 kW and Over Option (Schedule 34)	The program is open to non-residential customers on Schedules 6, 8, and 9. Customers must contract for at least 2 MW and the program is capped at 300 MW total peak delivered to customers.	RMP provides delivery service through the tariff. RMP purchases renewable energy from facilities that are owned or contractually tied to the customer.	Customers contract with RMP to pay all incremental costs associated with service from a Renewable Energy Facility.	Customers pay delivery and customer charges to RMP under the tariff. Supplementary Energy, or energy not provided by the Renewable Energy Facility, is billed at standard rates.	RMP's delivery charges are outlined in the tariff. RMP purchases power for resale from the Renewable Energy Facility and passes the energy costs to the customer at the rate charged by the Renewable Energy Facility.	RECs belong to the Renewable Energy Facility. Customers can contract with the facility for the RECs.

SURVEY OF RENEWABLE ENERGY PROGRAMS

Utility	Program Name	Program Size / Limits	Facility Ownership	Cost Recovery	Bill Impact	Energy Pricing	RECs
Salt River Project Arizona	Renewable Energy Credit Pilot Rider (See page 176)	Customers can participate in 100 kWh increments or at a percentage of their monthly consumption, up to 100%.	SRP uses its own RECs for the program and then purchases replacement RECs for its 20% sustainable portfolio goal.	Program costs are limited to program participants. Any excess funds are credited to the Environmental Programs Cost Adjustment, which is applied to all customers.	No impact on a customer's bill beyond the additional program charges.	Customers purchase renewable energy at a rate posted on the website. Excess funds from this rate are credited to the Environmental Programs Cost Adjustment.	SRP dedicates RECs to the customer from its own portfolio. SRP then purchases replacement RECs to satisfy its own portfolio goals.
Salt River Project Arizona	Business Community Solar Pilot Rider (Referenced in ratebook but tariff no longer available)	Customers purchase capacity shares of one or more designated renewable facilities. The program is limited to customers taking service under the General Service, Large General Service, or Pumping price plans. Purchases cannot exceed 35% of a customer's peak demand. The pilot was suspended in April 2015.	SRP has a PPA for 100% of the output of a 20 MW solar project.	Cost of resource.	Subscriptions directly offset utility supplied power and reduce the amount of energy billed at standard rates.	Customers pay cost of resource.	The utility owns the RECs.

SURVEY OF RENEWABLE ENERGY PROGRAMS

Utility	Program Name	Program Size / Limits	Facility Ownership	Cost Recovery	Bill Impact	Energy Pricing	RECs
Salt River Project Arizona	Renewable Energy Services Pilot Rider (See page 178 of the pdf) Renewables Homepage	Participation is determined by SRP according to specific published individual programs. Program capacity is limited to 20 MW. Customers pay a fixed price per kWh attributable to one or more designated renewable facilities for a term of 10 years (or the terms set forth in published programs).	Facility ownership of the designated renewable facilities is not stated.	Cost recovery is not stated.	Purchases directly offset utility supplied power and reduce the amount of energy billed at standard rates. Fixed customer charge components and other non-fuel charges are still applied. Supplemental power and energy is provided under the standard rate.	Customers purchase renewable energy from SRP at the fixed price totaling the customer's pro-rata share of the energy production attributable to their subscribed capacity of the renewable facility regardless of the customer's demand.	The utility owns the RECs.