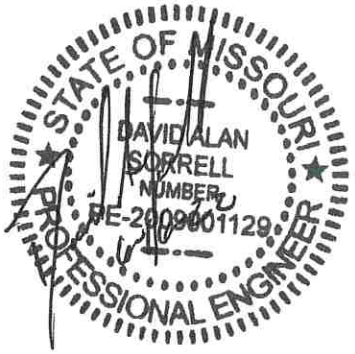
2022 Renewable Energy Plan

city of Columbia Utilities		
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Introduction

Columbia Water & Light

City of Columbia Water & Light's renewable energy portfolio is a diverse combination of wind, distributed and utility solar, and landfill gas resources. This resource mix aims to meet City Ordinances while maintaining reliable, cost-effective service and reducing reliance on non-renewable energy sources.

In November 2004, residents of Columbia approved a renewable energy ordinance for the City's power supply portfolio, directing Columbia Water & Light (CWL) to generate or purchase increasing levels of energy from renewable resources through 2029. The Columbia City Council revised the renewable energy ordinance January 6, 2014, to increase the renewable energy goals. The standard for 2021 was set at 15%.

In 2021, CWL purchased or generated 14.63% of its total electric usage through renewable energy sources. CWL possessed sufficient resources to meet the Renewable Energy Standard, however factors outside of CWL's control decreased the amount of renewable energy production. On recommendation by the Water & Light Advisory Board, CWL did not purchase Renewable Energy Credits to increase the percentage of renewable energy up to the ordinance standard of 15%.

The cost for renewable energy in 2021 was higher than recent years because of weather related events and transmission and generation related maintenance and outages resulting in congestion on the electric grid. Although more money was spent on renewables, the total cost remained below the target 3% rate impact limit. The additional cost for renewable energy compared to non-renewables was $3,686,476.25, which was 95.2% of the potential rate impact limit of $3,872,190.

Significant progress was made in expanding CWL's local renewable generation with Truman Solar coming online in May. Truman Solar contributed 10 MW to CWL's renewable portfolio, strengthening CWL's efforts to meet the Renewable Energy Standard and making progress toward climate goals supported by the 2019 Climate Action and Adaptation Plan.

CWL's future will be guided by the recently completed Integrated Electric Resource and Master Plan. The IERMP focuses on utility resource needs to meet long-term planning objectives and, in part, helps inform implementation of the Climate Action and Adaptation Plan goals related to energy supply.

Looking at 2022 and beyond, expected expansions in landfill gas, wind contracts, and local solar will play significant roles in meeting future energy needs. Additional growth in renewable energy supply will be sought through a request for proposal to be released for a new power purchase agreement (PPA). These expansions in CWL's renewable energy portfolio will allow the City to meet and exceed the current Renewable Energy Standard.

City of Columbia Ordinance Section 27-106: Renewable Energy Standard

(a) The city shall generate or purchase electricity generated from eligible renewable energy sources at the following levels:

- Two (2) percent of electric retail usage (kWhs) by December 31, 2007;
- Five (5) percent of electric retail usage (kWhs) by December 31, 2012;
- Fifteen (15) percent of electric retail usage (kWhs) by December 31, 2017;
- Twenty-five (25) percent of electric retail usage (kWhs) by December 31, 2022; and
- Thirty (30) percent of electric retail usage (kWhs) by December 31, 2028.

(b) This renewable energy shall be added up to these kilowatt hour levels only to the extent that it is possible without increasing electric rates more than three (3) percent higher than the electric rates that would otherwise be attributable to the cost of continuing to generate or purchase electricity generated from one hundred (100) percent non-renewable sources (including coal, natural gas, nuclear energy and other non-renewable sources).

(c) Eligible renewable energy generation may be provided by wind power, solar energy, bio-energy sources or other renewable sources that meet the environmental criteria approved by the City Council after review by the energy and environment commission and the water and light advisory board. Electricity produced from on-site renewable energy systems owned by Columbia Water & Light customers ("net-metering") may be included within the calculation of the levels required in subsection (a).

(d) Renewable energy generation sources located within Missouri may receive referential consideration in the selection process.

(e) Each year prior to February 1, the water and light department shall publicly release a renewable energy plan detailing a proposal for how the city would comply with this section during the following year. The plan will explain the City's due diligence in pursuing renewable energy opportunities and detail all cost assumptions and related utility rate calculations, except with regard to confidential information that may be withheld pursuant to state law. The plan will then be reviewed by the energy and environment commission and the water and light advisory board and submitted to the city council for approval following a public hearing.

(Ord. No. 18196, § 1, 8-16-04; Ord. No. 21935, § 1, 1-6-14)

Note: Ord. No. 18196, passed by city council on August 16, 2004, called for election; said ordinance was passed by the voters on Nov. 2, 2004.

Note: Ord. No. 024044, passed by city council on October 7, 2019, dissolved the energy and environment commission and replaced it with the Climate and Environment Commission. It is recommended to consider revising all references to the energy and environment commission.

2021 Renewable Energy Supply

Columbia Adjusted System Load: 1,218,313 MWH
Renewable Energy Total: 178,223 MWH or 14.63%

In 2021, 14.63% of Columbia's electric portfolio came from renewable sources: wind (9.69%), landfill gas (3.35%), and solar (1.59%). The total amount did not meet the 15% standard for 2021 by 0.37%.

Adjusted System Load is determined by adding the amount of electricity produced inside Columbia's distribution system to the metered load provided by outside sources. Basing the renewable percentage on Adjusted System Load more accurately describes the actual electric load in the City's service territory.

Summary of Significant Events for 2021

- The Truman Solar 10 MW facility began operation in May. The facility is connected to Columbia Water & Light's 13.8 kV distribution system at the Rebel Hill substation. The production of the Truman Solar facility was 14,583 MWH in calendar year 2021, 1.2% of the CWL renewable energy portfolio.
- The Crystal Lake wind farm completed its repower project. The amount of MWHs per year will grow incrementally to reach 40,000 by 2023, when the full contract goes into effect. The repower, combined with CWL's updated contract through 2040, means more renewable energy at a lower cost.
- On December 15, storms damaged transmission lines connected to the Crystal Lake III wind facility. The facility shut down, temporarily suspending the amount of energy supplied from the wind farm. Crystal Lake III returned to service Jan. 12, 2022.
- Congestion on the electric grid impacted energy prices in the MISO market, which contributed to higher costs for CWL. This volatility was created by weather as well as regional transmission and thermal generation related maintenance and outages. Significantly higher local costs for the utility's Crystal Lake contracts increased CWL's average monthly cost by more than 50% in the second half of 2021 compared to the first half.
- The City-appointed task force completed the Integrated Electric Resource and Master Plan process in December. Columbia Water & Light will now begin working to evaluate the utility needs and planning for the IERMP's energy supply projections. This opens CWL to continue seeking additional resources to meet future energy supply goals of the City of Columbia.
- In recent years, CWL purchased Renewable Energy Credits in order to meet the standards set by the ordinance. In 2021, however, the Water & Light Advisory Board, with input from City Council, recommended against the purchase of RECs and is evaluating alternatives to this process in coordination with the Climate and Environment Commission.
- In December, the City Council approved CWL to move forward on the design-build process on the fourth generator at the Columbia Landfill Gas Energy Plant. When complete, this project will increase the Landfill Gas Plant's capacity from 3.1 MW to 4.2 MW.

2021 Renewable Energy Production Amounts

Month	Columbia Adj. Load	Bluegrass Wind	Crystal Lake Contract 1	Crystal Lake Contract 2	Columbia Landfill	Jeff City Landfill	Truman Solar	Net-Metered Solar	Columbia Solar	Total Renewable	YTD % of System
1-21	105,250	970	2,291	5,401	1,522	2,208	—	143.7	13.3	12,548	11.92%
2-21	108,774	602	1,808	5,134	1,724	1,675	—	164.8	14	11,121	11.06%
3-21	88,380	1,363	2,610	4,213	2,091	2,198	—	379.9	31.2	12,886	12.09%
4-21	83,807	1,154	3,095	6,805	1,933	2,163	—	469.8	37	15,657	13.52%
5-21	88,215	925	3,154	8,133	1,666	1,733	1,226	414.7	31.6	17,283	14.65%
6-21	113,121	504	2,270	5,989	1,929	2,015	2,560	496.0	37.0	15,799	14.52%
7-21	122,265	351	1,425	3,927	1,855	2,013	2,548	495.1	36.6	12,651	13.80%
8-21	129,083	670	1,855	4,837	1,331	1,385	2,466	508.3	38.4	13,090	13.24%
9-21	107,649	1,016	2,463	6,585	1,119	1,374	2,148	480.7	36.7	15,222	13.34%
10-21	90,711	996	2,967	7,809	1,060	1,287	1,322	295.5	22.7	15,759	13.69%
11-21	87,076	1,206	4,426	11,557	921	2,203	1,265	323.0	25.5	21,927	14.58%
12-21	93,983	1,232	2,301	6,026	1,215	2,168	1,048	267.6	21.6	14,279	14.63%
TOTAL	**1,218,313**	**10,989**	**30,664**	**76,414**	**18,365**	**22,422**	**14,583**	**4,439**	**346**	**178,223**	
% of System		**0.90%**	**2.52%**	**6.27%**	**1.51%**	**1.84%**	**1.20%**	**0.36%**	**0.03%**	**14.63%**	

The amount of energy is measured in megawatt-hours (MWH)

2021 Renewable Energy Portfolio

Bluegrass Ridge Wind Energy

Columbia started receiving wind power from turbines near King City, Missouri, on September 5, 2007. The Columbia contract is for one-ninth of the electric output of the Bluegrass Ridge Wind Farm from Associated Electric Cooperative. At the maximum output, Columbia Water & Light could receive up to 6.3 MW. In 2021, Columbia received 10,989 MWH of power from this contract or 0.90% of the electric system total. The amount of wind energy Columbia receives is variable. There is a fixed transmission cost for this energy, so it is more expensive when less energy is received. The average cost for 2021 for wind power from the Bluegrass Ridge Wind Farm was $71.83 per MWH. Production at Bluegrass Ridge was 21.6% higher in 2021 because in 2020 the facility underwent major maintenance component work during the spring and summer.

Crystal Lake III Wind

CWL has two PPAs with NextEra for wind energy produced at the Crystal Lake III wind farm in Northern Iowa. The first PPA, effective February 2012, is for 21 MW of wind. The second PPA, effective December 2016, involves the purchase of energy in two phases. The first is for the production of 27 MW of wind beginning in January 2017 with an additional 18 MW in January 2023.

Both contracts were amended in 2020 and include updated pricing as a result of a turbine repower of the entire site NextEra completed in 2021, with estimates of an additional 40,000 MWHs per year. Table 1.1, detailing updated pricing for the contracts from 2022 through 2040, can be found in the appendix.

Energy from the first contract provided 30,664 MWH in 2021 representing 2.52% of CWL's system total at a cost of $28.06/MWH.

Energy from the second contract provided 76,414 MWH in 2021 representing 6.27% of CWL's system total at a cost of $25.75/MWH.

On Dec. 15, storms damaged transmission lines connected to this facility, forcing Crystal Lake to shut down, temporarily suspending the amount of energy supplied from the wind farm. Crystal Lake returned to service Jan. 12, 2022.

Columbia Landfill Gas

The Columbia Landfill Gas Energy Plant was constructed in 2008 and uses the gas created from decomposing waste at the Landfill. The amount of energy received from the Columbia Landfill Gas Energy Plant is fairly consistent, aside from times when there is routine maintenance work. In 2021, the Landfill Gas Energy Plant produced 18,365 MWH of energy at a cost of $40.05 per MWH, which was 1.51% of Columbia's energy system total. 2021 saw a 19% increase in production over 2020, when two units were unavailable for extended periods. In December 2021, the City Council approved CWL to

move forward on the design-build process on the fourth generator in 2022. When complete, this project will increase the Landfill Gas Energy Plant's capacity from 3.1 MW to 4.2 MW.

Jefferson City Landfill Gas

Columbia Water & Light has a 20-year power purchase agreement with Ameresco for 3.2 MW of energy from the landfill gas plant at the Jefferson City Landfill. Columbia started receiving energy from the plant in April 2009. The total amount of energy received in 2021 was 22,422 MWH, which is 1.84% of the electric system total. The utility paid $53.03 per MWH for the electricity.

Truman Solar

In December 2018, the City Council approved an amendment to a power purchase agreement and a solar interconnection agreement with Truman Solar LLC for the purchase of energy from a 10 MW solar facility constructed by Truman Solar. The facility is connected to Columbia Water & Light's 13.8 kV distribution system at the Rebel Hill substation. Construction of the solar field and the electric lines was completed in 2021, and the solar installation went into operation May 7. In 2021, the Truman Solar facility produced 14,583 MWH of energy at a cost of $44.81 per MWH, which was 1.20% of Columbia's energy system total. Production was lower than expected, as the facility's start date was pushed back from January 1 and again from April 1. The facility operator projected the facility would produce 23,567 MWH during its first 12 months of operation.

Net-Metered Customer Production

The Columbia City Council passed an ordinance in 2007 to allow customers to enter into a net-metering agreement with Columbia Water & Light. A net-metering arrangement is a billing agreement in which customers receive credits for electricity provided to the Columbia system.

During 2021, 77 customers installed their own photovoltaic systems, and the rated capacity grew from 3.24 MW to 3.75 MW. In 2021, the amount of energy sold to the electric utility was 1,620 MWH of 4,439 MWH estimated to have been generated. Net-metered production represented 0.36% of Columbia's electric portfolio in 2021.

Columbia Water & Light Solar Installations

Columbia Water & Light staff expanded the Bernadette site in 2015 to a total of 263 kW. This solar resource produced 346 MWH or 0.03% of the electric portfolio at a cost of $67.27 per MWH.

Costs of Renewable Energy

To minimize rate impacts on customers that could result from investments in renewable generation, Section 27-106(b) of the Renewable Energy Standard requires that rates will not increase by more than 3% due to the potentially higher cost of renewable compared to non-renewable energy.

For calendar year 2021, renewable energy as integrated into CWL's electric system without exceeding the 3% potential rate impact limit. The total expense of renewable energy in excess of non-renewable energy was $3,686,476, which is 95.2% of the rate impact limit of $3,872,190.

Congestion on the electric grid impacted energy prices in the MISO market, which contributed to higher costs for CWL. This volatility was created by weather as well as regional transmission and thermal generation related maintenance and outages. Significantly higher local costs for the utility's Crystal Lake contracts increased CWL's average monthly cost by more than 50% in the second half of 2021 compared to the first half.

From calendar year 2020 to calendar year 2021, the total amount of renewable energy decreased by 1,557 MWH, or 0.99%. This decrease was a result of the delay in the Truman facility coming online and a lower than normal output from Crystal Lake Wind because of the scheduled repower project and the unexpected loss of transmission in December because of storms in Iowa.

Relative to the cost for non-renewable energy, the average cost per megawatt-hour of renewables in 2021 was $35.76/MWH, which is comparable to the cost of non-renewables at an average cost of $23.75/MWH. While cost is not the only consideration in evaluating power supply options, this metric is important when considering Columbia's Renewable Energy Standard.

Impact of 2021 Renewable Energy Portfolio

Renewable Resource	Total 2021 MWH	Additional Cost/(Savings) Per MWH	Total Impact on Rates
Bluegrass Ridge Wind (Associated Electric)	10,989	$44.98	$494,285.22
Crystal Lake Wind Contract 1 (NextEra)	30,664	$23.13	$709,258.32
Crystal Lake Wind Contract 2 (NextEra)	76,414	$21.62	$1,652,070.68
Columbia Landfill	18,365	$12.12	$222,583.80
Jefferson City Landfill (Ameresco)	22,422	$23.21	$520,414.62
Truman Solar (Truman Solar LLC)	14,583	$6.43	$93,768.69
Net-Metered Photovoltaic Production	4,439	$(3.60)	$(15,980.40)
Columbia Water & Light Solar Production	346	$29.04	$10,075.32
Total Renewable Resource Impact on Rates			**$3,686,476.25**

Renewable Portfolio Cost Calculations

The City of Columbia has a fiscal year that does not match the calendar year outlined in the Renewable Energy Standard. Renewable energy costs for this report include information from January through September of the prior fiscal year and October through December of the current fiscal year.

Revenue Source	January – September (FY21)	October – December (FY22)
Residential	$45,212,673	$11,811,283
Commercial/Industrial	$54,749,965	$17,299,068
Total Revenue During Calendar Year 2021		$129,072,989
3% Impact Limit on Rates		$3,872,190

Calculating Renewable Energy Rate Impact

In 2014, Columbia Water & Light enlisted the services of Utility Financial Solutions LLC to provide guidance on the valuation of renewable generation. As outlined by UFS's Rate Impacts on Renewables report, CWL uses a combination of market prices of electricity and avoided cost to determine the cost for renewables and the impact on ratepayers.

Below is the approach and details used by the proposed renewable energy impact methodology:

- Start with total cost of renewable resource
- Subtract the capacity value
- Determine the difference between the renewable resource cost and Water & Light's cost of avoided production from the non-renewable resource
- Add the cost of any congestion and losses for each renewable resources relative to Water & Light's load
- Multiply by the production from the renewable resource

For 2021, the following factors have been established:

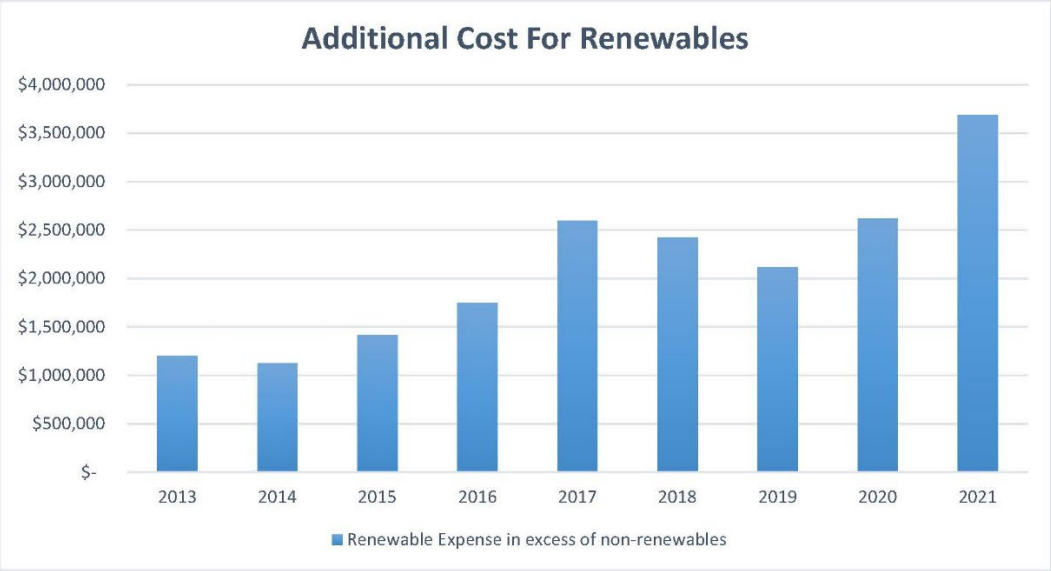
- Columbia's Non-Renewable Avoided Cost — $23.75/MWH
- The production weighted price of Columbia's Midcontinent Independent System Operator (MISO) Load Node for Crystal Lake Contract One — $33.94/MWH
- The production weighted price of Columbia's Midcontinent Independent System Operator (MISO) Load Node for Crystal Lake Contract Two — $34.61/MWH

	A	B	C	D	E	F	G	H	
Resource	Resource Cost ($/MWH)	Capacity Component ($/MWH)	Energy Component ($/MWH)	Energy Impact ($/MWH)	Resource MISO LMP ($/MWH)	Cong. & Loss Cost ($/MWH)	Energy Impact w/ C&L ($/MWH)	Production (MWH)	Renewable Rate Impact ($)
Bluegrass Ridge Wind	$ 71.83	$ 3.10	$ 68.73	$ 44.98	-	-	$ 44.98	10,989	$ 494,285.22
Crystal Lake C1 Wind	$ 28.06	$ 5.42	$ 22.64	$ (1.11)	$ 9.70	$ 24.24	$ 23.13	30,664	$ 709,258.32
Crystal Lake C2 Wind	$ 25.75	$ 2.82	$ 22.93	$ (0.82)	$ 12.17	$ 22.44	$ 21.62	76,414	$ 1,652,070.68
Wind RECs									
Columbia Landfill Gas	$ 40.05	$ 4.18	$ 35.87	$ 12.12	-	-	$ 12.12	18,365	$ 222,583.80
Jefferson City Landfill Gas	$ 53.03	$ 6.07	$ 46.96	$ 23.21	-	-	$ 23.21	22,422	$ 520,414.62
Truman Solar	$ 44.81	$ 14.63	$ 30.18	$ 6.43	-	-	$ 6.43	14,583	$ 93,768.69
Customer Generated PV (Net Meter)	$ 34.63	$ 14.48	$ 20.15	$ (3.60)	-	-	$ (3.60)	4,439	$ (15,980.40)
CWL Generated PV	$ 67.27	$ 14.48	$ 52.79	$ 29.04	-	-	$ 29.04	347	$ 10,075.32
								178,223	**$ 3,686,476.25**

- Column A - Total cost of the Renewable resource
- Column B - Amount of total cost that is determined to be providing capacity value, as outlined in the Utility Financial Solutions report
- Column C - Amount of total cost that is determined to be providing energy value (Column A minus Column B)
- Column D - Cost impact of the renewable resource energy above the incremental cost of Water & Light's non-renewable resource cost (Column C minus $23.75)
- Column E - Production weighted MISO LMP at the point of resource connection to the MISO system for the Crystal Lakes wind contracts
- Column F - Resource congestion and losses as compared to Water & Light's load Wind Resources ($33.94 minus Column E for contract 1, $34.61 minus Column E for contract 2)
- Column G - Energy Impact plus congestions and losses for the resource (Column D plus Column F)
- Column H - Resource Annual Production
- Renewable Rate Impact – Column G times Column H

Renewables Cost Impact by Year

The City Ordinance states that the renewable energy integrated into CWL's electric portfolio shall not increase electric rates more than 3% higher than the rates for electricity generated from 100% non-renewable resources. For calendar year 2021, the additional expense of renewable energy in excess of non-renewable energy was $3,686,476.25. Congestion on the electric grid impacted energy prices in the MISO market, which contributed to higher costs for CWL. Significantly higher local costs for the utility's Crystal Lake contracts increased CWL's average monthly cost by more than 50% in the second half of 2021 compared to the first half.

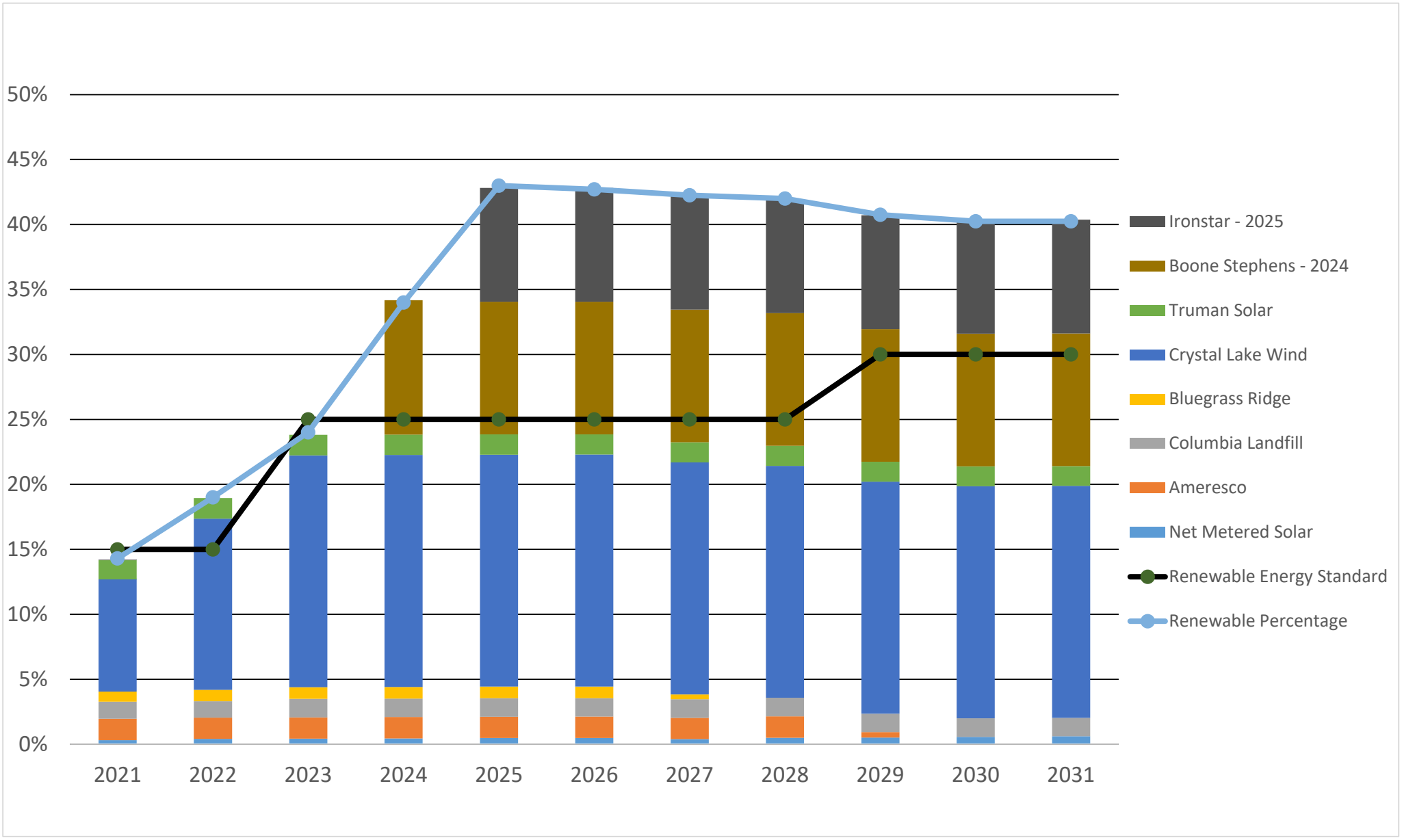


Planning for the Future of Renewables

CWL's Renewable Energy Plan is based on the revised 2014 Renewable Energy Standard. The recently completed Integrated Electric Resource and Master Planning process will help inform the planning and implementation process for energy supply for the coming years. The IERMP evaluated the Climate Action and Adaptation Plan goals related to the Utility, and CWL will work with the City Council and the Water & Light Advisory Board to determine the feasibility of those goals.

While sufficient renewable energy contracts were in place to achieve the current Renewable Energy Standard, factors outside of CWL's control resulted in lower than anticipated renewable energy production in 2021. These setbacks were enough to cause CWL to fall short of meeting the current standard. However, existing and future PPAs will substantially expand and diversify the renewable energy supply to the point where small setbacks will not likely inhibit the Utility from meeting the standard.

Renewable Energy Generation by Percentage of Load (2021-2031)



Planned Additions to the Renewable Energy Portfolio

Transitioning the power supply to renewable energy from traditional sources requires long-term planning to ensure all utility and customer needs are met. To address Columbia's future renewable energy needs, Columbia Water & Light is working on the following projects:

Truman Solar (2022)

In eight months during 2021, the Truman Solar facility produced 14,583 MWH of energy, which was 1.20% of Columbia's energy system total. Production was lower than expected, as the facility's start date was delayed four months. The facility operator projected the facility would produce 23,567 megawatt-hours during its first 12 months of operation, so having a full year of production will considerably increase CWL's portfolio.

Customer Net-Metered Solar (ongoing)

Customer-owned distributed generation has continued steady growth since approximately 2008. Market analysis predicts ongoing growth in this area. The recently completed IERMP will assist CWL in planning for continued expansion of customer-owned solar and will allow CWL to develop a plan to better serve this market. For the purposes of the Renewable Energy Plan, CWL has projected conservative growth in this area as many factors can impact the customer-owned solar market, including regulation changes, economic growth or recession, component pricing and rates.

Future Power Purchase Agreement (2022)

With the completion of the IERMP, CWL will explore expanding its renewable energy supply. Growth in renewable energy supply will be sought through a request for proposal for a new renewable energy power purchase agreement.

Columbia Landfill Gas Expansion (2022)

Construction for the fourth and final generator for the existing building design at the Columbia Landfill Gas Energy Plant was approved by the City Council in July 2021, with authority to use the design-build process approved in December 2021. When complete, this project will increase the Landfill Gas Plant's capacity from 3.1 MW to 4.2 MW.

Crystal Lake Wind III (2023)

The second Crystal Lake contract increases CWL's portion of wind generation from 27 MW to 45 MW in 2023, providing CWL the entire 66 MW of production generated from the NextEra Crystal Lake III Wind Energy Center located in Hancock County, Iowa.

The expansion of the Crystal Lake Wind contract is projected to produce an additional 57,200 MWH annually, which represents 4.5% of the projected 2023 system load.

Boone Stephens Solar (2024)

In November 2019, a 20-year power purchase agreement between City of Columbia and Boone Stephens Solar was approved. The solar field is expected to have an annual energy production estimated around 142,000 MWH per year, which is 11% of the projected electric system load in 2024.

In January 2022, Council authorized an amendment to the original agreement based on the results of an interconnection study for the facility estimated to be released in March 2022, which is beyond the original date in the PPA. This project is still on the original schedule with an expected commercial operation date of December 31, 2023. The solar field is planned to be tied directly into the City's 69 kV system at the existing Bolstad substation.

Ironstar Wind (2025)

In June 2017, the City Council approved a contract with the Missouri Joint Municipal Electric Utility Commission for the purchase of 35 MW of wind energy from western Kansas. Delivery of this energy depends upon the construction of the Grain Belt Express transmission line and a converter station in northeast Missouri. As of January 2022, Invenergy Transmission was continuing work on the right of way acquisition through property easements in Missouri and Kansas, keeping the anticipated delivery date at 2025.

Ironstar Wind is expected to have an annual energy production estimated around 122,640 MWH per year, which is 9.6% of the projected electric system total in 2025.

Biomass at the Municipal Power Plant (unknown)

As a result of federal emission and coal combustion residuals regulations, CWL stopped using coal and waste wood at the Municipal Power Plant (MPP) in September 2015. While biomass is considered a renewable form of energy, there are concerns about how biomass is sourced and about some of the emissions.

As part of the IERMP process, biomass combustion at the MPP was evaluated. The consultant cited a lack of reliably available fuel based on current market conditions and regional supply, and higher costs of additional demand in the market.

The IERMP Task Force recommended that CWL not pursue biomass combustion at the MPP for future power supply at this time, citing availability and costs of purchasing and transporting wood fuel.

2022 Estimated Renewable Energy Percentage

In order to meet the City's Renewable Energy Standard, Columbia Water & Light utilizes an array of renewable energy sources including wind, solar, and landfill gas. Based on a metered system energy requirement of 1,242,313 MWHs and similar renewable energy production levels, it is estimated that 18.6% of Columbia's electric portfolio will come from existing renewable resources in 2022.

	Location	Amount of Energy	% of System Load	Cost
Bluegrass Ridge	King City, MO	10,800 MWH	0.9%	$71.83/MWH
Crystal Lake Contract #1	Hancock County, IA	32,200 MWH	2.6%	$28.06/MWH
Crystal Lake Contract #2	Hancock County, IA	122,800 MWH	9.9%	$25.75/MWH
Jefferson City Landfill gas	Jefferson City, MO	22,400 MWH	1.8%	$53.03/MWH
Columbia Landfill gas	Columbia, MO	16,000 MWH	1.3%	$40.05/MWH
Net-Metered Customer Production	Columbia, MO	5,300 MWH	0.4%	$34.63/MWH
West Ash Solar Field	Columbia, MO	350 MWH	0.05%	$67.27/MWH
Truman Solar	Columbia, MO	21,000 MWH	1.7%	$44.81/MWH
TOTAL	—	**230,850 MWH**	**18.6%**	—

Summary

Columbia Water & Light strives to provide reliable, cost-effective service while achieving City of Columbia environmental and renewable energy goals. Although the renewable generation level in 2021 was lower than projected, CWL believes that the PPAs in place will put the utility well ahead of the ordinance requirements in the coming years. Market forces impact CWL's energy portfolio, and it will be important that the utility remains adaptable to those market forces as CWL transitions to a cleaner energy future.

By leveraging a diverse renewables portfolio, CWL expects to reach approximately 44% renewables by 2025, exceeding the minimum of 30% required by 2029 for the current Renewable Energy Standard and doing so four years early while positioning CWL to be aligned with climate goal trends for renewable energy growth. While short-term project delays might result in difficulties reaching the 25% mark before 2023, long-term issues in meeting the Renewable Energy Standard are not anticipated.

To continue this trend of increasing renewables, it will require significant commitment and planning. As the City of Columbia looks to the future of energy supply, the completion of the IERMP process will guide the City in achieving long-term goals laid out in the Renewable Portfolio Standard and the Climate Action and Adaptation Plan. Influenced by the recently completed IERMP, CWL will continue its efforts of increasing renewable energy supply by working to add additional renewable resources to its portfolio. In a rapidly changing market and environment, CWL will continue to provide customer-focused, reliable and cost-effective service that meets today's needs while planning for the future of the community.

Appendix

Glossary of Abbreviations

IERMP stands for Integrated Electric Resource & Master Plan.

kV means kilovolt, and is a standard unit for electromotive force. It is used to describe the infrastructure of the transmission and distribution systems.

kWh means kilowatt-hour(s), and is common unit for electric energy. Note that 1,000 kWh equals 1 MWH.

LMP stands for Locational Marginal Price. This is the hourly price that Columbia Water & Light buys or sells energy into the MISO marketplace.

MISO stands for Midcontinent Independent System Operator and is the regional transmission organization that Columbia Water & Light is a member.

MWH means megawatt-hour(s), and is a common unit for utility-scale electrical energy.

MW means megawatt(s), and is a common unit for utility scale electrical power.

REC stands for Renewable Energy Credit.

Table 1.1: Crystal Lake III Amended Price Chart

Period	Fixed Rate ($/MWH)
Repower Completion Date through Dec. 31, 2022	26.21
January 1, 2023 through December 31, 2023	25.11
January 1, 2024 through December 31, 2024	25.37
January 1, 2025 through December 31, 2025	25.63
January 1, 2026 through December 31, 2026	25.89
January 1, 2027 through December 31, 2027	26.16
January 1, 2028 through December 31, 2028	26.43
January 1, 2029 through December 31, 2029	26.71
January 1, 2030 through December 31, 2030	27.01
January 1, 2031 through December 31, 2031	27.30
January 1, 2032 through December 31, 2032	22.61
January 1, 2033 through December 31, 2033	22.00
January 1, 2034 through December 31, 2034	22.44
January 1, 2035 through December 31, 2035	22.89
January 1, 2036 through December 31, 2036	23.35
January 1, 2037 through December 31, 2037	23.81
January 1, 2038 through December 31, 2038	24.29
January 1, 2039 through December 31, 2039	24.78
January 1, 2040 through December 31, 2040	25.27

Historical Renewable Energy Data

For reference, Renewable Energy Data from the previous five years are included here. For all the data charts dating to 2005, visit https://www.como.gov/wp-content/uploads/2021/12/2022-Renewable-Report-Yearly-Production-Charts-1.pdf.

2020 Renewable Energy Production Amounts

Month	Columbia Adj. Load	Bluegrass Wind	Crystal Lake Contract 1	Crystal Lake Contract 2	Columbia Landfill	Jeff City Landfill	Free Power Solar	Net Metered Solar	Columbia Solar	Total Wind RECs	Total Renewable	YTD % of System
1-20	103,904	929	3,110	7,848	1,151	2,277	8.11	138.71	7.73	—	15,469	14.89%
2-20	96,923	856	3,213	8,696	1,589	2,131	13.88	149.71	17.14	—	16,666	16.00%
3-20	86,776	881	3,301	8,471	2,135	2,235	20.84	245.34	29.71	—	17,319	17.20%
4-20	76,639	704	3,080	7,810	1,247	2,158	26.40	314.18	36.82	—	15,376	17.80%
5-20	82,741	625	2,672	6,507	1,011	1,859	26.10	319.75	36.32	10,676	23,732	19.81%
6-20	109,963	581	3,025	7,080	1,396	2,094	32.10	397.08	43.66	9,324	23,973	20.21%
7-20	126,435	228	1,222	3,186	748	2,062	28.97	356.77	38.55	—	7,870	17.62%
8-20	115,374	388	2,198	5,594	578	1,993	28.83	369.81	39.09	—	11,189	16.47%
9-20	94,957	634	2,522	5,452	469	1,702	24.20	348.62	34.54	—	11,186	15.98%
10-20	88,430	1,010	1,908	4,196	1,337	1,845	11.73	280.43	27.79	—	10,616	15.62%
11-20	84,537	1,313	3,211	6,340	1,791	1,816	0.00	253.24	24.95	—	14,749	15.76%
12-20	99,725	890	2,006	4,397	1,975	2,118	0.00	226.65	21.93	—	11,635	15.41%
TOTAL	**1,166,405**	**9,039**	**31,467**	**75,578**	**15,427**	**24,290**	**221.2**	**3,400**	**358.2**	**20,000**	**179,780**	**15.41%**
% of System	**—**	**0.77%**	**2.70%**	**6.48%**	**1.32%**	**2.08%**	**0.02%**	**0.29%**	**0.03%**	**1.71%**		**—**

The amount of energy is measured in megawatt-hours (MWH)

2019 Renewable Energy Production Amounts

Month	Columbia Load	Bluegrass Wind	Crystal Lake Contract 1	Crystal Lake Contract 2	Columbia Landfill	Jeff City Landfill	Free Power Solar	Net Metered Solar	Columbia Solar	Total Wind RECs	Total Renewable	YTD % of System
1-19	109,535	1,169	3,300	8,648	515	1,745	9.39	96.78	17.35	-	15,499	14.15%
2-19	98,438	957	2,644	6,489	1,131	1,765	10.02	105.09	17.64	-	13,119	13.76%
3-19	94,656	1,332	3,540	9,049	940	2,069	21.69	222.00	33.45	-	17,207	15.14%
4-19	81,014	1,366	2,568	6,514	1,428	1,914	25.90	270.81	39.64	-	14,126	15.63%
5-19	91,789	821	2,971	7,670	1,245	1,609	30.71	284.77	39.47	-	14,671	15.70%
6-19	101,949	745	2,091	5,634	517	1,368	34.84	311.47	42.79	-	10,744	14.79%
7-19	123,326	657	1,808	4,776	1,217	2,112	37.59	337.89	45.92	-	10,992	13.75%
8-19	116,521	487	1,366	3,782	1,463	1,819	30.96	285.17	38.48	-	9,272	12.93%
9-19	112,748	1,015	2,583	6,853	965	1,253	27.45	281.99	34.52	20,000	33,012	14.91%
10-19	87,641	1,129	3,507	9,288	1,451	2,251	18.29	200.31	14.44	-	17,859	15.38%
11-19	90,026	1,238	3,340	8,898	1,481	2,211	14.55	175.52	12.26	-	17,370	15.70%
12-19	96,218	1,517	3,125	8,177	1,878	2,286	10.93	136.29	9.86	-	17,141	15.87%
TOTAL	**1,203,862**	**12,433**	**32,842**	**85,780**	**14,229**	**22,402**	**272.32**	**2,708.09**	**345.82**	**20,000**	**191,012**	**15.87%**
% of System	**-**	**1.03%**	**2.73%**	**7.13%**	**1.18%**	**1.86%**	**0.02%**	**0.22%**	**0.03%**	**1.66%**	**15.87%**	**-**

The amount of energy is measured in megawatt-hours (MWH)

2018 Renewable Energy Production Amounts

Month	Columbia Load	Bluegrass Wind	Crystal Lake Contract 1	Crystal Lake Contract 2	Columbia Landfill	Jeff City Landfill	Free Power Solar	Net Metered Solar	Columbia Solar	N. Dakota Wind RECs	Total Renewable	Annual % of System
1-18	113,783	1,442	3,931	9,684	1,463	1,852	16.67	111.55	25.57	25,000	43,526	38.25%
2-18	94,959	1,050	2,743	6,899	1,470	1,782	14.82	102.85	21.74	-	14,083	27.60%
3-18	93,030	1,525	3,419	9,083	1,868	2,052	18.81	134.59	27.75	-	18,127	25.10%
4-18	87,303	1,252	3,209	8,422	1,779	1,858	27.69	200.88	40.27	-	16,789	23.78%
5-18	106,787	646	2,184	5,778	1,534	1,907	34.49	224.35	43.73	-	12,352	21.15%
6-18	120,263	933	2,853	7,268	1,190	1,821	34.66	229.46	44.39	-	14,373	19.35%
7-18	126,035	335	1,852	4,806	940	1,824	36.78	245.09	46.42	-	10,086	17.43%
8-18	123,712	796	1,390	3,598	966	1,886	31.30	237.63	40.08	-	8,945	15.97%
9-18	105,292	724	2,546	6,536	845	2,200	28.30	235.03	38.50	-	13,153	15.59%
10-18	89,827	966	2,140	5,621	1,309	2,059	22.08	194.60	32.13	-	12,343	15.44%
11-18	93,526	1,072	3,321	8,386	1,537	2,092	12.28	99.10	15.69	-	16,534	15.62%
12-18	98,758	1,186	3,280	8,687	643	2,127	12.22	98.96	15.01	-	16,049	15.67%
TOTAL	1,253,275	11,927	32,867	84,767	15,544	23,460	290.00	2,114.00	391.00	25,000	196,361	15.67%
% of Total	-	0.95%	2.62%	6.76%	1.24%	1.87%	0.02%	0.17%	0.03%	1.99%	-	-

The amount of energy is measured in megawatt-hours (MWH)

2017 Renewable Energy Production Amounts

Month	Columbia Load	Bluegrass Wind	Crystal Lake Contract 1	Crystal Lake Contract 2	Columbia Landfill	Jeff City Landfill	Free Power Solar	Net Metered Solar	Columbia Solar	Total Renewable	Annual % of System
1-17	103,317	1,041	3,023	7,946	1,094	1,921	11.23	11.80	15.63	15,064	14.58%
2-17	84,331	1,287	3,821	9,821	1,075	1,365	22.87	29.77	27.92	17,449	17.33%
3-17	87,865	1,461	3,968	10,176	1,306	2,171	26.75	39.64	32.21	19,180	18.76%
4-17	83,932	1,336	3,175	7,699	168	1,503	30.69	50.99	37.40	14,000	18.28%
5-17	90,845	1,154	2,785	7,285	1,859	1,310	40.32	75.59	47.52	14,556	17.82%
6-17	108,284	918	2,303	6,713	1,847	1,871	41.56	72.20	50.19	13,816	16.84%
7-17	126,747	533	1,350	4,226	1,949	1,952	40.15	57.88	49.49	10,158	15.21%
8-17	109,516	377	1,329	4,140	1,913	1,965	32.63	66.83	44.49	9,867	14.35%
9-17	102,229	743	2,355	7,374	1,623	1,834	30.76	67.86	43.47	14,071	14.29%
10-17	89,532	1,626	3,459	11,032	1,331	1,652	20.35	67.17	29.66	19,217	14.94%
11-17	83,094	1,310	3,391	10,716	1,232	1,820	16.57	41.31	26.02	18,553	15.51%
12-17	100,764	1,381	3,161	10,020	1,279	1,881	14.55	60.41	22.97	17,820	15.70%
TOTAL	1,170,456	13,167	34,120	97,148	16,676	21,245	328.00	674.00	427.00	183,785	-
% of Total	-	1.12%	2.92%	8.30%	1.42%	1.82%	0.02%	0.06%	0.04%	15.70%	-

The amount of energy is measured in megawatt-hours (MWH)

2016 Renewable Energy Production Amounts

Month	System Total	Bluegrass Wind	Crystal Lake Wind	Columbia Landfill	Jeff City Landfill	Free Power Solar	Net Metered Solar	Columbia Solar	Total Renewable	Annual % of System
1-16	106,439	1,244	2,587	1,242	2,200	23.48	31.37	25.79	7,354	6.91%
2-16	94,654	1,452	2,901	976	1,981	25.66	39.84	28.46	7,404	7.34%
3-16	85,957	1,360	2,848	1,060	1,830	30.34	51.64	32.83	7,213	7.65%
4-16	83,451	1,567	3,317	1,143	1,775	41.75	76.16	44.29	7,964	8.08%
5-16	90,312	754	2,136	884	2,025	45.05	83.19	46.99	5,975	7.79%
6-16	121,086	697	1,938	598	1,952	49.25	94.10	51.14	5,380	7.10%
7-16	126,177	671	1,348	703	2,172	40.95	82.02	44.66	5,061	6.55%
8-16	121,427	531	1,162	1,684	1,796	34.90	73.30	40.64	5,322	6.23%
9-16	107,419	917	2,350	1,220	1,804	36.44	75.66	43.71	6,447	6.20%
10-16	89,128	1,137	2,341	1,805	2,142	26.46	56.90	33.53	7,542	6.40%
11-16	83,060	1,251	2,627	1,491	1,931	21.57	48.19	27.45	7,397	6.59%
12-16	104,028	1,119	3,315	1,343	2,083	14.86	41.58	23.27	7,939	6.68%
Total	1,213,138	12,700	28,871	14,149	23,691	391.00	754.00	443.00	80,998	-
% of Total	-	1.05%	2.38%	1.17%	1.95%	0.03%	0.06%	0.04%	6.68%	-

The amount of energy is measured in megawatt-hours (MWH)