2021 Renewable Energy Plan

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Introduction

Columbia Water & Light

Columbia Water & Light's renewable energy portfolio is a diverse mix 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. The ordinance mandates Columbia Water & Light (CWL) to purchase increasing levels of energy from renewable resources through 2029. The renewable energy ordinance was revised by the Columbia City Council on January 6, 2014, to increase the required amounts of renewable energy. According to the current standard, the City was required to generate or purchase electricity from eligible renewable energy sources at 15% of electric retail usage by December 31, 2020. This figure increases to 25% by December 31, 2022, and to 30% by December 31, 2028.

In 2020, CWL met the renewable energy ordinance by purchasing or generating 15.41% of electric retail usage. This was accomplished through a diverse renewable portfolio consisting of wind, solar, and landfill gas.

As mandated by ordinance, renewable energy was integrated into CWL's electric portfolio while costing less than the 3% renewable energy rate cap. The total cost of renewables in 2020 was $2,621,276.41, which was 70.29% of the $3,729,407 total allowed according to the ordinance.

Significant progress was made in 2020 toward expanding CWL's local renewable generation with Truman Solar expected to come online in 2021. At 10 MW, Truman Solar will greatly expand CWL's renewable portfolio, contributing to CWL's efforts to meet the Renewable Energy Standard and making progress toward climate goals supported by the adoption of the 2019 Climate Action and Adaptation Plan.

While the 2021 Renewable Energy Plan is based on the revised 2014 Renewable Energy Standard, Columbia Water & Light is undergoing an Integrated Electric Resource and Master Planning (IERMP) process that will help inform the implementation process of the Climate Action and Adaptation Plan goals related to energy supply. This process will provide guidance as to feasibility and ongoing Utility evaluation of those goals.

Looking beyond 2021, expansions in landfill gas, wind contracts, and local solar will play significant roles in meeting future energy needs. 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.

2020 Renewable Energy Supply

Columbia Adjusted System Load: 1,166,405 MWH
Renewable Energy Total: 179,780 MWH or 15.41%

In 2020, 15.41% of Columbia's electric portfolio came from renewable sources. The renewable portfolio comes from wind (11.66%), landfill gas (3.41%), and solar (0.34%). The total amount exceeds the requirement for 2020 of 15.00% by 0.41%. The additional cost is 70.29% of what is allowed by the Renewable Energy Standard.

Adjusted System Load is determined by adding the amount of electricity produced inside Columbia's distribution system to the net-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 Changes for 2020

- Construction of the Truman Solar 10 MW facility began in spring 2020 and by current contract is anticipated to be operational by January 31, 2021. Currently being proposed for Council consideration is an ordinance to amend the start date to April 1, 2021. The facility will be connected to Columbia Water & Light's 13.8 kV distribution system at the Rebel Hill substation. The estimated production of the Truman Solar facility is 18,100 MWH in calendar year 2021, assuming an April 1 start date.

- Free Power Company LLC defaulted on its lease agreement with the City in 2020. As a result, Free Power is no longer available in the City's renewable energy portfolio. In 2020, Free Power solar projects produced 221 MWH, which is 0.02% of Columbia's electric portfolio. Over the previous five years, Free Power produced an average of 338.86 MWH.

- As a result of the Coronavirus pandemic, there was approximately a 3% reduction in system load in 2020.

- There was a 34.2% increase in rated capacity in distributed solar power from 2019 to 2020.

- There was a 24.8% increase in produced MWH in distributed solar power from 2019 to 2020.

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)

2020 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 2020, Columbia received 9,039 MWH of power from this contract or 0.77% 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 2020 for wind power from the Bluegrass Ridge Wind Farm was $74.31 per MWH. Production at Bluegrass Ridge was 27.3% lower in 2020 as a result of major maintenance component work that was carried out during the spring and summer. Production is anticipated to return to normal in 2021.

Crystal Lake Wind Energy

CWL has entered into two power purchase agreements (PPA) 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 at a fixed price of $45/MWH. 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 being performed by NextEra. 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 31,467 MWH in 2020 representing 2.70% of CWLs system total at a cost of $54.74/MWH.

Energy from the second contract provided 75,578 MWH in 2020 representing 6.48% of CWL system total at a cost of $20.91/MWH.

Through the original PPA with NextEra, CWL and the University of Missouri collaborated with each entity purchasing half of the energy from the original 21 MW contract. This results in approximately 33,400 MWH annually being passed along to MU. While the University is not participating in the second contract, Columbia Water & Light did agree to provide the University with a blended cost based on the weighted average cost of the two contracts.

Both contracts require Columbia Water & Light to pay for deemed energy. Deemed energy is energy that would have been produced had CWL not requested production curtailment because of a negative Locational Marginal Price (LMP). A negative LMP means that Columbia Water & Light would be paying the energy market to take the energy. For the original contract, Columbia Water & Light currently requests curtailment at negative-$20. The second contract includes a deemed energy credit, therefore Columbia Water & Light currently requests curtailment at negative-$10.

Minnesota Wind Energy

A short-term purchase of 20,000 MWH of renewable energy credits from a wind farm in Minnesota was made to ensure compliance with Chapter 27-106 of the City's code of ordinances. In 2020, the City was a purchaser of energy from the MISO market in excess of 20,000 MWH. The City assigned the Renewable Energy Credits purchased from these wind facilities to 20,000 MWH that the City purchased from the MISO energy market. The cost of the renewable energy credits was $1.44/MWH.

Columbia Landfill Gas

The Columbia Landfill Gas Energy Plant was constructed in 2008. The plant 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. The plant can currently generate 3.1 MW of renewable power. In 2020, the Landfill Gas Energy Plant produced 15,427 MWH of energy at a cost of $38.71 per MWH, which was 1.32% of Columbia's energy system total. Although production was lower than expected, 2020 saw an 8.4% increase in production over 2019.

Production at Columbia Landfill was lower than expected in 2020 because of Unit #1 being unavailable from April to September and Unit #3 being unavailable from July through October. All units have been overhauled and are currently in service as of October 26.

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 2020 was 24,290 MWH, which is 2.08% of the electric system total. The utility paid $52.99 per MWH for the electricity. Columbia and Jefferson City are located within the MISO territory, so transmission fees do not substantially change the cost of the energy.

Free Power

The Columbia City Council approved a lease agreement with Free Power Company Inc. in December 2010 for the electricity generated from photovoltaic modules at $54.95 per MWH. In 2020, Free Power solar projects produced 221 MWH, which is 0.02% of Columbia's electric portfolio. The systems are located at the Transload Facility and are rated at 0.33 MW. Columbia Water & Light was only paying for the electricity generated from the panels. Free Power defaulted on its lease agreement and is no longer a part of future planning projects.

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 2020, there was an increase in customers installing their own photovoltaic systems from 238 to 293, and the rated capacity grew from 2.43 MW to 3.24 MW. In 2020, the amount of

energy sold to the electric utility was 1,249 MWH of 3,400 MWH estimated to have been generated. Net-metered production represented 0.29% of Columbia's electric portfolio in 2020.

Columbia Water & Light Solar Projects

Columbia Water & Light started the Solar One program in November 2008 as a way for customers to have an affordable way to invest in local solar energy projects. In October 2017, the Solar One Program was discontinued in favor of developing a community solar program that has an anticipated arrival date of 2021. Energy for the Solar One program was partially generated through 10-year power purchase agreements with two local businesses. These contracts were completed in 2020 with the projects being converted to standard net-metering customers.

The Bernadette site was expanded by Columbia Water & Light staff in 2015. These solar resources produced 358 MWH or 0.03% of the electric portfolio at a cost of $65.20 per megawatt-hour.

Costs of Renewable Energy

As outlined in Section 27-106(b) of the Renewable Energy Standard ordinance, renewable energy cannot cause electric rates to increase more than 3% above what rates would be with non-renewable energy. The 3% impact on rates limit is determined as 3% of total revenue from regulated rate sources. Utility Financial Solutions LLC, an outside utility consultant, was hired in 2014 to review the cost impact of renewable energy. A copy of this report can be found at www.como.gov/utilities/cwl-ufs-report/.

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. For calendar year 2020, the additional cost to address the renewable portfolio requirement was $2,621,276.41 and the limit was $3,729,407 as outlined in the following tables. The additional money spent on renewable energy was 70.29% of what was allowed according to the ordinance. From calendar year 2019 to calendar year 2020, the total amount of renewable energy decreased by 11,233 megawatt-hours, or 5.88%. This decrease was largely a result of maintenance and outages at Bluegrass Ridge and Crystal Lake Wind.

Relative to the cost for non-renewable energy, the average cost per megawatt-hour (MWH) of renewables in 2020 was $36.22/MWH, which is comparable to the cost of non-renewables at an average cost of $23.25/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 2020 Renewable Energy Portfolio

Renewable Resource	Total 2020 MWH	Additional Cost/(Savings) Per MWH	Total Impact on Rates
Bluegrass Ridge Wind (Associated Electric)	9,039	$47.96	$433,510.44
Crystal Lake Wind Contract 1 (NextEra)	31,467	$39.30	$1,236,653.10
Crystal Lake Wind Contract 2 (NextEra)	75,578	$3.14	$237,314.92
Columbia Landfill	15,427	$6.30	$97,190.10
Jefferson City Landfill (Ameresco)	24,290	$23.67	$574,944.30
Free Power Photovoltaic Production	221	$15.88	$3,509.48
Net Metered Photovoltaic Production	3,400	—	—
Columbia Water & Light Solar Production	358	$26.13	$9,354.07
Wind RECs	20,000	$1.44	$28,800.00
Total Renewable Resource Impact on Rates			**$2,621,276.41**

Maximum Renewable Portfolio Cost Calculations

Revenue Source	January – September (FY20)	October – December (FY21)
Residential	$43,152,667	$11,461,082
Commercial/Industrial	$53,082,715	$16,617,096
Total Revenue During Calendar Year 2020		$124,313,560
3% Impact Limit on Rates		$3,729,407

Calculating Renewable Energy Costs

In 2014, Columbia Water & Light enlisted the services of Utility Financial Solutions LLC to provide guidance on the valuation of renewable generation. To determine the cost for renewables and the impact on ratepayers, CWL uses a combination of market prices of electricity and avoided cost.

The City's renewable energy impact methodology assesses compliance with this requirement. 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 2020, the following factors have been established:

- Columbia's Non-Renewable Avoided Cost — $25.86/MWH
- The production weighted price of Columbia's Midcontinent Independent System Operator (MISO) Load Node for Wind Production — $17.97/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 ($/MWH)	Production (MWH)	Renwable Cost Impact ($)
Bluegrass Ridge Wind	$ 74.31	$ 3.10	$ 71.21	$ 47.96	-	-	$ 47.96	9,039	$ 433,510.44
Crystal Lake C1 Wind	$ 54.74	$ 3.10	$ 51.64	$ 28.39	$ 7.06	$ 10.91	$ 39.30	31,467	$ 1,236,653.10
Crystal Lake C2 Wind	$ 20.91	$ 3.10	$ 17.81	$ (5.44)	$ 9.39	$ 8.58	$ 3.14	75,578	$ 237,314.92
Wind RECs	$ 24.69	$ -	$ 24.69	$ 1.44	-	-	$ 1.44	20,000	$ 28,800.00
Columbia Landfill Gas	$ 38.71	$ 9.16	$ 29.55	$ 6.30	-	-	$ 6.30	15,427	$ 97,190.10
Jefferson City Landfill Gas	$ 52.99	$ 6.07	$ 46.92	$ 23.67	-	-	$ 23.67	24,290	$ 574,944.30
Free Power PV	$ 54.95	$ 15.82	$ 39.13	$ 15.88	-	-	$ 15.88	221	$ 3,509.48
Customer Generated PV (Net Meter)	-	$ 15.82	-	-	-	-	-	3,400	-
CWL Generated PV	$ 65.20	$ 15.82	$ 49.38	$ 26.13	-	-	$ 26.13	358	$ 9,354.07
								179,780	**$ 2,621,276.41**

- Column A - Total cost of the Renewable resource
- Column B - Amount of total cost that is determined to be providing capacity value, see Utility Financial Solutions, Rate Impacts on Renewable report in the appendix
- 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 $23.25)
- Column E - Production weighted MISO LMP at the point of resource connection to the MISO system
- Column F - Resource congestion and losses as compared to Water & Light's load
- Wind Resources ($17.97 minus Column E)
- Column G - Energy Impact plus congestions and losses for the resource (Column D plus Column F)
- Column H - Resource Annual Production
- Renewable Cost Impact – Column G times Column H

2021 Estimated Renewable Energy Portfolio

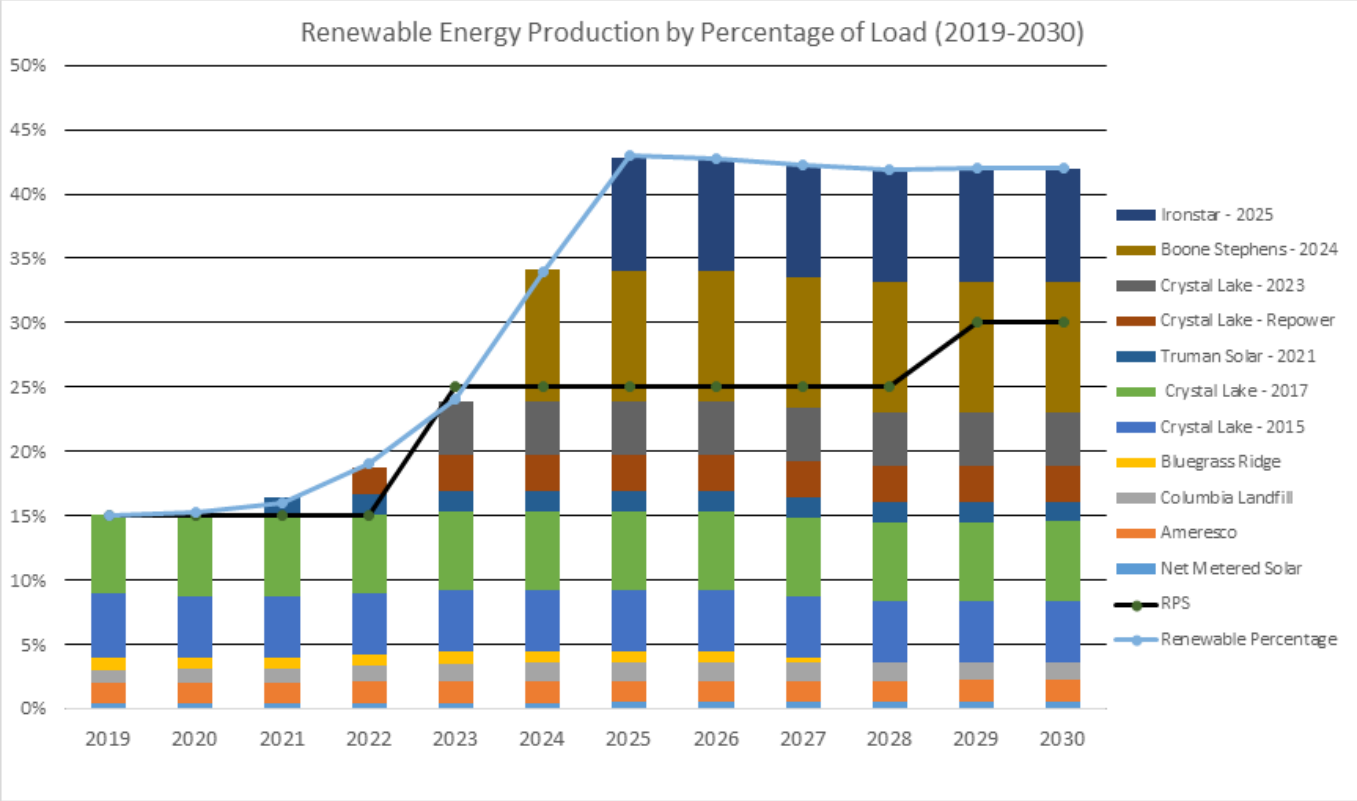
In order to meet the current City Renewable Energy Standard, Columbia Water & Light utilizes an array of renewable energy sources including wind, solar, and landfill gas. Based on a metered system energy requirement of 1,236,308 MWHs and similar renewable energy production levels, it is estimated that 15% of Columbia's electric portfolio will come from existing renewable resources in 2021.

	Location	Amount of Energy	% of System Load	Cost
Bluegrass Ridge	King City, MO	12,031 MWH	0.97%	$74/MWH
Crystal Lake Contract #1	Hancock County, IA	31,032 MWH	2.51%	$54/MWH
Crystal Lake Contract #2	Hancock County, IA	82,042 MWH	6.64%	$21/MWH
Jefferson City Landfill gas	Jefferson City, MO	23,206 MWH	1.88%	$38/MWH
Columbia Landfill gas	Columbia, MO	15,064 MWH	1.22%	$53/MWH
Net Metered Customer Production	Columbia, MO	4,500 MWH	0.36%	—
West Ash Solar Field	Columbia, MO	380 MWH	0.03%	$65/MWH
Truman Solar	Columbia, MO	18,100 MWH	1.46%	$44.81/MWH
TOTAL	**—**	**186,355 MWH**	**15.07%**	**—**

Future Renewable Energy Plan

CWL's Renewable Energy Plan is based on the revised 2014 Renewable Energy Standard. Columbia Water & Light is undergoing an Integrated Electric Resource and Master Planning process that will help inform the planning and implementation process for energy supply for the coming years. The IERMP will evaluate the Climate Action and Adaptation Plan goals related to the Utility and provide guidance as to feasibility of those goals.

While the power supply coming from these sources meets our current standard, it will be necessary to substantially expand these resources to meet proposed Climate Action and Adaptation Plan goals.



Planning for the Future of Renewables

Transitioning the power supply to renewable energy from traditional sources requires long-term planning to ensure all utility and customer needs are met. The following section focuses on existing contracts and ongoing evaluations. While this plan is based on the current Renewable Energy Standard, CWL will utilize the IERMP process to evaluate expansion of the renewable energy supply beyond existing contracts to meet City climate goals. To address Columbia's future renewable energy needs, Columbia Water & Light is working on the following projects:

Truman Solar (2021)

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 to be constructed by Truman Solar. The facility will be connected to Columbia Water & Light's 13.8 kV distribution system at the Rebel Hill substation. The City is extending two feeders from its Rebel Hill substation to receive this energy. Construction of the solar field and the electric lines began in spring 2020. Under the current contract, the solar installation is expected to go into operation January 31, 2021. Currently being proposed for Council consideration is an ordinance to amend the start date to April 1, 2021. Assuming an April 1 start date, the estimated production of the Truman Solar project is 18,100 MWH in calendar year 2021, which represents 1.46% of the projected 2021 system load.

Customer Net-Metered Solar (ongoing)

Customer-owned, distributed generation has continued a steady growth trend since approximately 2008. Market analysis predicts ongoing growth in this area. The ongoing 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.

Columbia Landfill Gas Expansion (2022)

The fourth and final generator for the existing building design at the Columbia Landfill Gas Energy Plant has been funded and a public hearing will be set for 2021 to garner feedback from the community. When complete, this project will increase the Landfill Gas Plant's capacity to 4 MW.

The amount of energy received from the Columbia Landfill Gas Energy Plant is fairly consistent, aside from times when there is routine maintenance work. The plant's three existing generators produce 3.1 MW of renewable power. Based on the current production level, we expect the fourth generator to increase output 33% subject to available fuel from the landfill.

Crystal Lake Wind 3 (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.

In 2020, CWL received a proposal from NextEra to repower the wind farm with updated equipment and estimates an additional 40,000 MWHs per year can be produced. This updated contract will deliver more renewable energy at a lower cost from the original contract and will extend the agreement through 2040. The nameplate capacity of the wind farm will remain the same at 66 MW. Table 1.1, detailing updated pricing for the contracts from 2022 through 2040, can be found in the appendix.

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 10.9% of the projected electric system load in 2024. An annual degradation rate of approximately 0.5% is anticipated. The field has 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 Clean Line transmission line and a converter station in northeast Missouri. Ironstar Wind is expected to have an annual energy production estimated around 122,640 MWH per year, which is 9.4% of the projected electric system total in 2025. The original delivery date was anticipated to be in 2021. As a result of legal action, the new anticipated delivery date has been pushed back to 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. As part of the IERMP process, a consultant will be investigating the feasibility of biomass alternatives at the MPP with respect to CWL's overall power supply portfolio.

While biomass is considered a renewable form of energy, there is concern about how biomass is sourced and about some of the emissions. If the IERMP process determines that biomass at the MPP is a feasible option for future power supply, then CWL will present viable biomass options to the Water & Light Advisory Board, the Climate and Environment Commission and the City Council to determine whether this is an acceptable option for the community.

Summary

CWL strives to provide reliable, cost-effective service while achieving City of Columbia environmental and renewables goals. Through this Renewable Energy Plan, CWL has demonstrated its ability to meet and ultimately exceed the Renewable Energy Standard requirements of the current ordinance.

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 in 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 IERMP process will guide the City in achieving long-term goals laid out in the Climate Action and Adaptation Plan. The IERMP will develop a resource plan to identify strategies to meet future goals, including 100% renewables and greenhouse gas emission reduction targets.

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/utilities/renewables-plan-yearly-energy-production-amounts/.

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)

2015 Renewable Energy Production Amounts

Month	System Total	Bluegrass Wind	Crystal Lake Wind	Columbia Landfill	Jeff City Landfill	Waste Wood	Free Power Solar	Net Metered Solar	West Ash Solar	Solar One	Total Renewable	Annual % of System
1-15	105,552	1,501	2,777	1,605	2,024	982	28.06	21.39	-	2.92	8,942	8.47%
2-15	101,106	1,039	2,784	1,744	1,910	127	25.83	16.82	-	2.52	7,649	8.03%
3-15	90,810	1,193	2,384	1,650	1,879	-	36.35	34.00	-	3.83	7,180	7.99%
4-15	81,568	1,233	1,175	1,475	2,094	-	38.90	37.68	-	3.97	6,058	7.87%
5-15	90,340	1,035	2,316	1,040	2,157	-	40.28	40.59	-	4.16	6,633	7.77%
6-15	107,377	748	1,329	1,020	1,620	-	40.25	37.73	-	3.77	4,799	7.15%
7-15	122,348	455	1,291	1,003	2,009	595	43.87	43.38	-	4.29	5,445	6.68%
8-15	114,671	549	1,779	927	1,996	812	43.11	44.61	4.28	4.39	6,160	6.50%
9-15	106,316	978	2,041	958	1,965	338	42.30	40.74	40.24	4.13	6,408	6.44%
10-15	86,400	1,140	2,609	1,122	1,986	-	33.50	34.32	33.02	3.44	6,961	6.58%
11-15	84,283	1,676	2,798	818	1,914	-	23.54	24.38	23.90	2.52	7,281	6.74%
12-15	94,107	1,400	2,603	997	2,225	-	17.45	18.24	17.86	1.99	7,280	6.82%
TOTAL	1,184,878	12,947	25,889	14,359	23,779	2,854	413.00	394.00	119.00	42	80,796	-
% of Total	-	1.09%	2.18%	1.21%	2.01%	0.24%	0.03%	0.03%	0.01%	0.00%	6.82%	-

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