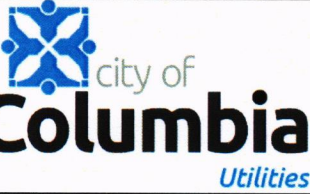
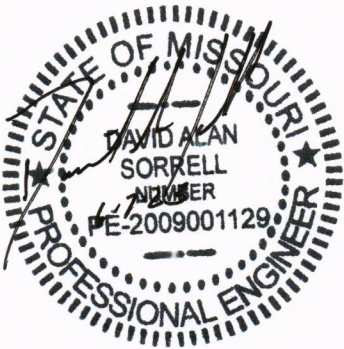
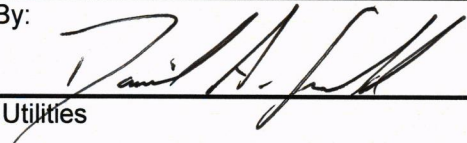




city of  
**Columbia**

*Utilities*

**2023 Renewable Energy Plan**

		
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<p>Approved By: </p> <hr/> <p>Director of Utilities</p>		<p><u>6-7-23</u></p> <hr/> <p>Date</p>

## 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 2022 was set at 15%.

In 2022, CWL purchased or generated 18.15% of its total electric usage through renewable energy sources.

The cost for renewable energy has been increasing in recent years. This trend continued and accelerated in 2022. These higher costs come at a time when the City of Columbia has been experiencing steadily increasing purchase power expenses due to the effects of higher market energy prices, reliability concerns, weather events and grid congestion. Energy price increases have been seen locally, throughout the entire Midcontinent Independent System Operator (MISO) footprint, nationwide and globally. At the grid level, higher costs could persist for the foreseeable future until MISO's Long Range Transmission Plan projects are in service in the late 2020s or early 2030s.

The additional cost for renewable energy compared to non-renewables was \$6,303,276, which was a 58.45% increase over the rate impact limit of \$3,978,176. The majority of the cost increase can be attributed to the two Crystal Lake contracts as a result of congestion on the grid. While this additional cost will not immediately result in a recommended rate increase, consideration for this increasing cost should be made when evaluating the need for rate increases.

CWL continued to make progress in 2022 toward expanding 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. 2022 was highlighted by progress in defining Columbia's energy future through taking necessary steps to better understand various options associated with the City adopting a 100% renewable by 2030 goal. Results from this study that will help define the path forward on a greater expansion of renewables are expected in 2023. This study will play a significant role in planning for the future of renewable energy supply in Columbia.

Looking at 2023 and beyond, expected expansions in landfill gas and wind contracts, and an ongoing request for proposal to increase renewable energy supply will play significant roles in meeting future energy needs. These expansions in CWL's renewable energy portfolio will allow the City to continue increasing renewable energy while evaluating next steps in a greater expansion of renewables on our grid.

## 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 preferential 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.

## 2022 Renewable Energy Supply

Columbia Adjusted System Load: 1,263,615 MWH

Renewable Energy Total: 229,371 MWH or 18.15%

In 2022, 18.15% of Columbia's electric portfolio came from renewable sources: wind (12.9%), landfill gas (2.9%), and solar (2.3%). The total amount exceeds the 15% standard for 2022 by 3.15%.

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 2022

- In late June 2022, Boone Stephens Solar provided notice of termination of its 64 MW PPA citing increased project cost as the reason for termination. The developer is still interested in proceeding with construction and is evaluating options for development.
- Utility staff finalized the request for proposal for Boone Stephens Solar replacement, which will include an expansion of renewable resources through 2025.
- Recent conversations with the Missouri Joint Municipal Electric Utility Commission (MJMEUC) indicates that energy delivery from the Iron Star project will be delayed until 2027 based on proposed transmission changes to the project.
- Utility staff notified MJMEUC of our interest in expanding our takeoff from Ironstar Wind based on additional energy being available.
- Congestion on the electric grid impacted energy prices in the MISO market, which contributed to higher costs for CWL. This volatility was created by several events including outages of resources located near CWL and weather events that put pressure on resources and transmission lines.
- Staff is currently in the contract award process for the Columbia Landfill Gas Energy Plant expansion. Work is expected to begin on the fourth generator in 2023.
- Utility staff started the process of evaluating the different options toward meeting a goal of 100% renewable energy by 2030. A consultant will begin work on the study during the first quarter of 2023.
- Utility staff proposed a utility scale battery study, of which, the request for proposal is currently under development. The result of the battery study should provide some insight on how batteries could affect CWL's capacity portfolio in the future.

### 2022 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
<b>1-22</b>	114,255	1,180	2,967	7,856	1,137	2,124	1,261	301	24	16,850	14.75%
<b>2-22</b>	99,995	1,283	3,653	10,037	1,160	1,875	1,505	299	23	19,836	17.12%
<b>3-22</b>	94,465	1,452	4,328	11,958	1,376	1,970	1,907	398	29	23,418	19.47%
<b>4-22</b>	86,861	1,472	4,827	12,612	1,421	2,023	2,046	482	33	24,916	21.49%
<b>5-22</b>	100,378	1,039	3,834	9,701	1,311	1,543	2,273	500	33	20,234	21.22%
<b>6-22</b>	117,760	751	2,603	6,963	1,250	1,497	2,817	597	38	16,516	19.84%
<b>7-22</b>	130,699	489	2,060	5,416	1,350	1,767	2,506	539	34	14,161	18.26%
<b>8-22</b>	128,406	309	1,877	4,993	1,328	1,819	2,608	557	35	13,526	17.12%
<b>9-22</b>	102,853	730	2,750	7,238	1,296	2,027	2,303	511	33	16,888	17.05%
<b>10-22</b>	87,400	1,071	3,393	9,049	1,317	1,637	1,964	459	29	18,919	17.43%
<b>11-22</b>	92,478	1,560	4,703	12,322	1,241	2,148	1,362	362	23	23,721	18.09%
<b>12-22</b>	108,065	1,355	4,268	11,158	1,332	1,299	741	221	13	20,387	18.15%
<b>TOTAL</b>	1,263,615	12,691	41,261	109,305	15,519	21,729	23,293	5,226	347	229,371	18.15%
<b>% of System</b>		1.00%	3.27%	8.65%	1.23%	1.72%	1.84%	0.41%	0.03%	18.15%	

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

## 2022 Renewable Energy Portfolio

### Bluegrass Ridge Wind Energy

Columbia started receiving wind power from turbines near King City, Missouri, in September 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 2022, Columbia received 12,691 MWH of power from this contract or 1.0% 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 2022 for wind power from the Bluegrass Ridge Wind Farm was \$70.34 per MWH.

### 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 41,261 MWH in 2022 representing 3.3% of CWL's system total at a cost of \$27.59/MWH.

Energy from the second contract provided 109,305 MWH in 2022 representing 8.7% of CWL's system total at a cost of \$26.21/MWH.

In 2022, congestion on the electrical system near Columbia resulted in additional cost increases to \$42.29/MWH and \$41.04/MWH for Contract 1 and 2, respectively.

Analysis from The Prime Group through the Electric Cost of Service Study noted in their Renewable Target Evaluation that:

*Future congestion costs from Crystal Lake will likely grow with the Expansion and Repower taking effect in 2022/2023. These costs could persist for the foreseeable future until MISO Long Range Transmission Plan projects are in service in the late 2020s/early 2030s.*

### 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 2022, the Landfill Gas Energy Plant produced 15,519 MWH of energy at a cost of \$43.99 per MWH, which was 1.23% of Columbia's energy system total.



### 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 2022 was 21,729 MWH, which is 1.72% of the electric system total. The utility paid \$53.05 per MWH for the electricity.

### Truman Solar

Truman Solar is a 10 MW solar facility connected to Columbia Water & Light's 13.8 kV distribution system at the Rebel Hill substation. The solar installation went into operation May 7, 2021. In 2022, the Truman Solar facility produced 23,293 MWH of energy at a cost of \$44.81 per MWH, which was 1.8% of Columbia's energy system total.

### 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 2022, there were 112 new customer-owned photovoltaic installations or expansions, and the rated capacity grew from 3.76 MW to 4.75 MW. In 2022, the amount of energy sold to the electric utility was 2,039 MWH of 5,226 MWH estimated to have been generated. Net-metered production represented 0.41% of Columbia's electric portfolio in 2022.

Analysis from The Prime Group through the Electric Cost of Service Study noted in their Renewable Target Evaluation that:

*If Net Metering continues to grow at similar rates as 2020 and 2021, it will become a substantial renewable cost to the City if credits remain at the current retail rates.*

Since growth in the distribution of solar energy sold to the utility and behind-the-meter generation are expected to remain steady, the financial risks from net-metering are not likely to affect the overall renewable energy cost, though they could be significant in the future when considering cost of service.

### 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 347 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 energy compared to non-renewable energy.

The trend of accelerating costs for renewable energy continued in 2022. The total expense of renewable energy in excess of non-renewable energy was \$6,303,276, which is 58.45% above the rate impact limit of \$3,978,176.

Congestion on the electric grid impacted energy prices in the MISO market, which contributed to higher costs for CWL. Cost increases were a result several events including outages of resources located near CWL and weather events that put pressure on resources and transmission lines. This congestion lead to significantly higher local costs for the utility's Crystal Lake wind contracts.

For Crystal Lake, costs from congestion and losses increased from 2021 to 2022 from \$24.24/MWH to \$42.29/MWH for Contract 1, and from \$22.44/MWH to \$41.04/MWH for Contract 2. These represent increases of 74% and 83%, respectively. These higher costs could persist for the foreseeable future until MISO's Long Range Transmission Plan projects are in service in the late 2020s or early 2030s.

While the additional cost for renewable energy will not immediately result in a recommended rate increase, consideration for increasing costs should be made when evaluating future rate increases.

From calendar year 2021 to calendar year 2022, the total amount of renewable energy increased by 51,238 MWH, or 28.75%. The average cost per megawatt-hour of renewables in 2022 was \$37.77/MWH, which is comparable to the cost of non-renewables at an average cost of \$34.85/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 2022 Renewable Energy Portfolio

Renewable Resource	Total 2022 MWH	Additional Cost/(Savings) Per MWH	Total Impact on Rates
Bluegrass Ridge Wind (Associated Electric)	12,691	\$ 35.57	\$ 451,419
Crystal Lake Wind Contract 1 (NextEra)	41,261	\$ 38.21	\$ 1,576,583
Crystal Lake Wind Contract 2 (NextEra)	109,305	\$ 35.58	\$ 3,889,072
Columbia Landfill	15,519	\$ 8.14	\$ 126,325
Jefferson City Landfill (Ameresco)	21,729	\$ 15.25	\$ 331,367
Truman Solar (Truman Solar LLC)	23,293	\$ (1.49)	\$ (34,707)
Net-Metered Photovoltaic Production	5,226	\$ (8.69)	\$ (45,414)
Columbia Water & Light Solar Production	347	\$ 21.12	\$ 7,327
<b>Total Renewable Resource Impact on Rates</b>			<b>\$ 6,303,276</b>



## 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 (FY22)	October – December (FY23)
Residential	\$46,009,348	\$11,852,523
Commercial/Industrial	\$57,190,832	\$17,553,150
Total Billed Revenue During Calendar Year 2022		\$132,605,853
3% Impact Limit on Rates		\$3,978,176

## 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 2022, the following factors have been established:

- Columbia's Non-Renewable Avoided Cost — \$31.67/MWH
- The production weighted price of Columbia's Midcontinent Independent System Operator (MISO) Load Node for Crystal Lake Contract One — \$59.29/MWH
- The production weighted price of Columbia's Midcontinent Independent System Operator (MISO) Load Node for Crystal Lake Contract Two — \$58.25/MWH

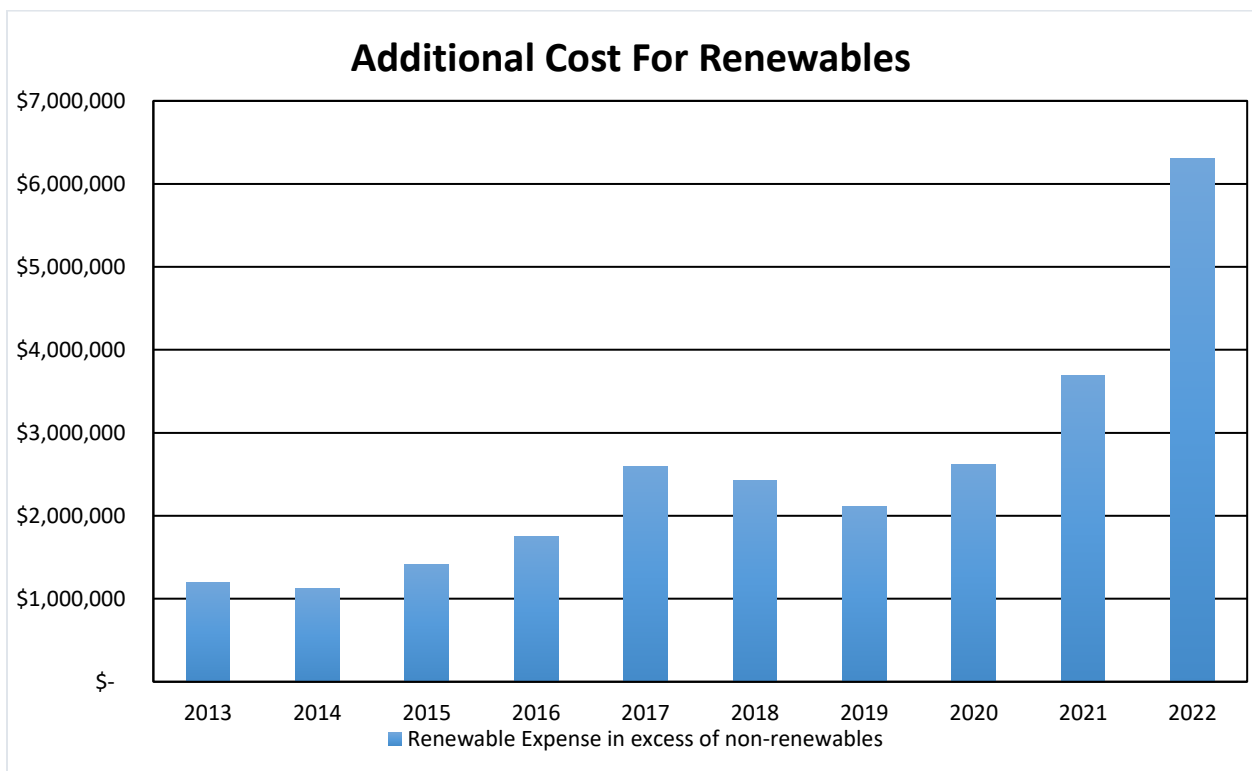
	A	B	C	D	E	F	G	H	
Resource	Resource Cost (\$/MWH)	Capacity Component (\$/MWH)	Energy Component (\$/MWH)	Energy Impact (\$/MWH)	Resource MISO LMP (\$/MWH)	Cong. & Loss Cost (\$/MWH)	Energy Impact w/ C&L (\$/MWH)	Production (MWH)	Renewable Rate Impact (\$)
Bluegrass Ridge Wind	\$ 70.34	\$ 3.10	\$ 67.24	\$ 35.57	-	-	\$ 35.57	12,691	\$ 451,419
Crystal Lake C1 Wind	\$ 27.59	\$ -	\$ 27.59	\$ (4.08)	\$ 17.00	\$ 42.29	\$ 38.21	41,261	\$ 1,576,583
Crystal Lake C2 Wind	\$ 26.21	\$ -	\$ 26.21	\$ (5.46)	\$ 17.21	\$ 41.04	\$ 35.58	109,305	\$ 3,889,072
Columbia Landfill Gas	\$ 43.99	\$ 4.18	\$ 39.81	\$ 8.14	-	-	\$ 8.14	15,519	\$ 126,325
Jefferson City Landfill Gas	\$ 53.05	\$ 6.07	\$ 46.98	\$ 15.31	-	-	\$ 15.31	21,729	\$ 332,671
Truman Solar	\$ 44.81	\$ 14.63	\$ 30.18	\$ (1.49)	-	-	\$ (1.49)	23,293	\$ (34,707)
Customer Generated PV (Net Meter)	\$ 37.46	\$ 14.48	\$ 22.98	\$ (8.69)	-	-	\$ (8.69)	5,226	\$ (45,414)
CWL Generated PV	\$ 67.27	\$ 14.48	\$ 52.79	\$ 21.12	-	-	\$ 21.12	347	\$ 7,327
								<b>229,371</b>	<b>\$ 6,303,276</b>

- 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 \$31.67)
- 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 (\$59.29 minus Column E for contract 1, \$58.25 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 2022, the additional expense of renewable energy in excess of non-renewable energy was \$6,303,276. Congestion on the electric grid impacted energy prices in the MISO market, which contributed to higher costs for CWL.

Significantly higher prices at Columbia’s Locational Marginal Price (LMP) for the utility’s Crystal Lake wind contracts resulted in increases of 74% and 83% when compared to the previous year. LMP is a way for wholesale electric energy prices to reflect the value of electric energy at different locations, accounting for the patterns of load, generation, and the physical limits of the transmission system. This increase can be attributed to congestion and losses on the grid resulting from outages of resources near Columbia and weather events that put pressure on resources and transmission lines.

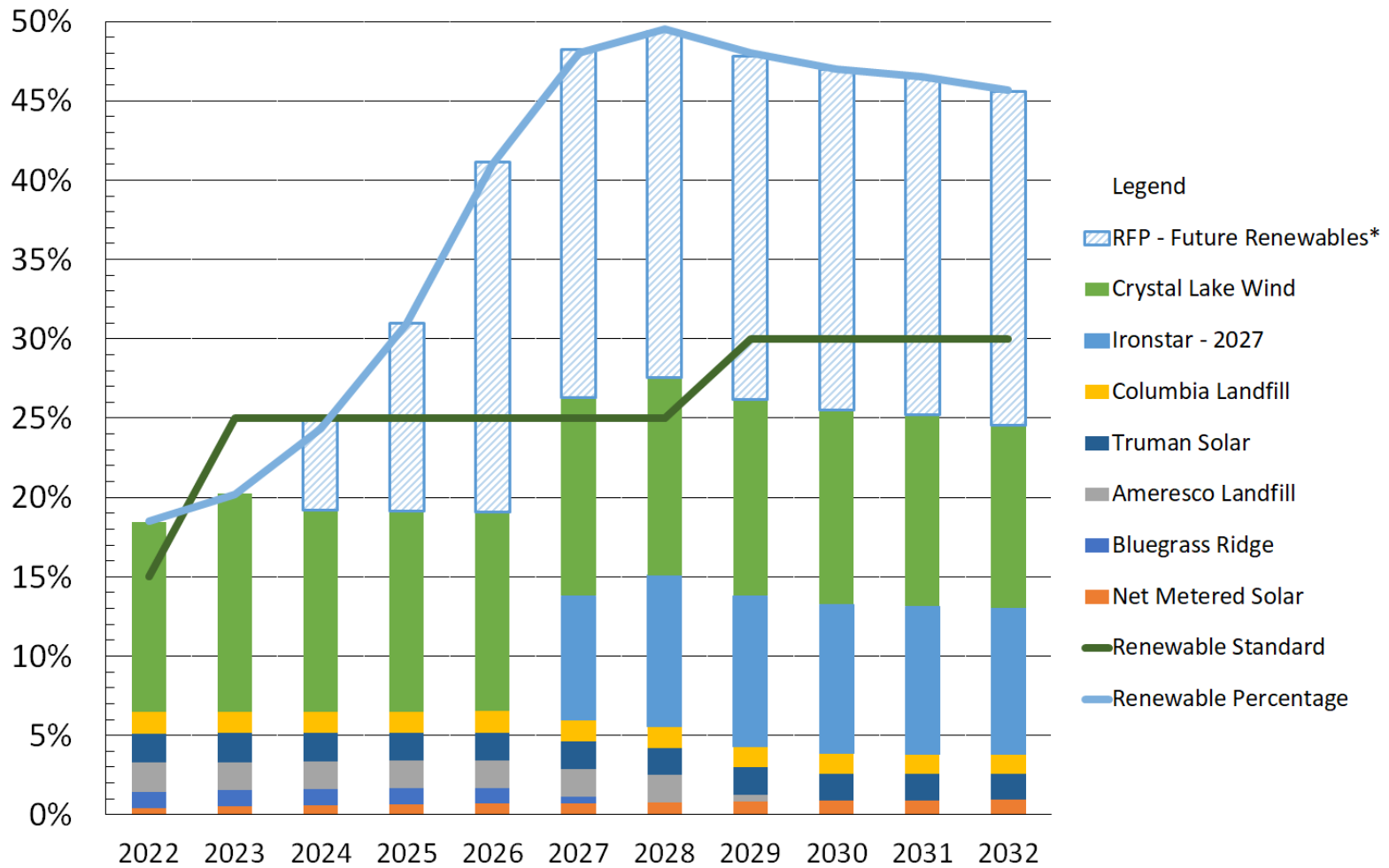


## Planning for the Future of Renewables

CWL's Renewable Energy Plan is based on the revised 2014 Renewable Energy Standard. The recently completed Integrated Electric Resource and Master Planning process laid the foundation for the future of energy planning in Columbia. In 2022, utility staff started the process of evaluating the different options toward meeting a goal of 100% renewable energy by 2030. A consultant will begin work on the study during the first quarter of 2023, with the final results of the study delivered in 2023. This study will further inform the planning and implementation process for a greater expansion of renewable energy supply in Columbia.

The chart on the following page depicts the 10 year outlook for renewable energy supply in Columbia. CWL has renewable energy provided by wind, solar, and landfill gas resources. With the loss of the Boone Stephens solar project, staff worked toward designing a path forward that would allow the utility to replace that resource and expand our renewable energy supply beyond our historical benchmarks. Although a shortfall in renewable energy is anticipated in 2023 as a result of project delays, CWL projects that existing power purchase agreements along with planned expansion of renewables will place the utility ahead of ordinance requirements in the coming years. This plan will hopefully allow the Utility to quickly replace the Boone Stephens contract as soon as 2024 with additional resources to be available in 2025. The specifics of these resources are not currently available as the request for proposal process is ongoing.

**Renewable Energy Generation by Percentage of Load (2022-2032)**



\* - Future Potential Contract

## **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:

### **Customer Net-Metered Solar (ongoing)**

Customer-owned distributed generation has continued steady growth since approximately 2008. Market analysis predicts ongoing growth in this area. 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 (2023)**

With authority to use the design-build process approved by Council in December 2021, staff is currently in the contract award process. Work is expected to begin on the fourth generator in 2023. 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.

### **Future Power Purchase Agreement (2024 - 2025)**

In 2022, Utility staff finalized the request for proposal to acquire additional resources to replace the 64 MW Boone Stephens solar project. Replacement of the solar resource as well as an expansion of renewable energy supply will be sought through a request for proposal for new renewable energy power purchase agreements.

Proposals must include offers of at least 130,000 MWH per year or the equivalent installed capacity of 65 MW with a target delivery beginning around January 1, 2024.

CWL is also seeking proposals for at least 150,000 MWH or the equivalent installed capacity of 75 MW with a target delivery beginning around January 1, 2025.

### **Ironstar Wind (2027)**

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 2023, Invenergy Transmission was continuing work on the right of way acquisition through property easements in Missouri and Kansas, with the majority of those easements being in place as of 2022.



As a result of a need to amend their Certificate of Convenience and Necessity due to the converter station changing locations, this project will return to the Missouri PSC in 2023. This change will push back the anticipated delivery date to 2027.

Under CWL’s current agreement, 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.

Utility staff has notified the Missouri Joint Municipal Electric Utility Commission of our interest in expanding our takeoff from Ironstar Wind based on additional energy being available. CWL has requested up to an additional 18 MW for delivery in 2027 bringing the total purchase potential to 53 MW of wind energy.

### 2023 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 1,257,198 MWHs and similar renewable energy production levels, it is estimated that 20.2% of Columbia’s electric portfolio will come from existing renewable resources in 2023.

	<b>Location</b>	<b>Amount of Energy</b>	<b>% of System Load</b>	<b>Cost</b>
Bluegrass Ridge	King City, MO	12,693 MWH	1.0%	70.34 \$/MWH
Crystal Lake Contract #1	Hancock County, IA	33,112 MWH	2.6%	27.59 \$/MWH
Crystal Lake Contract #2	Hancock County, IA	141,912MWH	11.3%	26.21 \$/MWH
Jefferson City Landfill gas	Jefferson City, MO	22,000 MWH	1.7%	53.05 \$/MWH
Columbia Landfill gas	Columbia, MO	16,970 MWH	1.3%	43.99 \$/MWH
Net-Metered Customer Production	Columbia, MO	6,500 MWH	0.5%	37.46 \$/MWH
West Ash Solar Field	Columbia, MO	350 MWH	0.0%	67.27 \$/MWH
Truman Solar	Columbia, MO	22,593 MWH	1.8%	44.81 \$/MWH
<b>TOTAL</b>	<b>—</b>	<b>256,130 MWH</b>	<b>20.2%</b>	<b>—</b>

## Summary

Columbia Water & Light strives to provide reliable, cost-effective service while achieving City of Columbia environmental and renewable energy goals. In 2022, CWL surpassed the goal of providing 15% renewable energy and is planning for future expansion of renewables on our grid. Market forces will impact CWL's energy portfolio, presenting new and unforeseen challenges. It will be important that the utility remains adaptable to those market forces as CWL transitions to a cleaner energy future.

Although a shortfall in renewable energy is anticipated in 2023, CWL projects that existing power purchase agreements along with planned expansion of renewables will place the utility ahead of ordinance requirements in the coming years. While existing renewable energy plans target the current Renewable Energy Standard, the utility is planning for a possible greater expansion of renewables through the ongoing effort to evaluate options associated with the City adopting a 100% renewable energy by 2030 goal. This evaluation will inform the City on future expansions of renewable energy supply. CWL has plans in place that will allow the Utility to reach approximately 48% renewables by 2028, exceeding the minimum of 30% required by 2029 for the current Renewable Energy Standard.

Energy price increases accelerated in 2022, resulting in significant impacts on the cost of renewable energy. Congestion on the electric grid impacted energy prices in the MISO market, which contributed to higher costs for CWL. Higher costs could persist for the foreseeable future, and CWL will need to evaluate these impacts when considering energy supply options.

To continue the trend of increasing renewables in an ever changing environment, it will require significant commitment and planning. As the City of Columbia looks to the future of energy supply, long-term goals laid out in the Renewable Portfolio Standard, Climate Action and Adaptation Plan and ongoing evaluation of the 100% renewable energy goal will guide the utility in future planning and resource selection.

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**

<b>Period</b>	<b>Fixed Rate (\$/MWH)</b>
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>.

### 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%
<b>TOTAL</b>	<b>1,218,313</b>	<b>10,989</b>	<b>30,664</b>	<b>76,414</b>	<b>18,365</b>	<b>22,422</b>	<b>14,583</b>	<b>4,439</b>	<b>346</b>	<b>178,223</b>	
<b>% of System</b>		<b>0.90%</b>	<b>2.52%</b>	<b>6.27%</b>	<b>1.51%</b>	<b>1.84%</b>	<b>1.20%</b>	<b>0.36%</b>	<b>0.03%</b>	<b>14.63%</b>	

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



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

## 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	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%
<b>TOTAL</b>	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%
<b>% of Total</b>	-	0.95%	2.62%	6.76%	1.24%	1.87%	0.02%	0.17%	0.03%	1.99%	-	-

### 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%
<b>TOTAL</b>	1,170,456	13,167	34,120	97,148	16,676	21,245	328.00	674.00	427.00	183,785	-
<b>% of Total</b>	-	1.12%	2.92%	8.30%	1.42%	1.82%	0.02%	0.06%	0.04%	15.70%	-