



# **2013 Renewable Energy Report**

calendar year 2012 data & forecast for 2013

**February 2013**

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# 2013 Renewable Energy Report

## Columbia Water & Light

In November 2004, Columbians approved a renewable energy ordinance for the city's power supply portfolio. The ordinance mandates Columbia Water & Light purchase increasing levels of energy from renewable resources. Each year, the utility is required to submit a plan outlining compliance with the ordinance. The Water & Light Advisory Board and the Environment and Energy Commission review the report before it goes to the Columbia City Council for a public hearing.

### Summary

Columbia Water & Light has been pursuing renewable energy sources since the mandate was passed by voter approval in 2004. In 2012, Columbia had 7.94% of the electric portfolio generated from renewable sources. This amount exceeds the requirement for 2012 of 2% by 5.94%. The following is a summary of the renewable energy accomplishments:

- 2005: The first renewable energy was delivered to Columbia through a short-term contract for landfill gas energy from Illinois.
- 2007: Columbia started receiving wind energy from Bluegrass Ridge.
- 2008: The landfill gas to energy project was completed in Columbia. The Columbia Power Plant started burning waste wood along with coal. The Solar One program was launched.
- 2009: Columbia started receiving landfill gas energy from Jefferson City.
- 2010: Three additional solar projects were added to the Solar One program.
- 2011: Columbia started receiving solar energy through a long-term contract with the Free Power Company.
- 2012: Columbia started purchasing wind energy from Crystal Lake.

### Renewable Energy Ordinance

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

1. 2% of electric retail sales by December 31, 2007
2. 5% of electric retail sales by December 31, 2012
3. 10% of electric retail sales by December 31, 2017
4. 15% of electric retail sales by December 31, 2022

The cost of the renewable energy mandated in the ordinance must not increase electric rates more than 3% higher than the electric rates attributed to the cost of electricity generated from 100% non-renewable sources. The full text of the Renewable Energy Standard and the approved list of renewable resources are listed in the appendix of this report.

## 2012 Renewable Energy Portfolio Overview

Month	System Total MWH	Bluegrass Wind MWH	Columbia Landfill MWH	Waste Wood MWH	Jeff City Landfill MWH	Crystal Lake Wind MWH	Solar MWH	TOTAL Renew MWH	Monthly % of System	Annual % of System
1-12	97,016	1,764	1,260	1,201	2,219	0	5.7	6,450	6.6%	6.6%
2-12	87,788	1,352	1,261	1,129	2,057	1,496	8.7	7,303	8.3%	7.4%
3-12	86,349	1,730	1,442	693	1,661	8,646	19.6	14,192	16.4%	10.3%
4-12	81,262	1,331	1,334	0*	1,887	9,014	21.2	13,584	16.7%	11.8%
5-12	99,813	1,323	1,218	0*	1,749	7,483	28.5	11,791	11.8%	11.8%
6-12	111,843	1,218	1,227	0*	1,658	2,177	29.3	6,310	5.6%	10.6%
7-12	137,598	734	1,328	542	1,551	935	27.8	5,118	3.7%	9.2%
8-12	120,822	661	1,326	1,234	1,719	873	28.4	5,841	4.8%	8.6%
9-12	93,415	756	1,140	722	1,476	885	31.1	5,010	5.4%	8.3%
10-12	86,334	1,418	1,156	443	1,890	1,576	23.0	6,506	7.5%	8.2%
11-12	83,778	1,324	1,300	0*	1,702	1,467	27.9	5,821	6.9%	8.1%
12-12	94,136	1,246	1,248	0*	1,860	1,447	19.8	5,821	6.2%	7.9%
Total MWH	1,180,154	14,844	15,240	5,964	21,429	35,998	271	93,746		
% of Total		1.26%	1.29%	0.51%	1.82%	3.05%	0.02%	7.94%		

NOTE: The amounts listed in this chart are subject to revisions while the costs associated with the energy are being finalized.

\*Waste wood was not used at the Columbia Power Plant while it was down for maintenance and a condition assessment in the spring and during the fall, natural gas was used to generate electricity.

Columbia system load: 1,180,154 megawatt hours

Renewable energy total: 93,746 megawatt hours or 7.94%

- Bluegrass Ridge wind energy: 1.26% of electric system @ \$67.58/MWH
- Columbia landfill gas: 1.29% of electric system @ \$47.38/MWH
- Waste wood (fuel cost only): 0.51% of electric system @ \$36.09/MWH
- Jefferson City landfill gas: 1.82% of electric system @ \$53.15/MWH
- Crystal Lake II wind energy: 3.05% of electric system @ \$39.46/MWH
- Solar: 0.02% of the electric system @ \$54.95/MWH. (does not include Solar One energy sources)

## 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 City of Columbia has a fiscal year that does not match the calendar year outlined in the Renewable Energy Standard. The maximum dollar amount would be 3% times the total revenue from sources impacted by rate changes during the calendar year. Renewable energy costs for this report include information from the January through September period of the prior fiscal year along with the October through December information from the current fiscal year. For calendar year 2012, the additional cost of renewable energy was \$1,151,716 and the limit was \$3,219,624, as outlined in the following tables. The extra money spent on renewable energy was 35.8% of what was allowed according to the ordinance.

## Cost of 2012 Renewable Energy Portfolio

Renewable Resource	Impact on Rates
Columbia landfill	\$(16,916)
Jefferson City landfill (Ameresco)	\$99,859
Bluegrass Ridge wind (Associated Electric)	\$668,385
Crystal Lake wind (NextEra Energy)	\$606,926
Solar (Free Power)	\$6,133
Wood at Columbia Power Plant	(\$212,671)
<b>Total Impact on Rates</b>	<b>\$1,151,716</b>

## Maximum Renewable Portfolio Cost Calculations

Revenue Source	January – September (FY12)	October – December (FY13)
Residential	\$35,443,189	\$8,747,906
Commercial/Industrial	\$40,704,325	\$12,084,281
Street Lights	\$390,028	\$130,844
Public Authority	\$6,542,979	\$2,047,884
Inter-Departmental	\$937,063	\$292,300
Total Revenue During Calendar Year 2012		\$107,320,799
<b>3% Impact Limit on Rates</b>		<b>\$3,219,624</b>

## Calculating Renewable Energy Costs

Renewable and non-renewable energy prices are divided into resources with similar characteristics compared and evaluated according to these similar characteristics.

1. Base Load Resources
  - a. A dispatchable resource that provides capacity and energy at a high capacity factor, on a year-round basis.
  - b. Current non-renewable base load resources
    - i. Sikeston
    - ii. Nearman
    - iii. Iatan II
    - iv. Prairie State – units 1 and 2
  - c. Current renewable base load resources
    - i. Columbia landfill gas plant
    - ii. Ameresco landfill gas plant contract
  - d. All-in cost (capacity, energy and transmission) comparisons are calculated for a monthly average cost per megawatt hour. The cost per megawatt hour variance between each renewable resource and non-renewable resources are applied to the total monthly megawatt hour output of each renewable resource to determine the annual renewable cost variation. The average non-renewable cost in 2012 was \$48.49/MWH
    - i. Columbia landfill gas plant
      - Produced 15,240 megawatt hours
      - The average cost is \$47.38/MWH
    - ii. Ameresco landfill gas plant
      - Produced 21,429 megawatt hours
      - The cost is \$53.15/MWH
2. Intermittent Resources
  - a. A limited or non-dispatchable resource that may provide capacity and energy.
  - b. Current renewable intermittent resources
    - i. Bluegrass Ridge wind
    - ii. Crystal Lake wind
  - c. All-in cost (energy and transmission) for Bluegrass Ridge will be compared to the Midwest Independent System Operator's (MISO) hourly day-ahead, the Locational Marginal Price (LMP) for energy at the Columbia pricing node for the megawatt hours of intermittent resource produced during the hour. The renewable cost per megawatt hour

will include any additional fees invoiced under the contract, which are primarily transmission costs. The cost per megawatt hour variance between the renewable energy and the market energy will be applied to the total megawatt hour output of the renewable resources to determine the annual renewable cost variation. For calendar year 2012, the average day-ahead LMP for the hours when the Bluegrass Ridge wind resource was producing energy was \$22.62 per megawatt hour.

For Crystal Lake III, the calculation is the same as Bluegrass Ridge with some differences. Crystal Lake III is located within MISO so there is no fixed transmission charge. In addition, the contract requires Columbia Water & Light to pay for "deemed" energy. Deemed energy is energy that would have been produced had Columbia Water & Light not requested production curtailment due to a negative LMP. Columbia Water & Light currently requests curtailment at negative ten dollars (-\$10.00). In addition, the LMP at the Crystal Lake III delivery point is subtracted from the contract price thereby reducing the contract price. For calendar year 2012, the average day-ahead Columbia Water & Light LMP cost for the hours when the Crystal Lake III wind resource was producing energy was \$22.60 per megawatt hour.

- i. Bluegrass Ridge wind
      - Produced 14,844 megawatt hours
      - The cost is \$67.58/MWH of which \$44.96/MWH represents the additional renewable expense per MWH.
    - ii. Crystal Lake III wind (NextEra)
      - Produced 35,998 megawatt hours
      - The cost is \$39.46/MWH of which \$16.86 represents the additional "renewable" expense per megawatt hour.
  3. Load Following and/or Ancillary Service Resources
    - a. The Columbia Power Plant is a resource that serves multiple functions. This resource does not provide energy production on a year round basis and should not be considered as a base load resource. For comparison of non-renewable and renewable energy costs, only the variation in the cost of fuel will be utilized for this resource. Adjustment will be made for BTU content of each fuel source to determine a cost per megawatt hour. The variance between the cost per megawatt hour of non-renewable fuel and cost per megawatt hour of renewable fuel will be applied to the total megawatt hour output attributed to the renewable fuel to determine the annual renewable cost variation.
      - i. Energy cost of coal is \$71.63/MWH
      - ii. Energy cost of wood
        - Produced 5,964 megawatt hours
        - The cost is \$36.09/MWH
  4. Peaking Resources
    - a. All electric utilities are required to maintain resources to meet the megawatt system peak requirements plus a reserve requirement. This capacity requirement is typically met with the lowest cost resource available. The cost is calculated and/or paid on a per megawatt basis, not on a megawatt hour basis. These resources fulfill a specific requirement that typically does not include energy production. Non-renewable capacity resources are the Columbia Energy Center, two natural gas generators at the Columbia Power Plant and Columbia's distributed generation projects. There are no renewable resources that are in place only for capacity purposes. For the purpose of evaluating non-renewable versus renewable energy costs, capacity resources are excluded from the calculations.
  5. The total additional cost of renewable energy is the sum of the calculations described in section 1, 2 and 3 above.

## 2012 Renewable Energy Portfolio Details

### 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 from the Bluegrass Ridge Wind Farm from Associated Electric Cooperative. At the maximum output, Columbia Water & Light could receive up to 6.3 megawatts. In 2012, Columbia received 14,844 megawatt hours of power from this contract or 1.26% of the electric portfolio. 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 2012 for wind power from the Bluegrass Ridge Wind Farm was \$67.58.

### **Columbia Landfill Gas**

The Columbia Landfill Gas Energy Plant was constructed within the \$3 million budgeted amount through the 2006 bond issue. Electricity is generated by using the gas created from decomposing waste at the landfill. It can currently generate 2.1 megawatts of renewable power. In 2012, the landfill gas plant produced 15,240 megawatt hours of energy which was 1.29% of Columbia's energy portfolio at a total cost of \$47.38 per megawatt hour. The amount of energy received from the Columbia Landfill Gas Energy Plant is fairly consistent aside from times when there is routine maintenance work.

There are plans to add another one megawatt generating unit at the landfill in 2013 since the amount of gas being generated has gone up with the addition of a bioreactor at the landfill. With the addition of the third generator it is expected to produce 23,000 megawatt hours a year which will be approximately 1.9% of the electric portfolio. After this unit is added, there is still room for a fourth generator. With four generators, electric production could grow to over 2.5% of Columbia's energy portfolio over the next several years.

### **Wood Fuel at the Columbia Power Plant**

Columbia Water & Light started burning waste wood along with coal at the local power plant in 2008. The wood chips are purchased from a barrel production plant in Lebanon, Missouri. The wood is a by-product of creating the curved planks so they are considered a carbon neutral energy source. Using this form of biomass has allowed the utility to lower emissions and rate the effectiveness of a biomass fuel source.

In 2012, the Columbia Power Plant produced 4.7% of the city's electric portfolio. In the spring the plant was not producing electricity while it was down for maintenance and a condition assessment. In November and December, natural gas was used instead of coal to generate electricity. Only 3.5% of Columbia's energy was produced from burning coal and waste wood at the plant and the rest was from natural gas. Of the coal/wood electricity produced, the city is using a 14.7% mixture of waste wood along with the coal. The energy produced by waste wood was 5,964 megawatt hours which is 0.51% of Columbia's electric portfolio.

The fuel cost per megawatt hour of power produced for waste wood was \$36.09 while coal during that same time period was \$71.63. Determining the other related costs of producing energy from waste wood is complicated. The Columbia Power Plant is used as a capacity resource and provides a number of different functions. The plant does not have one dedicated function like the Columbia landfill gas plant. The operations and maintenance costs are not accounted for by the generating unit and the fuel type at the Columbia Power Plant. The operations and maintenance costs for wood and coal are similar. The fuel cost for waste wood is lower than coal so using a wood mixture is a cost effective option for the utility at this time. Moving to a higher percentage of waste wood would require changes to the existing coal handling equipment.

There are several older generating units at the Columbia Power Plant that will need to be upgraded, replaced or retired to meet future regulatory requirements. Columbia Water & Light has completed research to determine the options available and the cost of the upgrades. The Biomass Combustion and Multi-Pollutant Emission Study was completed in 2011. It showed that the equipment could be updated to meet future regulations and to burn biomass. To further evaluate the effectiveness of burning more biomass at the plant, test burns were conducted in 2012. A condition assessment report of the existing equipment at the plant is being finalized. This research will help determine the cost of the upgrades and determine if it is feasible to change the fuel source of the generating units. These studies will be reviewed by the Water & Light Advisory Board in 2013 so they can make a recommendation on the best long-range plan to meet capacity and energy requirements while being compliant with new environmental regulations.

### **Jefferson City Landfill Gas**

Columbia Water & Light has a 20-year power purchase agreement with Ameresco for 3.2 megawatts 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 2012 was 21,429 megawatt hours which is 1.82% of the electric portfolio. The utility pays \$53.15 per megawatt hour for the electricity. Both Columbia and Jefferson City are located within the Midwest Independent System Operator's territory so transmission fees do not substantially change the cost of the energy.

### **Crystal Lake Wind Energy**

In early 2012, the Columbia City Council signed a contract for wind energy from NextEra Energy Resources, LLC. The 20 year contract is for power produced at the Crystal Lake III Wind Energy Center located in Hancock County, Iowa. The agreement is for 21 megawatts which could produce around 60,000 megawatt hours in one year. The fixed cost of the wind energy delivered to Columbia starts at \$42.50 per megawatt hour and then increases to \$43.50 in 2013, \$44.50 in 2014 and \$45.00 in 2015 for the remaining years of the contract. The total amount of energy received from this contract for the Columbia Water & Light system in 2012 was 35,998 megawatt hours which represents 3.05% of the electric supply.

This long-term contract allows Columbia Water & Light to lock in a favorable price for wind energy to meet future renewable energy requirements. In March, April and May of 2012, the city received the first 21 megawatts of output from the entire wind farm. Columbia Water & Light does not need an additional intermittent power resource at this time so the University of Missouri started purchasing half of the contracted energy in June 2012. This arrangement can be terminated by either party at any time.

### **Solar One**

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. At the time the program was started the price of solar panels did not fall below the cost threshold in the renewable energy ordinance. This prohibited the utility from starting projects with rate payer funds so the voluntary program was established. Solar One helped the community start developing local projects which lead to Columbia receiving national attention for being a supporter of solar energy.

Energy for the Solar One program is generated through solar systems located on city-owned property or at Columbia businesses. Columbia Water & Light partners with local businesses since commercial buildings have large roof tops with good solar exposure. Businesses can also take advantage of incentives for installing solar panels that are not available to the utility. After the business installs a system, Columbia Water & Light purchases the solar energy through a power purchase agreement. The cost of these power purchase agreements is paid for by customers who voluntarily pay an extra \$3.35 a month.

In fiscal year 2012 the installations at the West Ash Water Pumping Station, Quaker Oats and Bright City Lights were rated at 0.0368 megawatts and produced 46.2 megawatt hours of electricity. Subscriptions to the Solar One program raised \$9,507.30 and the purchased power costs were \$9,314.46. The money raised by Solar One donations is kept within the Solar One account and is not used for other utility or city projects. Due to the addition of Free Power solar energy projects, Columbia Water & Light's staff is reviewing the Solar One program and researching different options for customer based solar energy programs.

### **Free Power**

The Columbia City Council approved a lease agreement with the Free Power Company, Inc. in December 2010. The contract stipulates that Free Power will purchase and install photovoltaic systems in Columbia. The city is responsible for determining sites, preparing the sites and providing the electric system connection point. In 2012, the Free Power solar projects produced 241.6 megawatt hours which is 0.02% of Columbia's electric portfolio. The energy purchased from Free Power Company cost \$54.95 per megawatt hour. Once there are enough projects to generate 12,000 megawatt hours, there will be an annual cost escalation rate of 1.75%. In 2012, solar installations were done at the COLT Railroad's Transload Facility. The roof installation is rated at 0.2278 megawatts and the ground system is rated at 0.1044 megawatts.

The goal is to develop the Free Power Company's solar projects in stages. Developing solar projects with the Free Power Company involves many steps. A potential site is determined by identifying solar orientation and access, estimated solar output and other beneficial site characteristics. Once a site is agreed upon for development by Columbia Water & Light and Free Power, site plans are prepared, reviewed by various city departments and a cost analysis is determined for the electric interconnection. After a project has been approved to proceed, the site is prepared for the installation and the materials needed for the project are procured by both the utility and the Free Power Company.



Columbia Water & Light staff has been working with Free Power to potentially develop solar installations at the following sites:

1. COLT Transload (roof & ground mounted) - more to be added in 2013
2. Columbia Energy Center
3. West Ash Water Pumping Station
4. Creasy Springs Road property
5. Waste Water Treatment Plant
6. Landfill Buffer area

## **Renewable Energy Education**

### **Advancing Renewables in the Midwest**

On March 26, 2012, the 7<sup>th</sup> annual Advancing Renewables in the Midwest conference hosted 177 attendees. Key note speaker Mark Jacobson from Stanford University spoke about how renewable energy is the foundation of a sustainable economy. Other topics at the conference were rebuilding with renewable energy in Greensburg, Kansas, Mid-Missouri's first electricity from farm waste project and the deployment of large scale solar projects in Columbia. This 7<sup>th</sup> annual conference was hosted by Columbia Water & Light, the University of Missouri's Department of Soil, Environmental and Atmospheric Sciences and the Missouri Department of Natural Resources. The 2013 conference will be held at the University of Missouri on March 28.

### **Columbia Area Career Center**

Energy from the sun is helping to power the Columbia Career Center and provide a learning opportunity for its students. In 2007, Columbia Water & Light purchased photovoltaic panels for the Columbia Area Career Center. Students are now using the solar data in their studies of science and technology. The 2 kilowatt photovoltaic system installed by Columbia Water & Light generates around 2,700 kilowatt hours of electricity for the building. There are also six, 10-watt solar panels and one, 50-watt solar module at this site. Information about the amount of solar radiation, temperature, wind speed and humidity are all available to the students at the Columbia Career Center. The solar production amounts can be found on the City of Columbia's Web site at [www.GoColumbiaMo.com](http://www.GoColumbiaMo.com) although the service will be down for the first part of 2013.

## **Customer Based Renewable Energy Projects**

Columbia Water & Light has several programs to encourage electric customers to invest in private renewable energy systems.

### **Net Metering**

The Columbia City Council passed an ordinance in 2007 to allow customers to enter into a net metering agreement with Columbia Water & Light. There are currently nine net metering sites;

1. One solar system rated at 1.175 kilowatts
2. One solar system rated at 1.44 kilowatts
3. One solar system rated at 1.62 kilowatts
4. One solar system rated at 2 kilowatts
5. Two solar systems rated at 2.1 kilowatts
6. One solar system rated at 2.16 kilowatts
7. One solar system rated at 3.8
8. One wind system at 11 kilowatts

A net metering arrangement keeps track of the amount of electricity being consumed or being produced for the Columbia system by the customer. At the end of the month, the customer is billed for the difference or the 'net' amount of electricity used over the month's time. Columbia Water & Light credits the net metering customer's account for the electricity provided to the Columbia system. Solar systems provide energy during peak summer conditions so this energy is reimbursed at the customer's electric rate. The wind net metering credit is based upon the avoided average energy market price at the Columbia pricing node.

### **Solar Rebates**

Columbia Water & Light offers a one-time \$500 per kilowatt rebate for qualifying photovoltaic systems up to ten kilowatts. If a customer is installing a larger system, they can appeal to the Columbia City Council to allow a larger rebate. Customers installing a solar water heating system can qualify for up to \$800 in rebates. From 2007 through the end of 2012, \$23,667 has been awarded in solar rebates by the utility, \$9,667 for photovoltaic systems and \$14,000 for solar water heaters. Columbia Water & Light is

expecting more customers to take advantage of these programs as solar technology improves and the cost of the systems go down.

### Future Renewable Energy Projects

It is estimated that over 6% of Columbia's electric portfolio will come from renewable resources in 2013. This will surpass the renewable energy ordinance mandate of 5%. Depending on when in 2013 the third generator at the Columbia Landfill is added, the estimated amount of renewable energy in 2013 could be more.

#### 2013 Estimated Renewable Portfolio

Project	Location	Amount of Energy	%of Portfolio	Cost
Bluegrass Ridge wind energy	King City, MO	14,800 MWH	1.25%	\$67/MWH
Jefferson City landfill gas	Jefferson City, MO	22,000 MWH	1.86%	\$53/MWH
Columbia landfill gas	Columbia, MO	18,000 MWH	1.53%	\$48/MWH
Waste wood at local power plant	Columbia, MO	9,000 MWH	0.76%	\$36/MWH *
Free Power Solar	Columbia, MO	1,000 MWH	0.8%	\$55/MWH
Crystal Lake wind energy	Hancock County, Iowa	17,000 MWH	1.44%	\$40/MWH

\*Wood generated energy costs are only for the fuel source

# Appendix

## Historical Renewable Energy Data

### 2007 Renewable Energy Overview

Month	Total System MWH	Wind MWH	Columbia Landfill MWH	Waste Wood MWH	Jeff City Landfill MWH	Total Renew MWH	Monthly % of System	Annual % of System
9-07	104,618	592				592	0.6%	
10-07	91,357	1,030				1,030	1.1%	
11-07	84,135	1,153				1,153	1.4%	
12-07	97,985	969				969	1.0%	
<b>TOTAL</b>	<b>378,095</b>	<b>3,744</b>				<b>3,744</b>		

### 2008 Renewable Energy Overview

Month	System Total MWH	Wind MWH	Columbia Landfill MWH	Waste Wood MWH	Jeff City Landfill MWH	Solar MWH	Total Renew MWH	Monthly % of System	Annual % of System
1-08*	102,167	1,080					1,080	1.1%	1.1%
2-08*	95,852	671					671	0.7%	0.9%
3-08*	89,178	798					798	0.9%	0.9%
4-08*	83,215	782		158			940	1.1%	0.9%
5-08*	85,467	485		185			670	0.8%	0.9%
6-08*	104,001	321	672	802			1,795	1.7%	1.1%
7-08*	116,895	250	874	594			1,718	1.5%	1.1%
8-08*	111,956	229	1,279	821			2,329	2.1%	1.3%
9-08*	92,891	539	1,204	765			2,508	2.7%	1.4%
10-08	83,693	1,169	998	243		0.265	2,410	2.9%	1.5%
11-08	82,509	646	1,216	0		0.362	1,862	2.3%	1.6%
12-08	98,719	1,205	1,039	334		0.294	2,578	2.6%	1.7%
<b>TOTAL</b>	<b>1,146,543</b>	<b>8,128</b>	<b>7,282</b>	<b>3,902</b>	<b>0</b>	<b>1</b>	<b>19,313</b>		

\* Starting in January 2008 there were cracked blades on the wind turbines which lowered production amounts by approximately 5,557 megawatt hours.

Note: Solar energy amounts were not included in the totals due to the small amount.

### 2009 Renewable Energy Overview

Month	System Total MWH	Wind MWH	Columbia Landfill MWH	Waste Wood MWH	Jeff City Landfill MWH	Solar MWH	Total Renew MWH	Monthly % of System	Annual % of System
1-09	101,445	979	1,167	853		0.369	2,999	3.0%	3.0%
2-09	83,491	933	1,043	670		0.459	2,646	3.2%	3.1%
3-09	84,038	2,807	1,236	146		0.643	4,189	5.0%	3.7%
4-09	80,857	3,208	1,216	0	1,220	0.610	5,644	7.0%	4.4%
5-09	84,508	2,696	1,083	379	1,427	0.807	5,585	6.6%	4.8%
6-09	104,689	761	1,181	75	1,711	0.831	3,728	3.6%	4.6%
7-09	106,500	480	1,145	175	1,583	0.812	3,383	3.2%	4.4%
8-09	107,081	691	1,113	102	1,729	0.746	3,635	3.4%	4.2%
9-09	89,941	533	402	576	1,590	0.606	3,101	3.4%	4.1%
10-09	83,335	1,279	44	854	1,769	0.373	3,946	4.7%	4.2%
11-09	79,725	1,439	695	76	1,849	0.356	4,059	5.1%	4.3%
12-09	99,645	992	551	1,265	1,352	0.221	4,160	4.2%	4.3%
<b>TOTAL</b>	<b>1,105,255</b>	<b>16,798</b>	<b>10,876</b>	<b>5,171</b>	<b>14,227</b>	<b>7</b>	<b>47,079</b>		

In 2008, the amount of wind energy Columbia received was low due to some of the turbine blades cracking. Due to this shortfall of energy, Associated Electric Cooperative provided the first 6.3 MW of energy produced from the wind farm for March, April and May of 2009 and again in January, February and March of 2010.

### 2010 Renewable Energy Overview

Month	System Total MWH	Wind MWH	Columbia Landfill MWH	Waste Wood MWH	Jeff City Landfill MWH	Solar MWH	Total Renew MWH	Monthly % of System	Annual % of System
1-10	106,770	2,088	1,090	1,119	982	0.233	5,279	4.9%	4.9%
2-10	92,910	2,132	1,112	734	1,656	0.352	5,634	6.1%	5.5%
3-10	86,980	3,327	1,219	623	2,002	0.539	7,172	8.2%	6.3%
4-10	80,544	1,798	1,151	368	1,914	0.694	5,232	6.5%	6.3%
5-10	90,412	1,018	1,135	0	2,212	0.735	4,366	4.8%	6.0%
6-10	114,129	746	1,253	367	1,846	0.781	4,213	3.7%	5.6%
7-10	123,263	523	1,127	495	1,556	0.741	3,702	3.0%	5.1%
8-10	128,815	688	911	773	1,890	0.819	4,263	3.3%	4.8%
9-10	95,840	1,154	832	804	1,744	1.372	4,535	4.7%	4.8%
10-10	83,554	1,107	966	690	2,037	1.335	4,801	5.7%	4.9%
11-10	81,674	1,691	1,196	866	2,058	1.262	5,812	7.1%	5.1%
12-10	100,461	1,068	1,060	593	1,811	0.541	4,533	4.5%	5.0%
<b>TOTAL</b>	<b>1,185,352</b>	<b>17,340</b>	<b>13,052</b>	<b>7,432</b>	<b>21,708</b>	<b>9</b>	<b>59,541</b>		

In 2008, the amount of wind energy Columbia received was low due to some of the turbine blades cracking. Due to this shortfall of energy, Associated Electric Cooperative provided the first 6.3 MW of energy produced from the wind farm for March, April and May of 2009 and again in January, February and March of 2010.

### 2011 Renewable Energy Portfolio Overview

Month	System Total MWH	Bluegrass Wind MWH	Columbia Landfill MWH	Waste Wood MWH	Jeff City Landfill MWH	Solar MWH	Total Renew MWH	Monthly % of System	Annual % of System
1-11	104,370	1,050	1,255	950	2,018	0.7	5,274	5.1%	5.1%
2-11	89,644	1,369	1,043	1,305	1,931	1.2	5,649	6.3%	5.6%
3-11	88,683	1,358	1,269	1,380	2,220	1.9	6,229	7.0%	6.1%
4-11	79,860	1,646	1,187	985	1,685	2.4	5,505	6.9%	6.2%
5-11	88,794	1,363	1,301	0	2,099	2.8	4,766	5.4%	6.1%
6-11	111,595	1,312	771	814	1,510	3.2	4,410	4.0%	5.7%
7-11	137,604	631	1,133	1,389	1,632	3.3	4,788	3.5%	5.2%
8-11	124,170	531	1,116	1,929	1,956	3.0	5,535	4.5%	5.1%
9-11	90,389	874	604	1,350	1,679	2.7	4,510	5.0%	5.1%
10-11	84,257	1,260	1,344	497	1,870	2.4	4,973	5.9%	5.2%
11-11	81,591	1,968	1,299	37	2,033	1.1	5,338	6.5%	5.3%
12-11	92,894	1,407	1,362	1,182	2,215	3.0	6,170	6.6%	5.4%
TOTAL	1,173,851	14,769	13,684	11,818	22,848	28	63,148		

## Approved Sources of Renewable Energy

The following sources of renewable energy were approved by the Columbia City Council in March 2006 as sources of compliance with the Renewable Energy Standard ordinance.

**Wind Energy:** All electricity generated through wind power would qualify as a renewable resource, including wind energy that is stored in any form for later use as electrical power.

**Solar Energy:** All active solar energy systems would qualify as a renewable resource, including solar photovoltaics, solar water heating, solar space heating, and any other method of using the sun that requires 'active' collection techniques. In this regard 'passive' solar heating, or systems which do not employ the use of mechanical equipment to move or distribute the heat, would not be considered as eligible items.

**Biomass Energy:** Biomass energy is typically considered to be derived from plants which have accumulated solar energy through photosynthesis. This definition, however, is somewhat open-ended as virtually all our current fossil fuels are derived from plants, even though their life span may have occurred in the geologic past. To create a definition of biomass that would correspond with its commonly understood meaning, biomass energy is considered to be energy derived from plant origin, considering only those plants that have been harvested within the recent past, certainly within the last 100 years.

Columbia Water & Light suggests that eligible biomass energy specifically include (but not be limited to) the following materials:

- Landfill Gas
- Paper based products, such as cardboard and newsprint
- Wood and wood wastes
- Cellulose based products that originate from trees or shrubbery
- Other materials that come directly from trees or plants.

In the event that an energy source would be derived from a mixture of biomass and other non-renewable materials Columbia Water & Light would make a rigorous assessment to determine what energy content of the fuel is biomass derived, and only claim that portion for compliance with the renewable energy ordinance.

**Hydropower:** By all definitions, hydropower fits the definition of renewable power in that it is renewed by the earth's water cycle.

**Geothermal Power:** Columbia Water & Light considers that geothermal power, or any energy that may be extracted from the earth, is eligible as a renewable resource. This would only be in reference to active mechanical systems that extract the heat energy from the earth. Passive systems would not be eligible under this definition. It would be the utility's responsibility to provide details on what constitutes energy provided through geothermal power on a case-by-case basis.

**Green Tags:** The Green Tag system that has originated throughout the country allows a utility to make purchases of Green Tags and thus participate in the development of green, or renewable, energy without actually receiving that energy in the utility's system. In such situations the developer of the renewable resource is paid an agreed-to amount for the Green Tag for each Megawatt-hour sold; however, the electricity is not delivered to the utility. Thus Green Tags simply represent the value of the renewable portion of the project or the premium that is above the cost of conventional electricity project. Green Tags are commonly sold and traded across the US.

Although this works for other utilities, Columbia Water & Light has every intention of complying with the renewable energy ordinance by finding sources located close enough to Columbia that the power can be transmitted into our system. In the future, however, the higher compliance requirements may force the utility to look at Green Tags as an option. Columbia Water & Light would pursue this avenue only as a last resort and would seek approval before purchasing renewable energy in this manner.

**Future Projects:** The above list is not intended to be final because there may be new sources of power that could be a renewable resource in the future. Columbia Water & Light could come back to the city's governing bodies in the future should a new renewable resource come available.

## **Sec. 27-106. Renewable energy standard**

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

- (1) Two (2) percent of electric retail sales (kWhs) by December 31, 2007;
- (2) Five (5) percent of electric retail sales (kWhs) by December 31, 2012;
- (3) Ten (10) percent of electric retail sales (kWhs) by December 31, 2017; and
- (4) Fifteen (15) percent of electric retail sales (kWhs) by December 31, 2022.

(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 nonrenewable sources).

(c) Eligible renewable energy generation may be provided by wind power, solar energy, bio-energy sources or other renewable sources which meet the environmental criteria approved by the city council after review by the environment and energy commission and the water and light advisory board. Electricity purchased 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 environment and energy commission and water and light advisory board and submitted to the city council for approval following a public hearing.

(Ord. No. 18196, § 1, 8-16-04)

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

**Secs. 27-107--27-110. Reserved.**

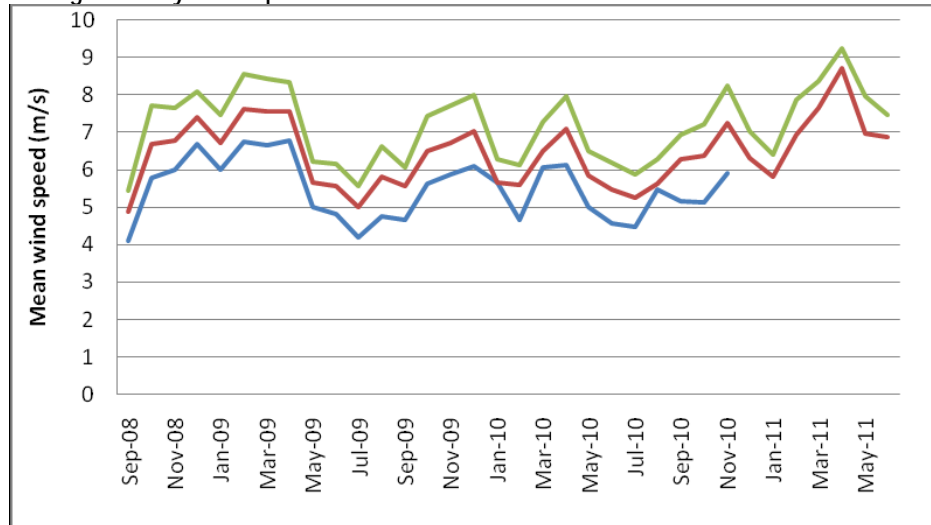


## Columbia Wind Speed Study

The University of Missouri's Atmospheric Sciences Department collected wind speed data for the City of Columbia at the KOMU tower on Columbia's south side from 2008 through 2011. The anemometers are no longer collecting accurate data so the study was ended.

The data was collected to evaluate the wind speeds for utility scale wind generation in Columbia. The site for the anemometers was placed in an open area of land with minimal obstructions at two different heights. In each case it can be seen that the average annual wind speed observed at the tower sites is significantly lower than that estimated in the AWS Truewind map of Missouri. The difference is of the order of 0.7 meters per second at the 70 meter level and 0.4 meters per second at the 100 meter level. These differences are similar to those found at other sites around the state.

Average Monthly Wind Speed at Each Anemometer



The green line represents observations at 147 meters, the red line is for 98 meters, and the blue line shows the measurements at 68 meters.

68 Meter Tower: As time goes on the instruments suffer declining performance and those operating at the 68 m height became too inconsistent to determine accurate observations in December 2010.

Note: One meter equals 3.28 feet, one meter per second equals 2.237 miles per hour