



## **2010 Renewable Energy Report**

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## **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 starting in 2008. Each year the utility is required to submit a plan outlining compliance with the ordinance. The 2010 report was sent to the Water & Light Advisory Board and the Environment and Energy Commission for review. A public hearing before the City Council is required before the draft version of this report can be approved.

### **Summary**

Columbia Water & Light has been pursuing renewable energy sources since the mandate was passed by voter approval in 2004. In 2009, Columbia had 4.3% of the electric portfolio being generated from renewable sources. This amount exceeds the current requirement of 2%. In 2010, Columbia Water & Light is expecting to have 5% of the energy portfolio from renewable sources. 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.
- 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. Requests for proposals went out at the end of the year for the Solar One program's energy supply and for 5,000 megawatt hours per year of renewable energy.

### **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 that would be attributable to the cost of electricity generated from one hundred percent 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.

## Renewable Energy Overview

Month	Total System MWH	Bluegrass Ridge Wind MWH	Columbia Landfill MWH	Columbia Power Plant 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%	
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		2,410	2.9%	1.5%
11-08	82,509	646	1,216	0		1,862	2.3%	1.6%
12-08	98,719	1,205	1,039	334		2,578	2.6%	1.7%
1-09	101,445	979	1,167	853		2,999	3.0%	3.0%
2-09	83,491	933	1,043	670		2,646	3.2%	3.1%
3-09	84,038	2,807	1,236	146		4,189	5.0%	3.7%
4-09	80,857	3,208	1,216	0	1,220	5,644	7.0%	4.4%
5-09	84,508	2,696	1,083	379	1,427	5,585	6.6%	4.8%
6-09	104,689	761	1,181	75	1,711	3,728	3.6%	4.6%
7-09	106,500	480	1,145	175	1,583	3,383	3.2%	4.4%
8-09	107,081	691	1,113	102	1,729	3,635	3.4%	4.2%
9-09	89,941	533	402	576	1,590	3,101	3.4%	4.1%
10-09	83,335	1,279	44	854	1,769	3,946	4.7%	4.2%
11-09	79,725	1,439	695	76	1,849	4,059	5.1%	4.3%
12-09	99,645	992	551	1,265	1,352	4,160	4.2%	4.3%

\* 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 produced.

## **2009 Columbia Renewable Energy Quantities**

Columbia system load: 1,105,255 megawatt hours

Renewable energy total: 47,075 megawatt hours or 4.3%

- Bluegrass Ridge wind energy: 1.5%
- Columbia Biogas: 1%
- Waste wood: 0.5%
- Jefferson City Biogas: 1.3%

## **Average Cost of Renewable Resources**

Bluegrass Ridge wind energy: \$66 per megawatt hour (includes transmission)

Columbia Biogas: \$50.50 per megawatt hour

Waste wood: \$41 per megawatt hour (fuel cost only)

Jefferson City Biogas: \$53 per megawatt hour (includes transmission costs)

## **2010 Portfolio Details**

### **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.

The amount of wind energy Columbia receives is variable, depending on the amount of wind. Due to this variability, the Midwest Independent System Operator only allows the utility to use an 8% capacity factor for wind energy.

In 2008, the amount of wind energy Columbia received was low due to some of the blades of the turbines cracking. The estimated amount of energy lost was 5,557 megawatt hours. 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. Columbia Water & Light has negotiated with Associated Electric Cooperative for the same arrangement in 2010.

The wind power contract supplied 16,800 megawatt hours in 2009 or 1.5% of Columbia's electric retail sales. The average cost of the wind energy in 2009 was \$66 per megawatt hour compared to \$74 in 2008. Transmission costs for this energy are fixed so they have less of an impact on the cost per megawatt hour when more energy is delivered to Columbia.

## Columbia Wind Energy Details

Month	MWH's Delivered	Percent of Total System Energy	Total Cost	Cost per MWH	Total Load Factor	MWH's @ 100% Load Factor
Jan 09	979	1.0%	\$68,044.06	\$69.50	20.89%	4,687.2
Feb 09	933	1.1%	\$65,349.06	\$70.04	22.04%	4,233.6
Mar 09	2,807	3.3%	\$174,359.10	\$62.12	59.89%	4,687.2
Apr 09	3,208	4.0%	\$198,339.06	\$61.83	70.70%	4,536.0
May 09	2,696	3.5%	\$168,419.06	\$62.47	57.52%	4,687.2
Jun 09	761	0.7%	\$55,339.06	\$72.72	16.78%	4,536.0
Jul 09	480	0.5%	\$38,894.06	\$81.03	10.24%	4,687.2
Aug 09	691	0.6%	\$51,214.06	\$74.12	14.74%	4,687.2
Sep 09	533	0.6%	\$41,974.06	\$78.75	11.75%	4,536.0
Oct 09	1,280	1.5%	\$85,644.06	\$66.91	27.31%	4,687.2
Nov 09	1,439	1.8%	\$94,939.06	\$65.98	31.72%	4,536.0
Dec 09	992	1.0%	\$68,814.06	\$69.37	21.16%	4,687.2

Note: "MWH's @ 100% Load Factor" is calculated by multiplying 6.3 times 24 hours times the number of days in the month. "Total Load Factor" is calculated by dividing "MWH's Delivered" by "MWH's @ 100% Load Factor". Total load factor is also referred to as the capacity factor.

## Columbia Biogas Energy Plant

The Columbia Biogas Energy Plant came online in June 2008. 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 2009, the biogas plant produced 10,876 megawatt hours of energy which was 1% of Columbia's energy portfolio. Without operation and maintenance expense, the cost of the energy was \$38 per megawatt hour.

From September through December, the landfill gas output was lower than normal. A water collection system at the Columbia landfill broke and it took some time for the Public Works Department to locate the problem and make repairs. The flooding reduced the amount of landfill gas that was available for generating electricity. The repairs have been completed and the energy production amounts went back up in January 2010.

The Columbia Biogas Energy Plant was constructed within the \$3 million budgeted amount. It was partially funded through a 2006 bond issue passed with overwhelming public support. The plant was designed for expansion. It is estimated that the new bioreactor at the landfill will increase landfill gas production within five years. Electric production could be as much as 2.5% of Columbia's energy portfolio over the next five to ten years.

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

Columbia Water & Light started a pilot project in April 2008 to evaluate burning waste wood along with coal at the local power plant. 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.

The Columbia Power Plant produces 6% of the city's electric portfolio. Of the electricity produced, the city has been using a 10% mixture of waste wood along with the coal. The energy produced by waste wood was 5,171 megawatt hours which is 0.5% of Columbia's electric portfolio. Moving to a higher percentage of waste wood would require changes to the existing coal handling equipment.

The fuel cost per megawatt hour of power produced for waste wood was \$41 while coal during that same time period was \$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 Biogas Energy Plant. Isolating the operations and maintenance costs for one fuel supply for a few of the Columbia Power Plant generating units is a very time consuming task. The operations and maintenance costs for wood and coal are similar. The fuel cost for waste wood is lower than coal so using at a 10% wood mixture is a cost effective option for the utility at this time.

### **Ameresco Biogas Plant**

Columbia Water & Light has a 20 year power purchase agreement with Ameresco for 3.2 megawatts of energy from the biogas plant at the Jefferson City landfill. Columbia started receiving energy from the plant in April 2009. The total amount received in 2009 was 14,230 megawatt hours which is 1.3% of the electric portfolio. In 2010, this amount is expected to go up since Columbia will be receiving energy over the entire year. The estimated annual electric production of 25,000 megawatt hours represents approximately 2% of Columbia Water & Light's annual energy sales. The utility is to pay a flat rate of \$52.50 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.

### **Solar Projects**

Solar energy is an abundant renewable energy resource but more costly than other options in our region. Many solar projects do not fall within the 3% cost cap in the renewable energy ordinance. However, Columbia Water & Light wanted to start developing this resource for the future. Solar One was started in November 2008 and its goal is to produce one percent of Columbia's electric portfolio from solar power in the year 2023.

Solar One energy is generated through local solar systems located on city-owned property or Columbia businesses. By partnering with local businesses, Columbia Water & Light can provide more solar energy at a lower cost. Columbia's 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.

The extra cost of providing the solar energy to the Columbia system is paid for by the voluntary subscribers to Solar One. Currently, customers can purchase 100 kilowatt hours of electricity for the year for \$48 or \$4 a month. The utility is currently selling 137 blocks of solar energy to 87 customers. A customer can purchase up to nine blocks. Participants in the Solar One program still pay the normal rate for the electricity they use and the Solar One charge of \$4 is applied in addition to that amount each month.

There is a solar production site at the West Ash Pump Station and one at Quaker Oats. Each is rated at a 5 kilowatt capacity. There were 6,522 kilowatt hours of energy produced at the utility's site last year and 6,801 kilowatt hours produced at Quaker for a total of 13,323 kilowatt hours. The current amount of solar energy being produced is a small amount so it is not counted towards the total renewable energy portfolio at this time.

Subscriptions to the Solar One program were successfully marketed and maintained throughout the year so Columbia Water & Light will increase solar energy purchases. Proposals that were submitted in January 2010 are currently being reviewed. Dow Chemical Company has also expressed an interest in installing another solar array, rated at two to five kilowatts, on city-owned property. The goal is to have 26 kilowatts of solar energy in the second year.

## **Renewable Energy Education**

### **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 two kilowatt photovoltaic system installed by Columbia Water & Light generated 2,874 kilowatt hours of electricity for the building in 2009. There were also six, 10 watt solar panels and one 50 watt solar module installed. They provide information about the amount of solar radiation, temperature, wind speed and humidity. A link to the solar production amounts can be found on the City of Columbia's Web site at [www.GoColumbiaMo.com](http://www.GoColumbiaMo.com).

### **Anemometers**

The University of Missouri's Atmospheric Sciences Department has been collecting wind speed data for the City of Columbia at the KOMU tower on

Columbia’s south side for the last year. The data is being collected to evaluate the wind speeds for utility scale wind generation in this area. The site is in an open area of land with minimal obstructions. Wind data was collected through anemometers placed at varying heights at different times during the day for a year. The wind speeds are higher between October and April and during the nighttime which do not correspond with peak energy use. The wind speeds recorded at this site are lower than the amounts listed on the Missouri Department of Natural Resources’ wind map for the state.

The average wind speed at the KOMU site was:

- 68 meters (223 feet): 5.66 meters per second
- 98 meters (321 feet): 6.49 meters per second
- 147 meters (482 feet): 7.27 meters per second.

Note: 1 meter per second = 2.237 miles per hour

#### Columbia Wind Data At KOMU Tower

Month	68 m	98 m	147 m
September 2008	4.11	4.87	5.45
October 2008	5.78	6.69	7.73
November 2008	6.01	6.79	7.64
December 2008	6.70	7.41	8.10
January 2009	6.00	6.71	7.46
February 2009	6.76	7.62	8.56
March 2009	6.66	7.55	8.43
April 2009	6.78	7.57	8.33
May 2009	5.00	5.65	6.23
June 2009	4.82	5.56	6.16
July 2009	4.21	4.99	5.57
August 2009	4.77	5.8	6.64
September 2009	4.66	5.57	6.08

The University of Missouri’s Atmospheric Sciences Department will continue to gather data from the anemometers located on the KOMU tower. Data from several years will give a clearer picture of the average wind speeds in the area.

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

The fourth annual “Advancing Renewables in the Midwest” conference was held on June 3, 2009. The focus of the conference was job creation and economic development opportunities within the renewable energy and energy efficiency sector. There was a full exhibit hall along with thirteen speakers from across the country. The conference is sponsored by Columbia Water & Light, the Missouri Department of Natural Resources and the University of Missouri – Columbia.

## Customer Based Renewable Energy Projects

Columbia Water & Light has several new programs to encourage electric customers to invest in solar energy.

### 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 two net metering customers; one solar system can produce two kilowatts and the other is rated at 1.5 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 at the residential electric rate.

### 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. To date, \$3,400 has been awarded in solar rebates by the utility, \$1,800 for photovoltaic systems and \$1,600 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.

## 2010 Estimated Renewable Portfolio

It is estimated that in 2010, Columbia will receive 5% of the electric portfolio from renewable resources. Columbia Water & Light is reviewing proposals that were solicited at the end of 2009 for an additional 5,000 megawatt hours of renewable energy. If there is renewable energy available this year and a contract can be finalized, the percentage of renewable energy could be 0.5% higher.

Project	Location	Amount of Energy (Megawatt Hours)	Percentage of Columbia Energy Portfolio	Cost per Megawatt Hour
A.E.C. Wind Energy	King City, MO	16,800	1.5%	\$65
Ameresco Landfill Gas	Jefferson City, MO	19,000	1.7%	\$53
Columbia Landfill Gas	Columbia, MO	14,700	1.3%	\$38*
Waste wood at power plant	Columbia, MO	5,000	0.5%	\$41**

\* Without operation and maintenance costs

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

## Appendix

### 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 as energy that is 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 as 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 utilities to make purchases of Green Tags and thus participate in the development of green, or renewable, energy without actually receiving that energy in the utilities' 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 physically 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 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 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.**