



2009 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. This report was reviewed and approved by the Water & Light Advisory Board and the Environment and Energy Commission. A public hearing before the City Council was held before they approved this version of the report.

Summary

Columbia Water & Light has been pursuing renewable energy sources since the mandate was passed by voter approval in 2004. Landfill gas energy from Illinois was purchased in 2005. In 2007, Columbia started receiving wind energy and the biogas project at the Columbia landfill was completed in 2008. In April 2008, the Columbia Power Plant started burning waste wood along with coal to evaluate its effectiveness as a power source. Several solar energy projects were also added to the renewable portfolio in the last year. It was predicted that Columbia would receive 5% of the energy portfolio from renewable resources in 2008. However, equipment problems and project delays brought that number closer to 2%. Columbia Water & Light did invest in renewable energy before the mandate went into effect which adds to the overall renewable portfolio. In 2009, the problems with the projects are expected to be resolved and the amount of renewable energy should be closer to 5%, which is the target for 2012.

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% percent 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

		System MWH's	Bluegrass Ridge Wind MWH's	Columbia Landfill MWH's	Columbia Power Plant Wood MWH's	Total Renewable MWH's	Renewable Percentage of System
Sep	2007	104,618	592			592	0.6%
Oct	2007	91,357	1,030			1,030	1.1%
Nov	2007	84,135	1,153			1,153	1.4%
Dec	2007	97,985	969			969	1.0%
Jan*	2008	102,167	1,080			1,080	1.1%
Feb*	2008	95,852	671			671	0.7%
Mar*	2008	89,178	798			798	0.9%
Apr*	2008	83,215	782		158	940	1.1%
May*	2008	85,467	485		185	670	0.8%
Jun*	2008	104,001	321	672	802	1,795	1.7%
Jul*	2008	116,895	250	874	594	1,718	1.5%
Aug*	2008	111,956	229	1,279	821	2,329	2.1%
Sep*	2008	92,891	539	1,204	765	2,508	2.7%
Oct*	2008	83,693	1,169	998	243	2,410	2.9%
Nov*	2008	82,509	646	1,216	0	1,862	2.3%
Dec*	2008	98,719	1,205	1,039	334	2,578	2.6%

* Starting in January 2008 cracked blades at the wind farm 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.

Columbia Renewable Energy Quantities

2008 total Columbia system load: 1,146,543 megawatt hours

2008 total renewable energy: 19,359 megawatt hours

2008 percentage of renewable energy: 1.7% (3,572 MWH short of goal)

2007 energy from Bluegrass Ridge wind farm: 3,744 megawatt hours

2005 energy from Milam landfill gas: 12,000 megawatt hours

Average Costs of Renewable Resources

Bluegrass Ridge wind energy: \$74 per megawatt hour

Columbia Biogas: \$38 per megawatt hour (without operation and maintenance costs)

Waste wood: \$32 per megawatt hour (fuel cost only)

Jefferson City Biogas: \$52.50 per megawatt hour (will begin in winter 2009)

2009 Projects

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, Columbia Water & Light estimated a 40% annual capacity factor for this resource although the Midwest Independent System Operator only allows the utility to use a 20% peak capacity factor for wind energy.

The level of wind energy Columbia received in 2008 was below estimated levels due to the blades of the turbines cracking. The estimated amount of energy lost was 5,557 megawatt hours. Had this energy been delivered, Columbia Water & Light would have surpassed the renewable energy standard goal. It has been reported to Columbia Water & Light that the cracked blades will all be replaced in the winter of 2009.

Over a whole year, the wind power contract was predicted to furnish roughly 22,000 megawatt hours to Columbia, or approximately 2% of Columbia's electric retail sales. The average cost of the wind energy in 2008 was \$74 per megawatt. Transmission costs for this energy are fixed so they drive up the cost per megawatt hour when there is a small amount of wind energy delivered. Due to the problems at the Bluegrass Ridge Wind Farm the cost per megawatt hour was higher in 2008 than expected. The cost predicted for 2009 is \$65 per megawatt hour since it is assumed that the energy delivered to Columbia will go up.

Month	MWH's Delivered	Percent of Total System Energy	Total Cost	Cost per MWH	Total Load Factor	MWH's @ 100% Load Factor
Sep 07	592	0.6%	\$45,714.06	\$77.22	15.06%	4,536.0
Oct 07	1,030	1.1%	\$70,794.06	\$68.73	21.97%	4,687.2
Nov 07	1,153	1.4%	\$77,999.06	\$67.65	25.42%	4,536.0
Dec 07	969	1.0%	\$67,164.06	\$69.32	20.67%	4,687.2
Jan 08	1,080	1.1%	\$74,149.06	\$68.66	23.04%	4,687.2
Feb 08	671	0.7%	\$50,059.06	\$74.60	15.30%	4,384.8
Mar 08	798	0.9%	\$54,734.06	\$68.59	17.03%	4,687.2
Apr 08	782	0.9%	\$56,549.06	\$72.31	17.24%	4,536.0
May 08	485	0.6%	\$39,169.06	\$80.76	10.35%	4,687.2
Jun 08	321	0.3%	\$29,599.06	\$92.21	7.08%	4,536.0
Jul 08	250	0.2%	\$25,474.06	\$101.90	5.33%	4,687.2
Aug 08	229	0.2%	\$24,209.06	\$105.72	4.89%	4,687.2
Sep 08	539	0.5%	\$42,359.06	\$78.59	11.88%	4,536.0
Oct 08	1,169	1.4%	\$79,154.06	\$67.71	24.94%	4,687.2
Nov 08	646	0.8%	\$48,574.06	\$75.19	14.24%	4,536.0
Dec 08	1205	1.2%	\$81,299.06	\$67.47	25.71%	4,687.2

Notes: "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. This project is using the gas created from decomposing waste at the landfill and can generate 2.1 megawatts of renewable power. In 2008, there were 7,282 megawatt hours of biogas energy produced which was 0.6% of Columbia's energy portfolio. (The amount of biogas energy produced each month is listed in the chart on page two of this document.) With a full year of production in 2009 the amount of energy produced should be about 1.5%. Without operation and maintenance expense, the cost of the energy was \$38 per megawatt hour. The capacity factor is estimated to be 71.89%.

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 a by-product of creating the curved planks used in barrel stave production so they are considered a carbon neutral energy source. Using this form of biomass allowed the utility to lower emissions and rate the effectiveness of using a biomass fuel.

The Columbia Power Plant produces 7% of the city's electric portfolio. The pilot project used a 10% mixture of wood along with the coal. 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 \$32 while coal during that same time period was \$63. Another request for burning waste wood has been requested from the Missouri Department of Natural Resources. If approved, Columbia could burn more waste wood in 2009.

Ameresco Biogas Plant

Columbia Water & Light signed a power purchase agreement with Ameresco for 3.2 megawatts of energy from a biogas plant at the Jefferson City landfill. Construction was expected to be completed in 2007 but has been delayed. It is expected to start delivering energy to Columbia in the winter of 2009. Columbia Water & Light has an agreement to buy the electricity for a period of 20 years. 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 should not substantially change the cost of the energy.

Solar Projects

Solar energy is an abundant renewable energy resource but more costly than other renewable options in our region. Many solar projects do not fall under 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.

The extra cost of providing the solar energy to the Columbia system is paid for by the voluntary subscribers to Solar One. Currently, 100 Kilowatt Hour blocks are being sold for \$48 annually or \$4 a month. Customers could purchase up to nine blocks of power. There are 140 blocks of energy available which are being sold to 96 electric customers. Solar One customers still pay the normal rate for the electricity they use.

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

Currently there are two projects producing Solar One energy for Columbia. The Dow Chemical Company through Missouri Solar Applications installed a system on city-owned property located on Bernadette Drive. The city also has a power purchase agreement with the Quaker Oats plant on Route B to supply solar energy. Each of these projects produced two megawatt hours in 2008. More detailed information on the output of the systems will be available as the program progresses in 2009. A request for proposals for additional Solar One projects will be sent out by the utility in 2009. Dow Chemical Company has also expressed an interest in installing another solar array, rated at two to five kilowatts, on city-owned property.

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.

There was a two kilowatt photovoltaic system installed on the roof by Columbia Water & Light that generated 3,117 kilowatt hours of electricity for the building. 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 information can be found on the City of Columbia's Web site at 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. 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 of the year. The data is as follows:

Month	68 m	98m	147m
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

According to the report from the University of Missouri's Atmospheric Sciences Department, Columbia showed lower wind speeds than other sites in Missouri where wind speeds were measured. The wind data collection will continue and should determine the daily and seasonal changes in the wind and wind shear along with comparisons to other sites within Missouri.

Advancing Renewables in the Midwest

On March 25, 2008, the annual conference "Advancing Renewables in the Midwest" was held in Ames, Iowa at the University of Iowa. The focus of the conference was to increase communication regarding renewable energy development in the Midwest. Region-based renewable energy projects and technologies, including the diverse resources of wind, efficiency, biomass and solar were discussed and exhibited at this one-day event. Columbia hosted the event in 2006 and 2007 and the event will return to Columbia again in 2009. Past sponsors of the program have been Columbia Water & Light, the Missouri Department of Natural Resources and the University of Missouri's Atmospheric Sciences Department, the Ames Municipal Electric System, Iowa Association of Municipal Utilities, Iowa Department of Natural Resources and Iowa State University.

Customer Based Renewable Energy Projects

Columbia Water & Light established 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 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 is now offering a one-time \$500 per kilowatt rebate for qualifying Photovoltaic systems. Customers installing a solar water heating system can qualify for up to \$800 in rebates. To date, \$2,600 has been awarded in solar rebates by the utility. Columbia Water & Light is expecting more customers to take advantage of these programs as solar technology improves and the cost of the systems goes down.

2009 Estimated Renewable Portfolio

Project	Location	Amount of Energy (Megawatt)	Percentage of Columbia Energy Portfolio	Cost per Megawatt
A.E.C. Wind Energy	King City, MO	6.3 MW	1.90%*	\$65.00
Ameresco Landfill Gas	Jefferson City, MO	3.2 MW	2.17%**	\$53.00
Columbia Landfill Gas	Columbia, MO	2.1 MW	1.47%	\$38.00

*This assumes wind blade problems will be fixed early in 2009. The amount of energy predicted to be supplied has also been adjusted to account for varying wind speeds.

**The Jefferson City project is expected to be completed early in 2009.

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.