City of Columbia

701 East Broadway, Columbia, Missouri 65201

Department Source: City Utilities - Water and Light
To: City Council
From: City Manager & Staff
Council Meeting Date: May 2, 2016
Re: Public Hearing to Consider the 2016 Renewable Energy Report

Executive Summary

Staff has prepared for Council consideration a resolution setting a public hearing for May 2 concerning consideration and approval of the 2016 Renewable Energy Report. The renewable energy mandate passed by voters in 2004 and modified by council in 2014 requires that each year prior to February 1, Columbia Water & Light publicly release a report outlining compliance with the ordinance. This year's report provides details on the amount of renewable energy provided, descriptions of projects and the forecast for the 2016 portfolio. Staff reports that 6.82% of the energy for electric retail sales was provided by the 2015 renewable portfolio.

The 2016 Renewable Energy Report was publicly released on January 30, 2016. It has been reviewed by the Water & Light Advisory Board and the Energy & Environment Commission. Ordinance requires a public hearing and a vote to approve the report.

Discussion

Columbia Water & Light has been pursuing renewable energy sources since the mandate was passed by voter approval in 2004. The following is a list of the renewable energy quantities for 2015:

- Bluegrass Ridge Wind - 1.09%
- Columbia Landfill Gas - 1.21%
- Municipal Power Plant Wood - .24%
- Jefferson City Landfill Gas – 2.01%
- Crystal Lake Wind - 2.18%
- Photovoltaic - .08%

Renewable Energy Total: 86,405 megawatt hours or 6.82%

It is estimated that in 2016 6.5% of Columbia's electric energy for retail sales will be provided by Columbia's renewable energy portfolio.

As outline in Section 27-106(b) of the Renewable Energy Standard ordinance, renewable energy cannot cause electric rates to increase more that 3% above what rates would be with non-renewable energy. Based on the methodology detailed in the Renewable Energy Report, current renewable energy resources have 42.8% of the allowed impact or 1.28%

impact on rates. In 2014 Staff contracted with a financial analyst to review and recommend a rate impact methodology for use in assessing the 3% rate impact limit, detailed in the ordinance. This recommended rate impact methodology was approved by the Water & Light Advisory Board at their December 3, 2014 meeting and used in this report to assess compliance with the 3% rate impact limit. As required by the Ordinance, the report has been review by the Water & Light Advisory Board and the Energy & Environment Commission. Their comments are included with this memo.

Fiscal Impact

Short-Term Impact: NA

Long-Term Impact: NA

Vision & Strategic Plan Impact

Vision Impacts:
Environment

Strategic Plan Impacts:
NA

Comprehensive Plan Impacts:
Environmental Management

Legislative History

Date	Action

Suggested Council Action

Council to hold a public hearing for approval of the 2016 Renewable Energy Report.

COLUMBIA WATER & LIGHT

2016

Renewable Energy Report

COLUMBIA WATER & LIGHT

6.82%

of all energy sources for 2015 were renewable, **exceeding goal** of 5%.

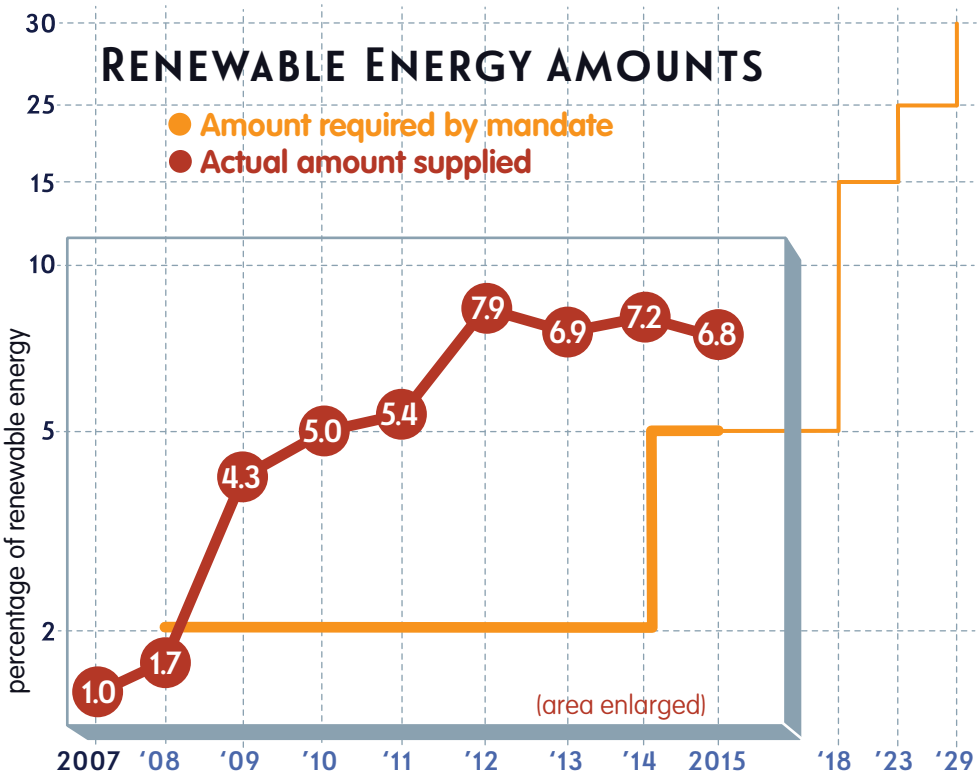
SOLAR 0.08%

WIND 3.27%

LAND FILL GAS 3.22%

BIO MASS 0.24%

RENEWABLE ENERGY AMOUNTS



$3.38 million
(allowable cost limit)

COST LIMIT:
Renewable energy cannot cause electric rates to increase more than **3%** above what rates would be with non-renewable energy.

$1.45 million
(amount spent = 42.8% of cost limit)

Extra spent on renewable energy

2015

Table of Contents

Renewable Energy Overview 2

Renewable Energy Production Amounts Chart 3

Costs of Renewable Energy 4

Renewable Energy Portfolio Details 7

Renewable Energy Education 10

Future Renewable Energy Production 11

Appendix 12
- Historical Renewable Energy Data 13
- Approved Sources of Renewable Energy 17
- Renewable Energy Ordinance 27-106 18
- Columbia Wind Speed Study 19
- Renewable Cost Accounting Report 20

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2016 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 approval of the report after holding a public hearing.

Renewable Energy Overview

In 2015, Columbia had 6.82% of the electric portfolio generated from renewable sources. The renewable portfolio comes from wind (3.27%), landfill gas (3.22%), biomass (0.24%) and solar (0.08%). The total amount exceeds the requirement for 2015 of 5% by 1.82%. The additional cost is 41.8% of what is allowed by the renewable energy ordinance.

2015 Renewable Energy Sources

Columbia system load: 1,184,878 megawatt hours (MWH)
Renewable energy total: 80,796 megawatt hours or 6.82%

- Bluegrass Ridge wind energy: 1.09% of electric system @ $68.52/MWH
- Crystal Lake wind energy: 2.18% of electric system @ $49.60/MWH
- Jefferson City landfill gas: 2.01% of electric system @ $53.00/MWH
- Columbia landfill gas: 1.21% of electric system @ $63.72/MWH
- Waste wood: 0.24% of electric system @ $38.52/MWH (fuel cost only)
- Free Power Solar: 0.03% of the electric system @ $54.95/MWH
- Net Metered Customer Production: 0.03% of the electric system. The average retail rate for net metered energy was $90.17/MWH.
- Solar One: 0.00% of the electric system (42 MWH). Solar One program costs were covered by customers subscribing to the program.
- West Ash Solar Field: 0.01% of the electric system @ $62.30/MWH

2015 Renewable Energy Supply Activities

- The West Ash Solar Field rated at 267.8 kilowatts began production in August 2015.
- There was a 54% reduction in energy production from biomass during 2015 due to the discontinuation of solid-fuel firing at the Municipal Power Plant in September of 2015. The plant no longer uses coal due to new federal regulations and the age of the equipment.
- There was a 55% increase in the rated capacity of customer installed photovoltaic systems during 2015.
- Issues with the cooling systems for two units decreased the Columbia Landfill Gas Plant production of electricity.
- A Request for Proposals for wind energy resources with a minimum annual production of 60,000 megawatt hours was released in December 2015. Responses will be evaluated in early 2016.

Renewable Energy Ordinance Requirements

According to the current standards, the city shall generate or purchase electricity generated from eligible renewable energy sources at the following levels: 2% of electric retail sales by December 31, 2007, 5% of electric retail sales by December 31, 2012, 15% of electric retail sales by December 31, 2017, 25% of electric retail sales by December 31, 2022 and 30% of electric retail sales by December 31, 2028

The renewable energy ordinance was revised by the Columbia City Council on January 6, 2014 to increase the required amounts of renewable energy in the future. The full text of the Renewable Energy Standard and the approved list of renewable resources are listed in the appendix of this report.

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2015 Renewable Energy Production Amounts

Month	System MWH's	Bluegrass Wind MWH's	Crystal Lake Wind MWH's	Columbia Landfill MWH's	Jeff City Landfill MWH's	Waste Wood MWH's	Free Power Solar MWH's	Net Meter Solar MWH's	West Ash Solar MWH's	Solar One MWH's	Total Renew MWH's	YTD Annual % of System
1-15	105,552	1,501	2,777	1,605	2,024	982	28.06	21.39	0	2.92	8,942	8.47%
2-15	101,106	1,039	2,784	1,744	1,910	127	25.83	16.82	0	2.52	7,649	8.03%
3-15	90,810	1,193	2,384	1,650	1,879	0	36.35	34.00	0	3.83	7,180	7.99%
4-15	81,568	1,233	1,175	1,475	2,094	0	38.90	37.68	0	3.97	6,058	7.87%
5-15	90,340	1,035	2,316	1,040	2,157	0	40.28	40.59	0	4.16	6,633	7.77%
6-15	107,377	748	1,329	1,020	1,620	0	40.25	37.73	0	3.77	4,799	7.15%
7-15	122,348	455	1,291	1,003	2,009	595	43.87	43.38	0	4.29	5,445	6.68%
8-15	114,671	549	1,779	927	1,996	812	43.11	44.61	4.28	4.39	6,160	6.50%
9-15	106,316	978	2,041	958	1,965	338	42.30	40.74	40.24	4.13	6,408	6.44%
10-15	86,400	1,140	2,609	1,122	1,986	0	33.50	34.32	33.02	3.44	6,961	6.58%
11-15	84,283	1,676	2,798	818	1,914	0	23.54	24.38	23.90	2.52	7,281	6.74%
12-15	94,107	1,400	2,603	997	2,225	0	17.45	18.24	17.86	1.99	7,280	6.82%
Total	1,184,878	12,947	25,889	14,359	23,779	2,854	413	394	119	42	80,796	
Percent of Total		1.09%	2.18%	1.21%	2.01%	0.24%	0.03%	0.03%	0.01%	0.00%	6.82%	

Note: Energy production amounts are listed in megawatt hours (MWH)

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Costs of Renewable Energy

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

The City of Columbia has a fiscal year that does not match the calendar year outlined in the Renewable Energy Standard. Renewable energy costs for this report include information from January through September of the prior fiscal year and October through December of the current fiscal year. For calendar year 2015, the additional cost to address the renewable portfolio requirement was $1,446,068.35 and the limit was $3,375,234.01, as outlined in the following tables. The additional money spent on renewable energy was 42.8% of what was allowed according to the ordinance.

The latest change in costs for 2015 was due to:

- The wholesale capacity cost of electricity dropped
- The Columbia Landfill Gas Plant produced less energy due to issues with the cooling system for two of the generators, scheduled outages for maintenance and the commissioning of the third generator. The fixed cost for the plant therefore impacted the overall cost for this energy more than in previous years.

Cost of 2015 Renewable Energy Portfolio

Renewable Resource	Total 2015 MWH's	Additional Cost/(Savings) Per MWH	Total Impact on Rates
Bluegrass Ridge Wind (Associated Electric)	12,947	$43.96	$569,150.12
Crystal Lake Wind (NextEra)	25,889	$39.09	$1,012,001.01
Columbia Landfill	14,359	$2.11	$30,297.49
Jefferson City Landfill (Ameresco)	23,779	($8.61)	($204,737.19)
Wood at Columbia Power Plant	2,854	($25.42)	($72,548.68)
Free Power Photovoltaic Production	413	$12.86	$5,311.18
Net Metered Photovoltaic Production	394	$48.99	$19,302.06
West Ash Solar Field Photovoltaic Production	119	$21.68	$2,579.92
Solar One Photovoltaic Production	42	($41.18)	($1,729.56)
Total Renewable Resource Impact on Rates			$1,359,626.35
2015 Photovoltaic Rebates to Customers			$52,872
Total 2015 Renewable Standard Impact on Rates			$1,446,068.35

Maximum Renewable Portfolio Cost Calculations

Revenue Source	January – September (FY15)	October – December (FY16)
Residential	$36,694,127.17	$9,744,428.01
Commercial/Industrial	$42,475,108.11	$12,868,462.39
Street Lights	$44,404.56	$23,335.38
Public Authority	$7,024,761.43	$2,353,662.55
Inter-Departmental	$951,743.24	$327,767.54
Total Revenue During Calendar Year 2015		$112,507,800.38
3% Impact Limit on Rates		$3,375,234.01

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Calculating Renewable Energy Costs

Renewable and non-renewable energy prices are divided into the four resource categories below. The cost or savings associated with a renewable resource is determined through comparison with cost of the non-renewable resource(s) in the same category. Definitions of the types of electric supply resources are listed at the beginning of each category.

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. Iatan II
      iii. 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 2015 was $61.61/MWH
      i. Columbia landfill gas plant
         - Produced 14,359 megawatt hours
         - The average cost was $63.72/MWH
         - There was a renewable resource cost of $2.11/MWH ($63.72-$61.61)
         - Columbia landfill gas impact on rates for 2015 was a cost of $30,297.49 (14,359 MWH @ $2.11/MWH)
      ii. Jefferson City (Ameresco) landfill gas plant
         - Produced 23,779 megawatt hours
         - The cost was $53.00/MWH
         - There was a renewable resource savings of $8.61/MWH ($53.00-$61.61)
         - Jefferson City landfill gas impact on rates for 2015 was a savings of $204,737.19 (23,779 MWH @ $8.61/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
      iii. Free Power
      iv. Net metered customer production
      v. Solar One
      vi. West Ash Solar Field
   c. All-in cost (energy and transmission) for intermittent resources will be compared to the appropriate Midcontinent Independent System Operator's (MISO) Locational Marginal Price (LMP) for energy at the pricing node where Columbia Water & Light takes delivery of the energy. The renewable cost per megawatt hour will include any additional fees invoiced under the contract, such as 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. Qualified intermittent resources are credited with a capacity offset value to recognize the corresponding reduction in capacity requirements during peak periods. The capacity credit values are: $3.10 per MWH for wind resources and $15.80 per MWH for solar resources.
      i. Bluegrass Ridge: This resource in not in MISO so a fixed charge for transmission to MISO is necessary in addition to the purchase price. For calendar year 2015, the average real-time Columbia LMP for the hours when this wind resource was producing energy was $21.46 per megawatt hour. The total cost of energy, including transmission, was $68.52 per megawatt hour. The difference in these two values is the renewable cost of $47.06 per megawatt hour.

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- Produced 12,947 megawatt hours at a renewable cost of $47.06 per MWH
- A capacity credit of $3.10 per MWH reduces the renewable cost to $43.96 per MWH Total renewable expense and impact on rates for 2015 was $569,150.12 (12,947 MWH's @ $43.96/MWH)

ii. Crystal Lake: This resource is in MISO so no fixed transmission charge exists. This contract requires Columbia Water & Light to pay for "deemed" energy. This is energy that would have been produced had Columbia Water & Light not requested production curtailment due to a negative LMP. A negative LMP means that Columbia Water & Light would be paying the energy market to take the energy. Columbia Water & Light currently requests curtailment at negative twenty dollars (-$20.00). For calendar year 2015, the average real-time Crystal Lake LMP for the hours when this wind resource was producing energy was $10.51 per megawatt hour. The total cost of energy, including deemed energy, was $49.60 per megawatt hour. The difference in these two values is the renewable cost of $39.09 per megawatt hour.

- Produced 25,889 megawatt hours at a renewable cost of $39.09 per MWH
- This resource does not qualify for a capacity credit because purchase occurs at Crystal Lake
- Total renewable expense and impact on rates for 2015 was $1,012,001.01 (25,889 MWH's @ $39.09/MWH)

iii. Free Power: These photovoltaic systems are connected with the Columbia Water & Light electric distribution system, so they operate behind the meter in MISO. For calendar year 2015, the average real-time Columbia LMP for the hours when the Free Power solar resource was producing energy was $26.27 per megawatt hour. The Free Power contract price is $54.95 per megawatt hour. The difference in these two values is the renewable cost of $28.66 per megawatt hour.

- Produced 413 megawatt hours at a renewable cost of $28.66 per MWH
- A capacity credit of $15.80 per MWH reduces the renewable cost to $12.86 per MWH Total renewable expense and impact on rates for 2015 was $5,311.18 (413 MWH's @ $12.86/MWH)

iv. Net metered customer production: These customer-owned photovoltaic developments are also connected with the Columbia Water & Light electric distribution system, so they operate behind the meter in MISO. For calendar year 2015, the average real-time Columbia LMP for the hours when the customer-owned solar resources were producing energy was $25.38 per megawatt hour. The average retail energy price is $90.17 per megawatt hour. The difference in these two values is the renewable cost of $64.79 per megawatt hour.

- Produced 394 megawatt hours at a renewable cost of $64.79 per MWH
- A capacity credit of $15.80 per MWH reduces the renewable cost to $48.99 per MWH
- Total renewable expense and impact on rates for 2015 was $19,302.06 (394 MWH @ $48.99/MWH)
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v. Solar One: Production is connected with the Columbia Water & Light electric distribution system and operates behind the meter in MISO. For calendar year 2015, the average real-time Columbia LMP for the hours when the Solar One resources were producing energy was $25.38 per MWH. Voluntary customer subscriptions pay for the cost of this energy so there is no cost to the utility. The savings to the utility is $25.38 per MWH.

- Produced 42 megawatt hours at a renewable savings of $25.38 per MWH
- A capacity credit of $15.80 per MWH increases the renewable savings to $41.18 per MWH
- Total renewable savings and impact on rates was a savings of $1,729.56 (42 MWH's @ $41.18/MWH)

vi. West Ash Solar Field: The West Ash Solar Field began production in August 2015. Production is connected with the Columbia Water & Light electric distribution system and operates behind the meter in MISO. For calendar year 2015, the average real-time Columbia LMP for the hours when the West Ash Solar Field was producing energy was $24.82 per

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MWH. Based on the installed cost of the system and estimated energy production over a 25 year period with a 0.5% degradation rate and no cost of money or operation and maintenance cost included, the average cost was $62.30 per MWH. The difference in these two values is the renewable cost of $37.48 per megawatt hour.

- Produced 119 megawatt hours at a renewable cost of $37.48 per MWH
- A capacity credit of $15.80 per MWH reduces the renewable cost to $21.68 per MWH
- Total renewable expense and impact on rates for 2015 is $2,579.92 (119 MWH @ $21.68/MWH)

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 in 2015 was $63.94/MWH
      ii. Energy cost of wood
         - Produced 2,854 megawatt hours at $38.52 per MWH
         - There was a renewable resource savings in 2015 of $25.42/MWH ($63.94 - $38.52)
         - Power plant waste wood impact on rates for 2015 is a savings of $72,548.68 (2,854 MWH @ $25.42/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 and two natural gas generators at the Columbia Power Plant. No renewable resources 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 which equals $1,446,068.35.

2015 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 2015, Columbia received 12,947 megawatt hours of power from this contract or 1.09% 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 2015 for wind power from the Bluegrass Ridge Wind Farm was $68.52 per megawatt hour.

Crystal Lake Wind Energy

Columbia Water & Light has a 20 year contract for 21 megawatts of power produced at the Crystal Lake III Wind Energy Center located in Hancock County, Iowa. In 2015, the utility received 51,763 megawatt hours from NextEra Energy Resources. The University of Missouri purchased 25,874 megawatt hours of the contracted energy from the utility. This arrangement can be terminated by either party at any time. Columbia Water & Light's portion of the contract was 25,889 megawatt hours which represents 2.18% of the electric system total. The total cost of energy, including deemed energy, was $49.60 per megawatt hour. Deemed energy is energy that would have been produced had Columbia Water & Light not requested production curtailment due to a negative Locational Marginal Price (LMP). A

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negative LMP means that Columbia Water & Light would be paying the energy market to take the energy. Columbia Water & Light currently requests curtailment at negative twenty dollars (-$20.00). The fixed cost of the wind energy delivered to Columbia started at $42.50 per megawatt hour in 2012, increased to $43.50 in 2013, $44.50 in 2014, and $45.00 in 2015. For the remaining years of the contract, the price per MWH will remain at $45.00.

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. The amount of energy received from the Columbia Landfill Gas Energy Plant is fairly consistent aside from times when there is routine maintenance work. A third generator was added in October 2013 since the amount of gas generation had increased with the addition of a bioreactor. The plant can currently generate 3.1 megawatts of renewable power. Energy production at this facility was down in 2015 due to heat exchanger issues (cooling system), scheduled outages for maintenance and the addition of the third generator. Upgrades for the cooling system are planned for these units. In 2015, the landfill gas plant produced 14,359 megawatt hours of energy which was 1.21% of Columbia's energy system total at a cost of $63.72 per megawatt hour. The reduced production means the fixed costs of the project had more of an impact on the cost per megawatt hour. There is room for a fourth generator to be installed when the gas production increases and is budgeted for future years with bond funds. With four generators, electric production could grow to over 2% of Columbia's energy system total over the next several years.

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 2015 was 23,779 megawatt hours which is 2.01% of the electric system total. The utility paid $53.00 per megawatt hour for the electricity. Both Columbia and Jefferson City are located within the MISO territory so transmission fees do not substantially change the cost of the energy.

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 a residual waste produced from Missouri sawmills. The wood is a by-product so it is considered a carbon neutral energy source. Using this form of biomass has allowed the utility to address lower emission requirements and rate the effectiveness of a biomass fuel source.

In 2015, the Columbia Power Plant as a whole produced 2.4% of the city's electric portfolio from coal, natural gas and waste wood. Of the coal/wood electricity produced, the city used an 11.4% mixture of waste wood along with the coal. The energy produced by waste wood was 2,854 megawatt hours which is 0.24% of Columbia's electric portfolio. Columbia stopped burning coal in September 2015 due to new federal regulations and the age of some of the equipment.

The fuel cost per megawatt hour of power produced from waste wood was $38.52 while coal during that same time period was $63.94. 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.

To evaluate the effectiveness of burning more biomass at the plant without changing any of the equipment, biomass products have been investigated. In October 2012 a test burn of 176 tons of a Miscanthus based product was conducted. Columbia Water & Light continues to search for a biomass solution for the Municipal Power Plant and will present any new options to the Water & Light Advisory Board, the City Council and customers in the future

Free Power

The Columbia City Council approved a lease agreement with the Free Power Company, Inc. in December 2010 for the electricity generated from photovoltaic modules at $54.95 per megawatt hour. In 2015, the Free Power solar projects produced 413 megawatt hours which are 0.03% of Columbia's electric portfolio. The systems are located at the COLT

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Railroad's Transload Facility and are rated at 0.33 megawatts. Free Power has not made any new installations in since 2012. Columbia Water & Light is only paying for the electricity generated from the panels.

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. During 2015, there was a substantial increase in customers installing their own photovoltaic systems. The number of net metering customers grew from 36 to 51 and the rated capacity grew from 0.287 megawatts to 0.446 megawatts. In 2015, the estimated output of the net metered sites was 394 megawatt hours and the estimated renewable cost impact on rates was $19,302.06.

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. Columbia Water & Light credits the net metering customer's account for the electricity provided to the Columbia system at the following rates:

- Solar: Columbia Water & Light will pay the customer's current electric rate for the delivered solar generated electricity when the utility retains the Renewable Energy Credits (REC). If the customer wants to keep the solar RECs, the customer will receive a credit based on the avoided average energy market price at the Columbia pricing node. There is a 100 kilowatt capacity cap on the net metering arrangement.
- Other: For non-solar renewable generated energy, the customer shall receive a credit based on the avoided average energy market price at the Columbia pricing node.

An Interconnection and Net Metering Agreement must be in place for the customer to receive a credit for the energy they deliver to Columbia Water & Light. For billing periods in which the net energy is less than zero, credits for the amount of net energy will be applied to the account. Credits can be carried over and applied to the next billing cycle except for the March billing in which any credits remaining after the March billing will be removed without compensation to the customer.

Columbia Water & Light offers a one-time rebate for qualifying photovoltaic systems of $500 per kilowatt up to ten kilowatts. If a customer wants to install a larger system, requests must be approved by the Columbia Water & Light Director. Customers installing a solar water heating system can qualify for up to $800 in rebates.

In calendar year 2015, $52,872 in solar electric system rebates were provided. In 2014, Solar Energy Loans were made available to customers with the same terms as the existing Home Performance with Energy Star Loan program. To be eligible for a Solar Energy Loan, customers' property must meet specific energy efficiency improvement requirements. In calendar year 2015, there was two solar loan issued.

West Ash Solar Field

The solar electric field on Bernadette was expanded by Columbia Water & Light staff members in 2015. In order to keep the cost down for this 267.8 kilowatt project, Columbia Water & Light employees were used to install the panels. The project was energized in August and the energy production will be closely monitored. The field produced 119 megawatt hours or 0.01% of the electric portfolio at a cost of $62.30 per megawatt hour. A community solar project is being considered by the utility at this site which will enable Columbia Water & Light customers to receive part of the solar energy output to power their homes and businesses. The City of Columbia Legal Department is reviewing the parameters of the program and customer agreements. More details about community solar will be announced in the spring of 2016.

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 led to Columbia receiving national attention for being a supporter of solar energy.

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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 2015 the installations at the West Ash Water Pumping Station, Quaker Oats and Bright City Lights were rated at 0.0328 megawatts and produced 42 megawatt hours of electricity. Subscriptions to the Solar One program raised $8,522 and the purchased power costs were $8,628. The money raised by Solar One donations is kept within the Solar One account and is not used for other utility or city projects. Columbia Water & Light's staff is reviewing the Solar One program and researching different options for customer based solar energy programs. The Solar One program could be combined with a community solar program in 2016.

Renewable Energy Education

Advancing Renewables in the Midwest

On April 6 and 7, 2015, the 10th annual Advancing Renewables in the Midwest conference hosted around 200 attendees. The Missouri Energy Plan was reviewed, and the financial aspects of renewable power, biomass initiatives and energy efficiency were topics of discussion at the conference. The conference was hosted by Columbia Water & Light, the University of Missouri's Department of Soil, Environmental and Atmospheric Sciences and the Missouri Department of Economic Development. The 2016 conference will be held at the University of Missouri on April 11 and 12.

Columbia Public Schools Solar Installations

Energy from the sun is helping to power the Columbia Area Career Center and Benton Elementary School, providing a unique learning opportunity for students. In 2007, Columbia Water & Light purchased a 2-kilowatt photovoltaic system for the Career Center which generates around 2,700 kilowatt-hours of electricity for the building annually. In January 2014, Benton Elementary School utilized a $5,000 grant from the UPS Foundation to purchase and install a 1.5-kilowatt system, expected to produce approximately 1,600 kilowatt-hours per year. Information about the amount of solar radiation, weather conditions and electricity output are available to students at both sites.

Civic and Environmental Group Outreach

In 2015, Columbia Water & Light staff visited a number of groups to present information about Columbia's renewable energy portfolio and the availability of net metering to customers. At Earth Day, the Sustainable Living Fair and other events, over 900 attendees were able to receive information about installing solar systems from utility representatives. Paid advertising was also placed to inform customers about the availability of solar rebates, low-interest loans and net metering agreements.

K-12 Educational Programs

Renewable energy is often a focus of outreach efforts in the local public and private schools along with public events and approximately 1,300 young people were reached. In April, 900 students and their families, and in May, 175 Boy Scouts learned the basics of solar electricity by making their own solar cells from copper sheets and sports drinks. Students at Battle High School learned about solar water heating and electricity as part of the Bottle Battle engineering project. In September, Columbia Water & Light staff participated in the Benton Elementary School STEM event and demonstrated how solar panels work. Water & Light staff presented information about renewable energy to students at West and Jefferson Middle Schools. Students at Jefferson Middle School, participating in the Regional Future Cities competition with assistance and mentorship from Columbia Water & Light representatives, have incorporated power generation from landfill gas in their submission.

Future Renewable Energy Production

It is estimated that over 6.5% of Columbia's electric portfolio will come from renewable resources in 2016. This will surpass the renewable energy ordinance mandate of 5%. In order to increase the amount of renewable energy to meet future mandates, Columbia Water & Light issued a Request for Proposal (RFP) for wind energy in late 2015. That RFP will be evaluated in 2016 with the possibility of an additional wind resource being added to the renewable energy supplies. Additional RFP options will be investigated in 2016.

The Environmental Protection Agency's (EPA) Cross State Air Pollution Rule (CSAPR), the Boiler Act and the Coal Combustion Rule, eliminated energy produced by coal at the Municipal Power Plant in 2015. The coal was mixed with wood waste (biomass), so there will be no biomass production in 2016 at the plant.

2016 Estimated Renewable Portfolio

Project	Location	Amount of Energy	%of Portfolio	Cost
Bluegrass Ridge	King City, MO	13,000 MWH	1.09%	$67/MWH
Crystal Lake wind energy	Hancock County, IA	26,000 MWH	2.18%	$45/MWH
Jefferson City landfill gas	Jefferson City, MO	22,000 MWH	1.93%	$53/MWH
Columbia landfill gas	Columbia, MO	16,000 MWH	1.34%	$55/MWH
Free Power Solar	Columbia, MO	400 MWH	0.03%	$55/MWH
Net Metered Customer Production	Columbia, MO	400 MWH	0.03%	$72/MWH
West Ash Solar Field	Columbia, MO	400 MWH	0.03%	$62/MWH
Solar One	Columbia, MO	40 MWH	0.00%	Paid by customer subscriptions

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Appendix

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Historical Renewable Energy Data

2005 Renewable Energy

The first renewable energy was delivered to Columbia through a short-term contract for landfill gas energy from Illinois.

2007 Renewable Energy Production Amounts

Columbia started receiving wind energy from Bluegrass Ridge.

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%	
TOTAL	378,095	3,744				3,744		

2008 Renewable Energy Production Amounts

The initial phase of 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.

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%
TOTAL	1,146,543	8,128	7,282	3,902	0	1	19,313		

* Cracked blades on the wind turbines lowered production amounts for 9 months for a total of approximately 5,557 megawatt hours.

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

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2009 Renewable Energy Production Amounts

Columbia started receiving landfill gas energy from Jefferson City.

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%
TOTAL	1,105,255	16,798	10,876	5,171	14,227	7	47,079		

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 Production Amounts

Three additional solar projects were added to the Solar One program.

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%
TOTAL	1,185,352	17,340	13,052	7,432	21,708	9	59,541		

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.

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2011 Renewable Energy Production Amounts

Columbia started receiving solar energy through a contract with the Free Power Company.

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		

2012 Renewable Energy Production Amounts

Columbia started purchasing wind energy from Crystal Lake.

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%		

*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.

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2013 Renewable Energy Production Amounts

Installed a third generator at the Columbia Landfill Gas Energy Plant

Month	System Total MWH	Bluegrass Wind MWH	Crystal Lake Wind MWH	Jeff City Landfill MWH	Columbia Landfill MWH	Waste Wood MWH	Free Power Solar MWH	Net Metered & Solar One MWH	TOTAL Renew MWH	Monthly % of System	Annual % of System
1-13	101,588	1,492	3,038	1,723	1,196	71	23.99	5.55	7,549	7.43%	7.43%
2-13	90,544	1,392	1,418	1,817	964	1,194	27.26	6.31	6,819	7.53%	7.48%
3-13	95,182	1,334	1,740	1,650	803	280	31.37	7.54	5,846	6.14%	7.04%
4-13	84,918	1,360	2,771	2,050	743	688	36.24	10.82	7,659	9.02%	7.49%
5-13	92,147	13,006	2,454	1,803	923	986	41.09	11.95	7,525	8.17%	7.62%
6-13	103,711	1,093	1,898	1,561	1,201	694	46.59	13.30	6,506	6.27%	7.38%
7-13	115,604	667	1,846	1,498	1,194	1,086	49.21	14.29	6,355	5.50%	7.06%
8-13	118,489	534	1,189	2,035	984	1,161	48.02	13.18	5,964	5.03%	6.76%
9-13	103,749	775	2,023	2,010	1,017	1,115	43.12	11.74	6,994	6.74%	6.76%
10-13	88,624	1,309	1,756	1,938	1,576	652	36.74	10.72	7,278	8.21%	6.89%
11-13	88,152	1,561	1,845	1,942	1,557	0*	25.33	7.59	6,938	7.87%	6.97%
12-13	105,775	1,162	2,213	1,813	1,168	1,044	15.33	6.79	7,422	7.02%	6.97%
Total MWH	1,188,483	13,985	24,189	21,840	13,326	8,971	424.29	119.77	82,855		
% of Total		1.18%	2.04%	1.84%	1.12%	0.75%	0.04%	0.01%	6.97%		

*Waste wood was not used at the Columbia Power Plant in November while it was down for regular maintenance.

2014 Renewable Energy Production Amounts

Month	System Total MWH	Bluegrass Wind MWH	Crystal Lake Wind MWH	Jeff City Landfill MWH	Columbia Landfill MWH	Waste Wood MWH	Free Power Solar MWH	Net Metered MWH	Solar One MWH	TOTAL Renew MWH	Monthly % of System	Annual % of System
1-14	113,677	1,882	2,794	1,917	1,418	428	25.2	7.79	2.77	8,475	7.45%	7.45%
2-14	101,423	1,006	2,295	1,825	1,597	1,078	26.55	7.18	2.42	7,837	7.73%	7.58%
3-14	93,794	1,640	2,640	1,461	1,638	566	43.29	13.66	4.24	8,006	8.54%	7.87%
4-14	82,590	1,594	1.989	1,905	1,004	0	38.84	13.25	3.84	6,548	7.93%	7.88%
5-14	96,277	1,042	2,151	1,490	957	0	48.49	18.57	4.43	5,712	5.93%	7.50%
6-14	108,638	875	1,653	1,864	811	1,380	43.25	17.1	4.22	6,648	6.12%	7.25%
7-14	109,772	694	1,703	2,001	1,633	1,316	51.86	20.11	4.82	7,424	6.76%	7.17%
8-14	120,073	518	917	1,808	1,871	1,085	44.17	18.46	4.35	6,266	5.22%	6.89%
9-14	95,125	675	1,253	1,813	1,953	159	39.48	17.59	3.64	5,914	6.22%	6.82%
10-14	84,624	1,266	1,882	1,954	1,903	129	32.75	15.22	3.29	7,185	8.49%	6.96%
11-14	91,886	1,866	3,344	2,049	1,662	0	24.30	16.66	2.62	8,964	9.76%	7.19%
12-14	98,873	841	2,675	1,956	1,819	110	14.66	10.68	1.40	7,428	7.51%	7.22%
Total MWH	1,196,752	13,899	25,295	22,043	18,266	6,251	433	176	42	86,405		
% of Total		1.16%	2.11%	1.84%	1.53%	0.52%	0.04%	0.01%	0.00%	7.22%		

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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.

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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:

(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) Fifteen (15) percent of electric retail sales (kWhs) by December 31, 2017; and
(4) Twenty-five (25) percent of electric retail sales (kWhs) by December 31, 2022.
(5) Thirty (30) percent of electric retail sales (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 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; Ord. No. 21935, § 1, 1-6-14)

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.

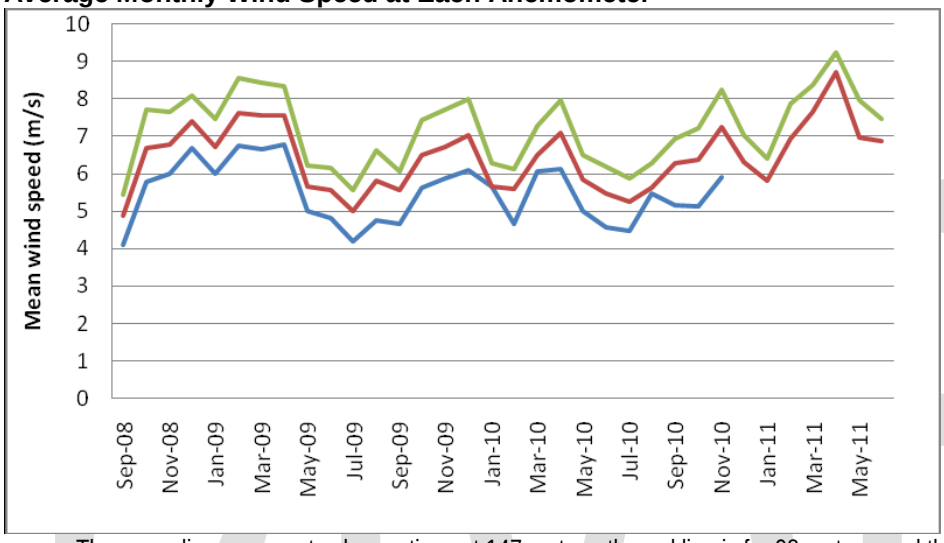
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Columbia Wind Speed Study

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

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COLUMBIA WATER AND LIGHT ELECTRIC DEPARTMENT
RATE IMPACTS ON RENEWABLES
JANUARY 26, 2015

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COLUMBIA WATER AND LIGHT ELECTRIC DEPARTMENT

TABLE OF CONTENTS

	PAGE NO.
INTRODUCTION	2
REVIEW OF CURRENT METHODOLOGY	2
SUMMARY OF SCOPE OF SERVICES	4
CWL'S SYSTEM LOAD PROFILES	4
ANALYSIS OF RENEWABLES	
WIND LOAD PROFILES AND PRODUCTION CHARACTERISTICS	6
SOLAR LOAD PROFILES AND PRODUCTION CHARACTERISTICS	9
VALUE OF RENEWABLE CAPACITY	12
RECOMMENDATIONS	14

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COLUMBIA WATER AND LIGHT ELECTRIC DEPARTMENT

EXECUTIVE SUMMARY – RATE IMPACTS OF RENEWABLES

INTRODUCTION

This report was prepared to provide guidance on the valuation of renewable generation for the Columbia Water and Light (CWL) Electric Department. In 2004, the City passed a renewable energy ordinance setting goals for renewable energy production. The ordinance was modified in in 2014 and established the following renewable energy goals:

- 15% of electric retail sales from renewables by December 31, 2017
- 25% from renewables December 31, 2022
- 30% from renewables by December 31, 2028

To minimize rate impacts on customers that could result from investments in renewable generation, the City's ordinance required that rates would not increase by greater than 3% due to the potentially higher cost. The electric department periodically produces a report detailing the cost to purchase renewables with a comparison of the cost to purchase energy from the market.

In 2013, the Columbia Water and Light's Electric Department produced 82,855 megawatt hours from renewable generation accounting for 6.97% of the total energy consumed by the Columbia Water and Light Ratepayers. The renewable production as a percent of total City production in listed below:

1. Wind accounted for - 3.2% of total energy production
2. Landfill Gas – 3.0%
3. Waste wood – 0.75%
4. Solar - 0.04%
5. Net Metered Solar from customer installed solar units - .01%

Review of Current Methodology

To determine the cost for renewables and the impact on ratepayers, CWL uses a combination of market prices of electricity and avoided cost. The table below is the 2013 cost and credits for renewables used by CWL. (The values vary slightly from 2014 Renewable Energy Report due to rounding)

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COLUMBIA WATER AND LIGHT ELECTRIC DEPARTMENT

EXECUTIVE SUMMARY – RATE IMPACTS OF RENEWABLES

Table One – Rate Impacts on 2013 Rates Using Current Methodology

2013 Report Values								
	Blue Grass - Wind	Crystal Lake - Wind	Jeffereson City Land Fill	Columbia Landfill	WasteWood	Solar - Free Power	Net Metered Solar One	Total
mWh's Produced	13,985	24,189	21,840	13,326	8,971	424	120	82,855
Value per mWh	32.59	18.30	54.88	54.88	54.25	36.47	36.81	40.25
Value- Total	455,771	442,659	1,198,579	731,331	486,677	15,474	4,409	3,334,899
Cost - mWh	67.76	56.76	53.05	47.38	38.11	54.95	94.40	54.16
Total Cost	947,624	1,372,968	1,158,612	631,386	341,885	23,315	11,306	4,487,095
Total Value	**$ 491,852**	**$ 930,309**	**$ (39,967)**	**$ (99,945)**	**$ (144,792)**	**$ 7,841**	**$ 6,898**	**$ 1,152,196**
2013 North American Renewable Registry Membership								$ 14,000
2013 Photovoltaic Rebates to Customers								43,305
2013 Capacity Credit for Wind Resources								(6,570)
Total Impact on 2013 Rates								**$ 1,202,931**

To determine the value to CWL each resource was classified based on production characteristics into base load and intermittent units to assign a value to the resource.

Units considered base load:
- Columbia landfill gas plant
- Jefferson landfill gas plant contract

Units considered intermittent
- Bluegrass Ridge wind
- Crystal Lake wind
- Net metered customer production
- Free Power
- Solar One

Units (Fuel) considered load following
- Waste wood

The table below shows the cost of each resource, value of the resource and how the valuation was determined.

Table Two – Resource Valuation Current Methodology

Resource	Cost	Value	Valuation
Columbia landfill gas plant	47.38	54.88	Average cost of base load non-renewable
Ameresco landfill gas plant contract	53.05	54.88	Average cost of base load non-renewable
Bluegrass Ridge wind	67.76	32.59	LMP - Market Prices
Crystal Lake wind	56.76	18.30	LMP - Market Prices
Free Power	54.95	36.47	LMP - Market Prices
Solar One	94.40	36.81	LMP - Market Prices
Wastewood	38.11	54.25	Cost of Fuel

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Summary of Scope of Services

Utility Financial Solutions completed a review of the current methodology to identify the potential value of renewables. The following analysis was completed:

1. Reviewed methodologies used by Public Service Commissions
2. Analyzed system loads and profiles
    a. Identified actual time peak demands occurred on the system for each month and each season
    b. Identified potential time that peak demands have potential to occur (On Peak hours)
3. Analyzed wind and solar production from for each resource
    a. Identified production of each unit at time CWL's peak occurred
    b. Identified production of each unit during on-peak hours of system
4. Valuation of capacity from renewables
5. Identified capacity value of each renewable resource
6. Presented results to Board of Directors for review and comment

Revenue methodologies used by Public Service Commissions

In June, 2014 UFS reviewed scope of services and valuation methods used by the Minnesota Public Service Commission and potential areas of valuation that may not be present in the existing methodology. A copy of this presentation is included as Appendix One to this report.

CWL's system load profiles

UFS analyzed the hourly loads for 2013 to identify the time of the system peaks and the area that potential peaks could occur.

Table Three - CWL's MWH's, peak demand of system, date and time of peak demand

DISTRIBUTION SYSTEM (Using 2013 system data)									
Month	Assigned Season	MWhs in Month	Peak Demand Month (MW)	Days in Month	Hours in Month	Monthly Load Factor	System Peak Hour	System Peak Date	System Peak Day
January	W	98,583	162.20	31	744	82%	19	1/14/2013	Monday
February	W	86,756	152.40	28	672	85%	19	2/13/2013	Wednesday
March	W	85,661	138.40	31	744	83%	20	3/4/2013	Monday
April	INTER4	82,583	141.00	30	720	81%	21	4/21/2013	Sunday
May	INTER4	91,298	174.20	31	744	70%	17	5/28/2013	Tuesday
June	INTER2	107,496	213.00	30	720	70%	17	6/22/2013	Saturday
July	S	121,129	229.00	31	744	71%	17	7/31/2013	Wednesday
August	S	119,144	230.20	31	744	70%	17	8/5/2013	Monday
September	INTER2	95,866	179.00	30	720	74%	17	9/4/2013	Wednesday
October	INTER4	85,679	165.00	31	744	70%	16	10/1/2013	Tuesday
November	INTER4	83,816	155.60	30	720	75%	18	11/27/2013	Wednesday
December	W	93,769	164.60	31	744	77%	19	12/4/2013	Wednesday
TOTAL		**1,151,800**	**2,105**	**365**	**8,760**				

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CWL's average usage by hour and season was identified to determine when peaks could occur and the on-peak period that will be used to identify the peak production of wind and solar.

Table Four hourly CWL usages by season and hour

	AVERAGE MWh BY SEASON			
Hour	S	W	INTER2	INTER4
1	135.26	110.71	117.51	99.72
2	126.42	107.74	109.97	95.74
3	120.02	106.18	104.80	92.50
4	116.13	105.62	101.45	90.79
5	114.40	106.82	100.26	91.18
6	116.70	111.94	102.83	95.06
7	122.65	123.20	111.03	104.91
8	133.21	131.28	121.82	113.61
9	145.14	132.89	131.08	118.90
10	157.88	133.69	140.72	122.93
11	169.49	134.40	150.12	126.85
12	179.15	133.14	157.01	128.74
13	186.32	131.17	161.85	129.04
14	192.87	129.46	166.96	129.74
15	197.35	127.73	170.08	129.80
16	200.48	127.10	172.50	129.90
17	202.36	129.95	174.07	131.27
18	200.48	137.15	172.01	133.13
19	196.20	141.26	168.69	133.40
20	188.85	140.48	165.46	132.50
21	185.42	138.92	162.42	132.85
22	178.21	133.58	155.89	127.73
23	163.05	124.54	142.54	117.44
24	147.34	115.66	128.31	106.81

S = Summer (July, August)
W = Winter (December, January, February, March)
Inter 2 – (June, September)
Inter 4 – Valley period (April, May, October, November)

Determination of on peak hours

The analysis of hourly system data identified the following on-peak hours:

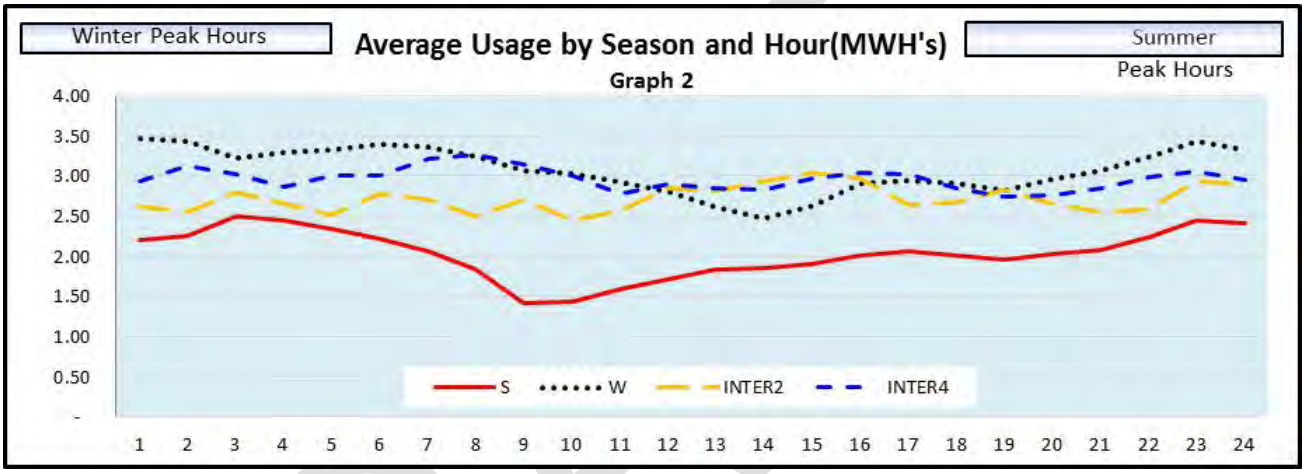
Summer – 14:00 – 19:00
Winter – 17:00 – 22:00
Inter 2 – 14:00 – 19:00
Inter 4 – 16:00 – 21:00

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Analysis of Renewables Production

The hourly production for 2013 was analyzed for the wind and solar resources. The graph below is the production from Crystal Lake for each hour broken down by season.

Graph One – Hourly Wind Production – Crystal Lake



The table below is the MWH's produced each month for Crystal Lake, the peak production and the time the unit produced at its maximum capacity.

Table Five – Crystal Lake Production Characteristics

CRYSTAL LAKE (BILLED MWh)									
Month	Assigned Season	MWhs in Month	Peak Demand Month (MW)	Days in Month	Hours in Month	Monthly Load Factor	System Peak Hour	System Peak Date	System Peak Day
January	W	2,789	8.14	31	744	46%	11	1/13/2013	Sunday
February	W	2,219	8.09	28	672	41%	2	2/22/2013	Friday
March	W	1,729	8.19	31	744	28%	13	3/18/2013	Monday
April	INTER4	2,722	8.30	30	720	46%	23	4/3/2013	Wednesday
May	INTER4	2,376	8.91	31	744	36%	24	5/14/2013	Tuesday
June	INTER2	1,897	11.49	30	720	23%	9	6/5/2013	Wednesday
July	S	1,846	8.24	31	744	30%	13	7/13/2013	Saturday
August	S	1,188	8.06	31	744	20%	3	8/25/2013	Sunday
September	INTER2	2,022	8.24	30	720	34%	8	9/30/2013	Monday
October	INTER4	1,755	7.93	31	744	30%	8	10/27/2013	Sunday
November	INTER4	1,844	8.13	30	720	32%	23	11/3/2013	Sunday
December	W	2,212	8.13	31	744	37%	5	12/29/2013	Sunday
TOTAL		**24,600**	**102**	**365**	**8,760**				

Graph Two – Hourly Wind Production– Bluegrass

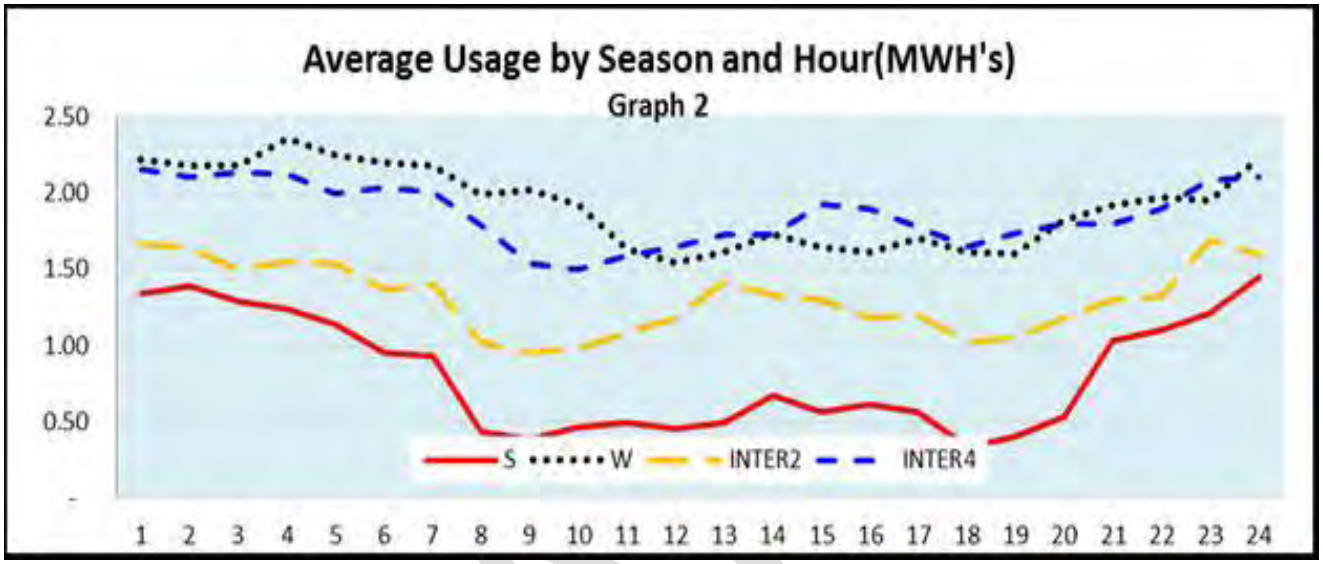


Table Six – Bluegrass Production Characteristics

BLUEGRASS WIND PRODUCTION									
Month	Assigned Season	MWhs in Month	Peak Demand Month (MW)	Days in Month	Hours in Month	Monthly Load Factor	System Peak Hour	System Peak Date	System Peak Day
January	W	1,696	6.00	31	744	38%	7	1/6/2013	Sunday
February	W	1,007	6.00	28	672	25%	24	2/11/2013	Monday
March	W	1,700	6.00	31	744	38%	18	3/3/2013	Sunday
April	INTER4	1,610	6.00	30	720	37%	16	4/3/2013	Wednesday
May	INTER4	972	6.00	31	744	22%	11	5/13/2013	Monday
June	INTER2	1,101	6.00	30	720	25%	13	6/11/2013	Tuesday
July	S	670	5.00	31	744	18%	24	7/7/2013	Sunday
August	S	540	6.00	31	744	12%	3	8/2/2013	Friday
September	INTER2	786	5.00	30	720	22%	2	9/9/2013	Monday
October	INTER4	1,311	6.00	31	744	29%	20	10/14/2013	Monday
November	INTER4	1,560	6.00	30	720	36%	11	11/3/2013	Sunday
December	W	1,168	6.00	31	744	26%	23	12/9/2013	Monday
TOTAL		**14,100**	**70**	**365**	**8,760**				

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EXECUTIVE SUMMARY – RATE IMPACTS OF RENEWABLES

The wind resources were combined and the average production during on peak hours was identified and is listed in the table below:

Table Seven – Total Production Characteristics of Wind Generation

Combined Wind Production and Production at System Peak							
		Capacity Factor				Production @ System Peak	
Month	Peak	Hours	mWh Produced	100% Load Factor	Capacity Factor	Average Production during On-Peak Hours	Capacity Factor @ Peak
January	14.14	744	4,485	13,013	34%	4.8	27%
February	14.09	672	3,226	11,753	27%	4.8	27%
March	14.19	744	3,429	13,013	26%	4.8	27%
April	14.30	720	4,332	12,593	34%	4.7	27%
May	14.91	744	3,348	13,013	26%	4.7	27%
June	17.49	720	2,998	12,593	24%	4.0	23%
July	13.24	744	2,516	13,013	19%	2.5	14%
August	14.06	744	1,728	13,013	13%	2.5	14%
September	13.24	720	2,808	12,593	22%	4.0	23%
October	13.93	744	3,066	13,013	24%	4.7	27%
November	14.13	720	3,404	12,593	27%	4.7	27%
December	14.13	744	3,380	13,013	26%	4.8	27%

The average production from the wind units during the on peak hours was used to value the capacity component of wind generation and is listed below.

Table Seven – Average production of Wind during on peak hours

Season	Average Production
Summer	2.5 MW
Winter	4.8 MW
Inter 2	4.0 MW
Inter 4	4.7 MW

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Load Characteristics of Solar Generation.

Graph Three – Hourly Solar Production Characteristics – Quaker 10 MW Unit

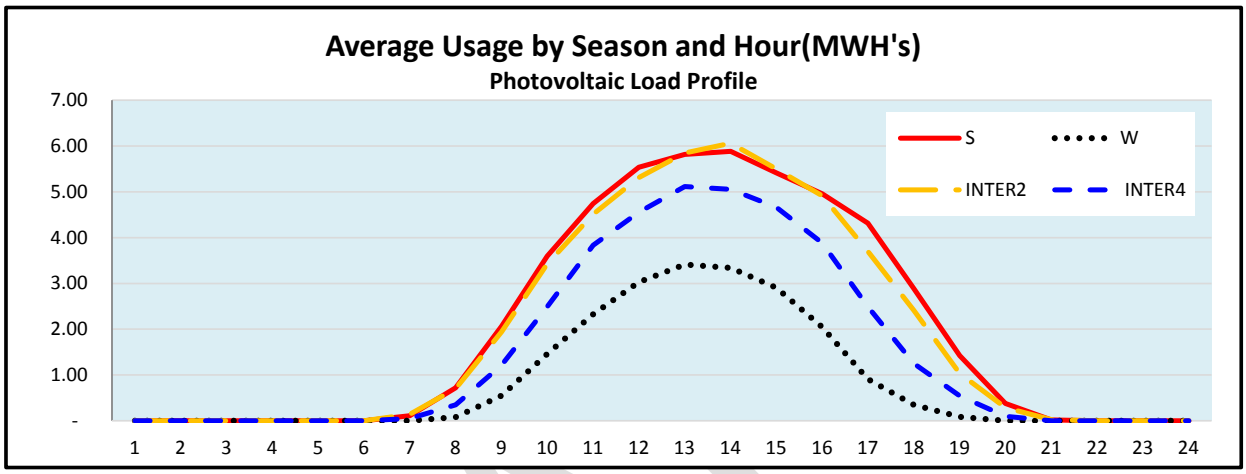


Table Eight – Quaker 10 MW Production Characteristics

QuakerSolar 10kW (2013)									
Month	Assigned Season	MWhs in Month	Peak Demand Month (MW)	Days in Month	Hours in Month	Monthly Load Factor	System Peak Hour	System Peak Date	System Peak Day
January	W	565	6.40	31	744	12%	13	1/25/2013	Friday
February	W	670	8.07	28	672	12%	13	2/19/2013	Tuesday
March	W	791	8.66	31	744	12%	15	3/20/2013	Wednesday
April	INTER4	1,217	9.04	30	720	19%	14	4/24/2013	Wednesday
May	INTER4	1,348	9.07	31	744	20%	14	5/11/2013	Saturday
June	INTER2	1,508	8.24	30	720	25%	14	6/3/2013	Monday
July	S	1,538	8.18	31	744	25%	14	7/1/2013	Monday
August	S	1,430	8.33	31	744	23%	14	8/17/2013	Saturday
September	INTER2	1,241	7.61	30	720	23%	14	9/21/2013	Saturday
October	INTER4	1,045	7.06	31	744	20%	14	10/8/2013	Tuesday
November	INTER4	733	6.60	30	720	15%	14	11/3/2013	Sunday
December	W	454	5.82	31	744	10%	14	12/31/2013	Tuesday
TOTAL		**12,500**	**93**	**365**	**8,760**				

Load Characteristics of Solar Generation.

Graph Four – Hourly Solar Production Characteristics – Quaker 5 MW Unit

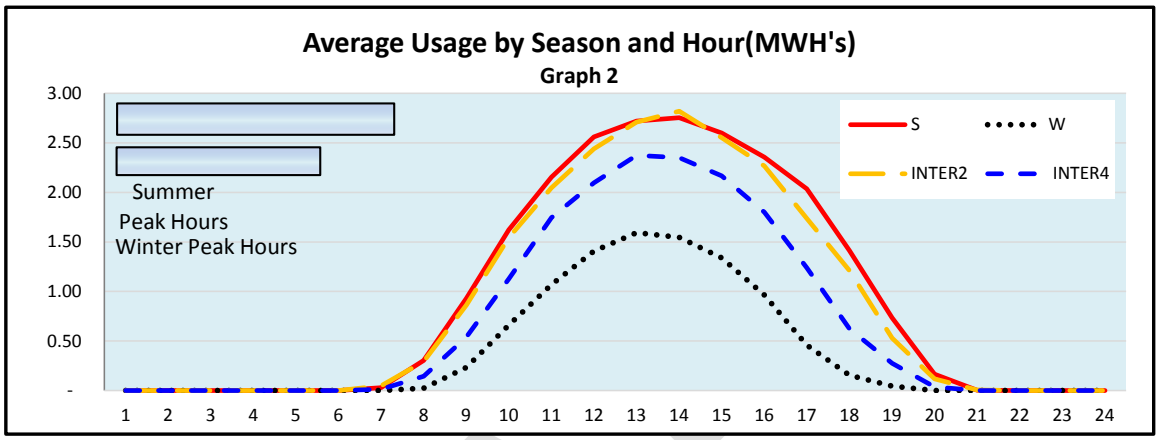


Table Nine – Quaker 5 MW Production Characteristics

QuakerSolar 5kW (2013)									
Month	Assigned Season	MWhs in Month	Peak Demand Month (MW)	Days in Month	Hours in Month	Monthly Load Factor	System Peak Hour	System Peak Date	System Peak Day
January	W	267	2.98	31	744	12%	13	1/25/2013	Friday
February	W	307	3.79	28	672	12%	13	2/19/2013	Tuesday
March	W	368	4.11	31	744	12%	15	3/20/2013	Wednesday
April	INTER4	573	4.27	30	720	19%	14	4/24/2013	Wednesday
May	INTER4	627	4.28	31	744	20%	14	5/11/2013	Saturday
June	INTER2	696	3.87	30	720	25%	14	6/3/2013	Monday
July	S	725	3.85	31	744	25%	14	7/1/2013	Monday
August	S	662	3.92	31	744	23%	14	8/17/2013	Saturday
September	INTER2	575	3.54	30	720	23%	14	9/21/2013	Saturday
October	INTER4	481	3.24	31	744	20%	14	10/1/2013	Tuesday
November	INTER4	337	3.02	30	720	15%	14	11/12/2013	Tuesday
December	W	207	2.68	31	744	10%	13	12/7/2013	Saturday
TOTAL		**5,800**	**44**	**365**	**8,760**				

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EXECUTIVE SUMMARY – RATE IMPACTS OF RENEWABLES

The solar resources were combined and the average production during on peak hours was identified and is listed in the table below:

Table Ten – Total Production Characteristics of Solar Generation

Combined Solar Production and Production at System Peak							
		Capacity Factor				Production @ System Peak	
Month	Peak	Hours	kwh Produced	100% Load Factor	Capacity Factor	Average Production during On-Peak Hours	Capacity Factor @ Peak
January	9.37	744	832	11,160	7%	0.3	2%
February	11.86	672	977	10,080	10%	0.3	2%
March	12.76	744	1,159	11,160	10%	0.3	2%
April	13.31	720	1,789	10,800	17%	2.0	14%
May	13.35	744	1,974	11,160	18%	2.0	14%
June	12.11	720	2,204	10,800	20%	5.8	39%
July	12.03	744	2,263	11,160	20%	6.1	41%
August	12.25	744	2,092	11,160	19%	6.1	41%
September	11.15	720	1,816	10,800	17%	5.8	39%
October	10.29	744	1,526	11,160	14%	2.0	14%
November	9.62	720	1,071	10,800	10%	2.0	14%
December	8.50	744	661	11,160	6%	0.3	2%

The average production from the wind units during the on peak hours was used to value the capacity component of wind generation and is listed below.

Table Eleven – Average production of Wind during on peak hours

Season	Average Production
Summer	6.1 KW
Winter	0.3 KW
Inter 2	5.8 KW
Inter 4	2.0 KW

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Value of Renewable Capacity

CWL obtained bids on market value of capacity from 2017 – 2027 and is listed in the table below. The average value of capacity over this period was $3.46/KW-Month when the reserve component of 14% is added the capacity value increases to $3.94/KW-Month or $47.33 KW Year. The current methodology used by CWL does not include a capacity component and it is recommended a capacity component be added to the renewables valuation.

Table Twelve – Capacity Value for 2017 - 2027

Year		Market Capacity Value
2017	$	2.50
2018		2.70
2019		2.90
2020		3.10
2021		3.30
2022		3.50
2023		3.70
2024		4.00
2026		4.30
2027		4.60
Average Value	**$**	**3.46**
Reserve Capacity		14%
Adjusted Capacity Value - Monthly	**$**	**3.94**
Annual Capacity Value	**$**	**47.33**

The capacity value of $47.33 was applied to the estimated production from wind and solar during the on peak hours. The wind production at the time of the system peak for the summer was 2,497 KWH (2.5 MWH) and resulted in a value of $118,189. When the value is divided by the total KWH production of wind resulted in a capacity value of 0.0031/kWh.

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Table Thirteen – Capacity Value of Wind Generation

Wind Capacity Value	
Estimated Production at Annual Peak of System - kW	2,497
Marginal Cost of Capacity - kW	$ 47.33
Total Value	**118,189**
kWh Production	38,719,796
Capacity Value per kWh	**0.0031**

Solar production at the time of CWL's peak was 6.1 KW and resulted in a value of 0.0158/kWh of solar production.

Solar Capacity Value	
Estimated Production at Annual Peak of System	6.1
Marginal Cost of Capacity	$ 47.33
Total Value	**$ 290.09**
kWh Production	18,364
Capacity Value per kWh	**0.0158**

These values were applied to the production of each renewable generating unit and resulted in the following modifications to adjust for capacity values.

2013 Report Values								
	Blue Grass - Wind	Crystal Lake - Wind	Jeffereson City Land Fill	Columbia Landfill	WasteWood	Solar - Free Power	Net Metered Solar One	Total
mWh's Produced	13,985	24,189	21,840	13,326	8,971	424	120	82,855
Value per mWh	32.59	18.30	54.88	54.88	54.25	36.47	36.81	40.25
Value- Total	455,771	442,659	1,198,579	731,331	486,677	15,474	4,409	3,334,899
Cost - mWh	67.76	56.76	53.05	47.38	38.11	54.95	94.40	54.16
Total Cost	947,624	1,372,968	1,158,612	631,386	341,885	23,315	11,306	4,487,095
Total Value	**$ 491,852**	**$ 930,309**	**$ (39,967)**	**$ (99,945)**	**$ (144,792)**	**$ 7,841**	**$ 6,898**	**$ 1,152,196**
2013 North American Renewable Registry Membership								$ 14,000
2013 Photovoltaic Rebates to Customers								43,305
2013 Capacity Credit for Wind Resources								(6,570)
Total Impact on 2013 Rates								**$ 1,202,931**
Avoided Capacity Costs	**0.0031**	**0.0031**				**0.0158**	**0.0158**	
Capacity Value	**$ 42,688**	**$ 73,835**	**$ -**	**$ -**	**$ -**	**$ 6,702**	**$ 1,892**	**$ 125,117**
Adjusted Value (Cost) for 3% Rate Determination								**$ 1,077,813**

1) The value per MWH for landfill gas is based on the average production cost of existing base load generation which includes a capacity component. No changes are recommended in the valuation
2) Waste wood does not add capacity but replaces natural gas and the valuation is determined using the difference in the variable cost of fuel to the cost of waste wood. No changes to the existing methodology is recommended

Recommendations

1. CWL should apply the following capacity values in the determination of rate impacts to customers.

   Wind - 0.0031/KWH
   Solar - 0.0158/KWH

2. No change from the current methodology is recommended for landfill gas and waste wood.

3. The analysis completed by UFS used the market capacity values provided by CWL. It is recommended the capacity values be periodically reviewed

4. The analysis is based on the system load profile data for 2013. System load profile data can change periodically due to addition of load or weather patterns. It is recommended CWL periodically review the load profile data to ensure the on peak hours are consistent with the hours used in this analysis.

5. The load profiles for Wind and Solar are not anticipated to change unless new technologies such as battery back-up are installed on the renewable generation. As technology changes it may have an impact on the results of this analysis

6. It is recommended CWL review this analysis every three years.

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ENVIRONMENT & ENERGY COMMISSION

City of Columbia & County of Boone
City Hall, Conference Room 1A

February 23, 2016

Mayor McDavid and Council Members,

Re: 2016 Renewable Energy Report

The Environment and Energy Commission is disappointed to see that the quantity of renewable energy in 2015 has declined from 2014. Columbia is not on track at 6.8% to meet our 2018 renewable energy goal of 15%. In addition, the EEC raised two issues in the 2015 report that were not resolved in the 2016 report.

We still have issues with the report. Specifically, calculations of net-metering costs confuse opportunity costs with paid costs. This results in an inflated cost for renewable energy.

Renewable energy charges net-metering as a cost in the report.

> *"For calendar year 2015, the average real-time Columbia LMP for the hours when the customer-owned solar resources were producing energy was $25.38 per megawatt hour.* ***The average retail energy price is $90.17 per megawatt hour. The difference in these two values is the renewable energy cost of $64.79 per megawatt hour."*** *(Renewable Energy Report, page 6)*

This statement confuses opportunity costs with paid costs - resulting in an inflated cost for renewable energy. Were it not for these net-metered systems, Columbia Water & Light (CWL), would have bought market energy, marked it up to residential rates, and sold it to those customers. The difference (or renewable cost of $64.79) in the two values represents an opportunity cost of not-selling fossil fuel energy to these customers. This is not an actual paid cost and exaggerates the cost of renewable energy. It is similar to calculating savings due to adding attic insulation as cash outlays to the utility.

The EEC continues to recommend that future reports not exaggerate net-metered costs.

We do not want to use accounting practices that undervalue renewable energy and overestimate its cost. In 2016, we are well below the 3% maximum "impact on rates" permitted in the Renewable Energy Ordinance – appearing that there is no immediate negative impact from these accounting practices. However, continuing this accounting practice gives a misleading impression that we will only be able to afford 20% renewable energy in 2028 rather than the 30% which is the goal. We believe the 30% goal is achievable and affordable.

Respectfully Yours,

Jan Dye
Environment and Energy Commission, Chair

Renewable Energy Report 2016 comments 4/6/16

The Water and Light Advisory Board feels that the acquisition of renewable energy is progressing appropriately and is well demonstrated in the 2016 Renewable Energy Report. However, we have some concerns about the method used to calculate the "impact on rates" from obtaining renewable energy as it is presented in the Report.

A) Photovoltaic Electricity

An initial disagreement with the method used to calculate the impact on rates used in the 2016 Renewable Energy Report is the charge of $0.0917 ($91.70 per MWH) for each kWh of electricity produced by owner installed photovoltaic systems, *i.e.* net metered customers. This is done on the basis that CWL did not collect much revenue from this energy. There is no direct payment to these PV owners. This *reasoning* is very similar to saying that the energy efficiency savings of 30% *achieved by* City Hall should *be considered* an impact on rates *because it* did not pay for the energy it would have used had it not *been* so efficient.

We agree that it is appropriate to include the cost to CWL of the rebates provided for the installation of PV systems. This has been included in the Report as a separate item. In the numbers presented below in these comments it was included as a cost of Net Metered energy.

As the number of homeowner installed PV systems increases the $0.0917 per kWh cost *will increase substantially.* There are problems with recovering costs for transmission and backup capacity from homeowners with PV systems. CWL is working on a rate structure to address that issue.

It is not appropriate to assign $0.0917 / kWh as an impact on rates for renewable energy, and thus reduce the final quantity of renewable energy which can be purchased in the future.

B) Intermittent Renewable Energy

The major disagreement which the Advisory Board has with the method used to calculate the impact on rates is how that impact is calculated for electricity coming from the intermittent energy sources of wind and solar energy.

CWL spent $56.63 per MWH on intermittent renewable energy in 2015.
CWL spent $55.67 per MWH on non-Intermittent renewable energy in 2015.
CWL spent $61.61 per MWH on non-renewable energy in 2015.
Intermittent renewable energy made up half of our renewable energy last year. Future wind energy is anticipated to cost *approximately* $30 per MWH.

The two *non-intermittent* renewable energy sources are landfill gas, *from which we*

expect only modest increases. The second biomass-burning, which we could increase by converting one boiler at the Columbia Power Plant. This conversion is desirable, if cost effective, but would add only a moderate amount to the total renewable energy. In 2015 non-intermittent renewable energy cost $55.67 per MWH.

The current system used to calculate the Renewable Energy Standard cost impact on rates substantially overestimates the cost of intermittent renewable energy obtained from wind and solar sources.

There are several ways in which one could calculate the cost impact on rates of intermittent renewable energy, four of which are outlined below.

1) **A Dollar to Dollar Comparison**

A direct comparison of what was paid for intermittent renewable energy, $56.63, compared to the cost paid to three companies from which we purchase coal-fired electricity, $61.61. This is probably what the voters were expecting when they passed the referendum by 68% in 2005.

Thus the impact on rates would be a <u>savings</u> of $4.98 per MWH.

The Advisory Board agrees with staff that a direct comparison of payments to fossil-fueled companies and intermittent renewable energy companies is not a realistic comparison because the non-renewable energy is always available and wind and solar energy is not.

2) **Comparison to MISO Market Price (Current System)**

This is the comparison which the Advisory Board believes is inappropriate and greatly over estimates the additional cost of renewable energy.

Intermittent renewable energy cost is currently compared to the Midwest Independent System Operator (MISO) market energy cost to calculate the impact on rates. This market is the cost of energy bid into the market for energy which is not committed to existing contracts. It is essentially the marginal cost of electricity, the price needed to justify producing additional energy at a power plant. It is (A) mainly fuel cost combined with (B) additional maintenance, (C) additional operating costs and (D) profit. It does not cover the capital cost of constructing the power plants as that is covered by electric distribution companies which have long term contracts similar to CWL's contracts. The cost of energy for the MISO market varies hourly on the day ahead market around the mid $20 per MWH at the node where Columbia connects to the grid and $10 at the Crystal Lake wind farm node. The calculated cost averages $15.42 per MWH in the 2016 Renewable Energy Report.

The cost of intermittent renewable energy, $56.63 per MWH, which when compared to the MISO energy market price, $15.42, as it is in the 2016 Renewable Energy Report, places an unrealistically high cost on the impact on rates.

Thus the impact on rates would be an impact of $41.21 per MWH.

This is an unrealistic comparison.
Columbia's contracts with fossil-fueled power plants have two parts. 1) Capacity charges: cover the cost of construction (bonds) and 2) Energy charges cover the cost of fuel, maintenance and operation. For the three companies with which Columbia has contracts, the cost of Capacity *ranges* from 62% of the total *charge* for the least cost capacity to 70% for the highest cost capacity. Those ratios are based upon the companies producing electricity every hour of the year, a very rare occurrence. Since capacity charges are fixed, the capacity cost percentage increases with reduced electricity generation.

Intermittent power producers fueling with Wind and Solar sell electricity but do not split their charges into capacity and energy. Since their fuel is "free" all charges are rolled into a single charge per MWH. As a per MWH charge it makes it look like an "energy" cost when compared to typical electrical contracts despite the fact that it is in reality a capacity cost.

Contracts with wind and solar producers, in addition to contracts with fossil-fueled power plants, are long term contracts with cost stability.

Wind and Solar prices need to be realistically compared to fossil-fueled prices and the MISO market is not a realistic comparison.

3) Comparison of Cash Payments vs. Intermittent Energy Sources Payments which Include a Capacity Charge

One approach to addressing this problem is to calculate a cost which can be added to the cost of the intermittent renewable energy costs which reflects the cost of making energy available all the time. Columbia Energy Center was purchased with this in mind. It was a very cost effective price for Capacity but not a very cost effective plant for generating electricity. We *rarely* use it for producing electricity for CWL because the fuel costs are too high, but we do sell some energy from CEC into the MISO market when requested to do so by MISO.

Columbia Energy Center permits us to purchase energy, which lack accompanying capacity, from the MISO market. It also permits us to sign contracts to buy energy from intermittent renewable energy sources which have low capacity recognition.

We can assign a portion of the cost for the Capacity expense of CEC to the cost of contracts for intermittent renewable energy in our accounting to calculate the impact on

rates of renewable energy. This generates an average $8.95 / MWH cost which can be added to the cost of intermittent renewable energy. Thus resulting in a cost of intermittent renewable energy of $65.58 per MWH.

Thus the impact on rates would be an impact of $3.97 per MWH.

4) Comparison of Iatan II Payments vs. Intermittent Energy Sources which Include a Capacity Charge

Another way we could obtain a realistic comparison of intermittent renewable energy with fossil fueled energy would be to compare it to the cost of another contract for fossil-fueled energy. In 2013 we cancelled a contract with Nearman for 20 MW of capacity with energy because the price of their electricity was increasing too much, primarily due to having to pay local taxes where it was generated. In 2014 CWL sought bids for 20 MW to replace that contract. A contract was not signed because of the inability to come to an agreement on terms of the contract. This attempt to obtain additional fossil-fueled energy illustrates what we would have been paying for such energy at present. Iatan II with our 20 MW contract is the closest we have to that failed contract.

Since then CWL has not sought bids for new contracts from non-renewable energy companies.

Since Columbia owns the Columbia Energy Center (CEC) with about half of the capacity which Columbia is required to have available to meet peak demand we can purchase a significant fraction of our energy from the MISO market which provides no capacity with energy purchases. It is technically possible for CWL to find a buyer for our contract with Iatan II and purchase an equivalent amount of energy on the MISO market for much less cost, saving about $4,000,000 annually. That is roughly what the impact would have been of following through with the contract proposed in 2014. The Advisory Board agrees with the staff that selling Iatan II would not be wise as market prices are subject to unpredictable forces and long term contracts provide cost stability.

The current quantity of renewable energy from intermittent sources is about a quarter of what we would receive from 20 MW of capacity producing energy every hour. The contract with Iatan II is for 20 MW and without the related transmission costs results in a payment of $53.34 per MWH. This can be compared to a cost of intermittent renewable energy of $65.58 per MWH.

Thus the impact on rates would be an impact of $12.24 per MWH.

Summary Table of the Alternative Comparison Methods

Comparison of	Impact on rates	Intermittent	vs.

	Comparison Energy Costs	Renewable Energy		Fossil-fueled Energy
Cash outlays	$5.41 / MWH	$56.63 / MWH	vs.	$61.61 / MWH
MISO market	$41.21 / MWH	$56.63 / MWH	vs.	$15.42 / MWH
Cash outlays with Intermittent energy charged Capacity	$3.97 / MWH	$65.58 / MWH	vs.	$61.61 / MWH
Iatan II outlays with Intermittent energy charged Capacity	$12.24 / MWH	$65.58 / MWH	vs.	$53.34 / MWH

The last two ways for calculating the impact on rates for intermittent renewable energy are acceptable to the Water & Light Advisory Board.

Up to this time the quantity of renewable energy has been so low that the manner in which the calculations are done to generate the “impact of the cost of renewable energy on rates” has been of little consequence. Using the current calculation process with the inappropriately high apparent cost will probably still permit us to obtain 15% renewable energy in 2018. It would be impossible to reach the 2022 goal while staying within the 3% of retail electricity sales cap. This is particularly true if we have a more appropriate split in renewable energy between wind and solar. Each should be about half to more closely match our load. The cost of wind has come down considerably below the cost of solar and will likely stay that way.

The Advisory Board has recommended several times that a realistic method of estimating the “impact of the cost of renewable energy on rates” be developed. Since it has not been done by staff we recommend that the City Council adopt an appropriate methodology.

The Water & Light Advisory Board recommends that a City Council work session be scheduled that includes the Water & light Department Staff, Water & Light Advisory Board and the Environment and Energy Commission. The purpose of the work session is to have an open discussion of the methodology to be used to calculate the cost of the renewable energy and the 3% limitation by ordinance. We find the matter to be complex and that when considering the methodology that different options may be pursued in making the determination. Additionally, the resulting methodology will have a future impact on determining compliance with recently changed levels of renewable energy.