

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

Utility Financial Solutions, LLC
185 Sun Meadow Court
Holland, MI USA 49424

(616) 393-9722

Fax (616) 393-9721

Email: mbeauchamp@ufsweb.com

Submitted Respectfully by:

Mark Beauchamp, CPA, CMA, MBA

President, Utility Financial Solutions



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
APPENDICES:	
ONE – INITIAL PRESENTATION TO BOARD OF DIRECTORS	
TWO – PRESENTATION OF RESULTS TO BOARD OF DIRECTORS	

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 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 is 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)

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	Jefferson 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

COLUMBIA WATER AND LIGHT ELECTRIC DEPARTMENT

EXECUTIVE SUMMARY – RATE IMPACTS OF RENEWABLES

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				

COLUMBIA WATER AND LIGHT ELECTRIC DEPARTMENT

EXECUTIVE SUMMARY – RATE IMPACTS OF RENEWABLES

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

Hour	AVERAGE MWh BY SEASON			
	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

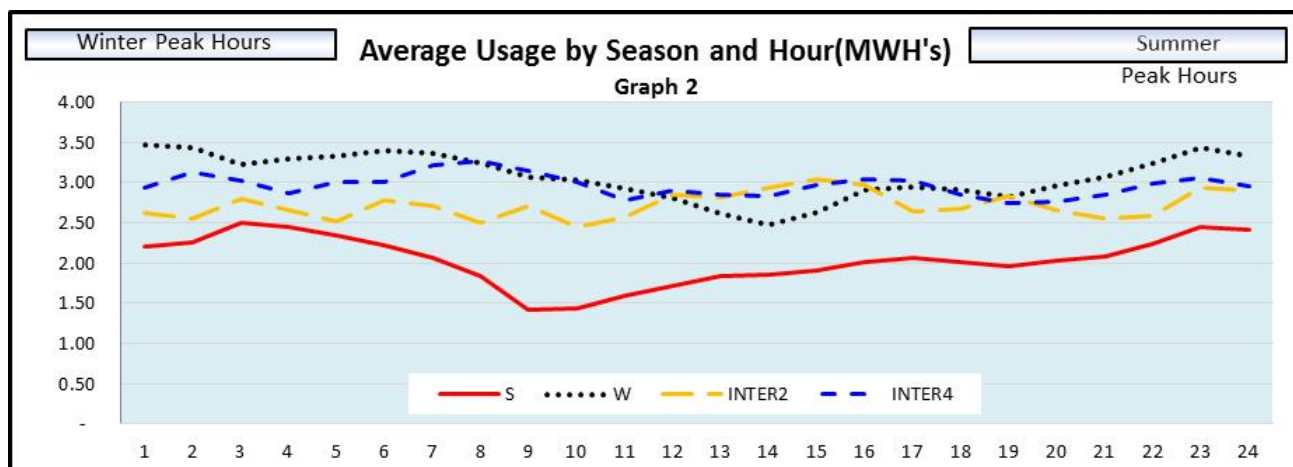
COLUMBIA WATER AND LIGHT ELECTRIC DEPARTMENT

EXECUTIVE SUMMARY – RATE IMPACTS OF RENEWABLES

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				

COLUMBIA WATER AND LIGHT ELECTRIC DEPARTMENT

EXECUTIVE SUMMARY – RATE IMPACTS OF RENEWABLES

Graph Two – Hourly Wind Production– Bluegrass

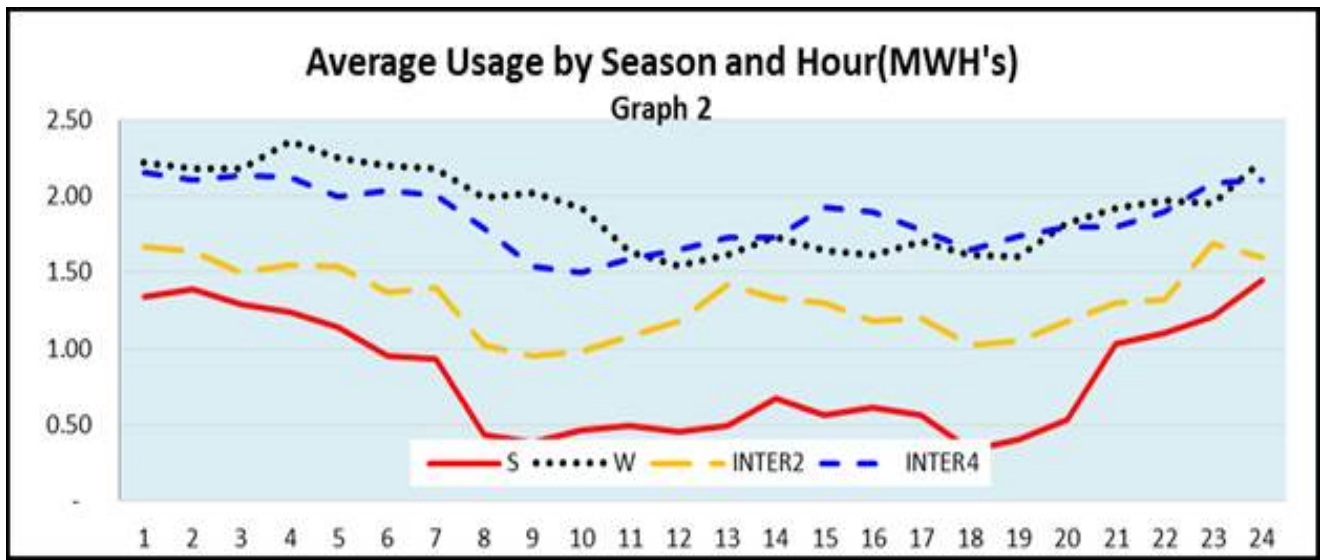


Table Six – Bluegrass Production Characteristics

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				

COLUMBIA WATER AND LIGHT ELECTRIC DEPARTMENT

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					Average	
		Hours	mWh Produced	100% Load Factor	Capacity Factor	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

COLUMBIA WATER AND LIGHT ELECTRIC DEPARTMENT

EXECUTIVE SUMMARY – RATE IMPACTS OF RENEWABLES

Load Characteristics of Solar Generation.

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

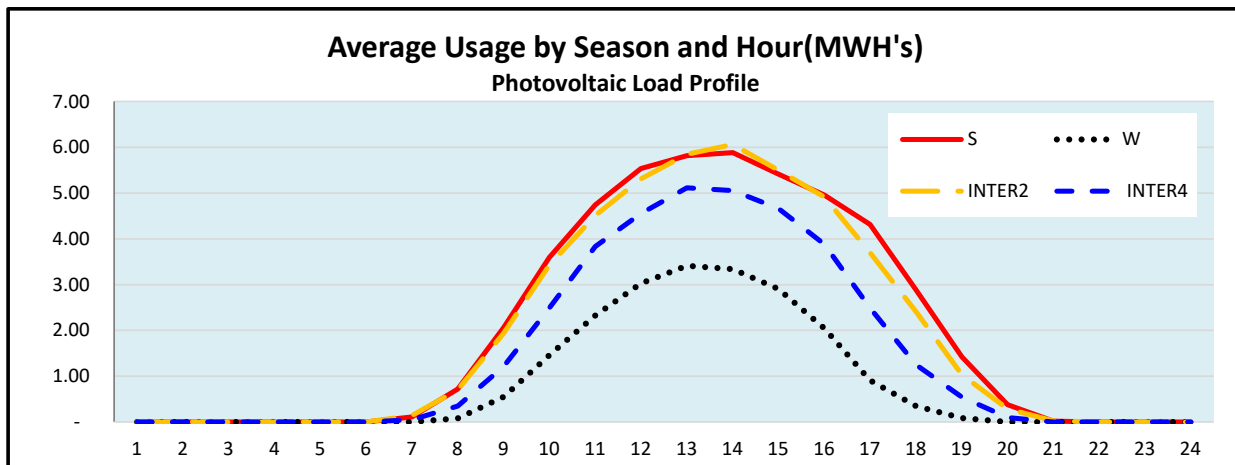


Table Eight – Quaker 10 MW Production Characteristics

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				

COLUMBIA WATER AND LIGHT ELECTRIC DEPARTMENT

EXECUTIVE SUMMARY – RATE IMPACTS OF RENEWABLES

Load Characteristics of Solar Generation.

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

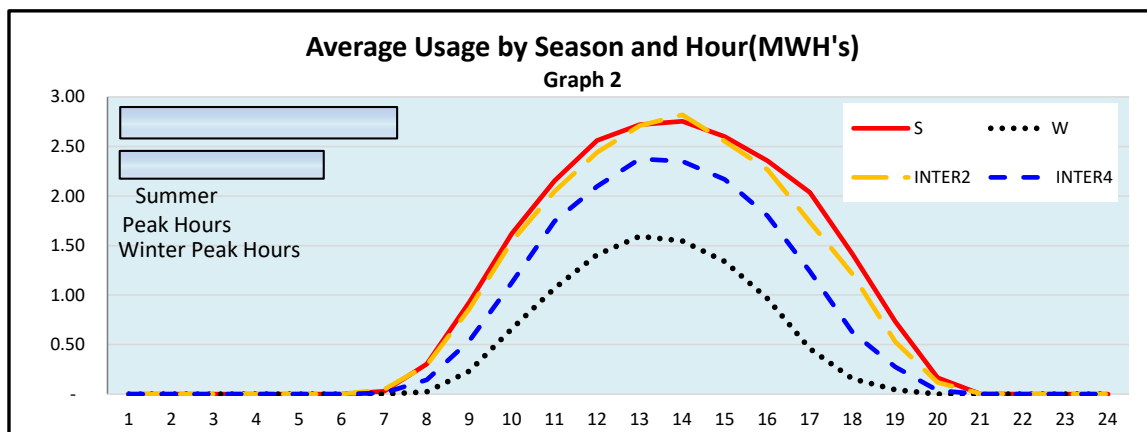


Table Nine – Quaker 5 MW Production Characteristics

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				

COLUMBIA WATER AND LIGHT ELECTRIC DEPARTMENT

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					Average	
		Hours	kwh Produced	100% Load Factor	Capacity Factor	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

COLUMBIA WATER AND LIGHT ELECTRIC DEPARTMENT

EXECUTIVE SUMMARY – RATE IMPACTS OF RENEWABLES

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.

COLUMBIA WATER AND LIGHT ELECTRIC DEPARTMENT

EXECUTIVE SUMMARY – RATE IMPACTS OF RENEWABLES

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	Jefferson 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

COLUMBIA WATER AND LIGHT ELECTRIC DEPARTMENT

EXECUTIVE SUMMARY – RATE IMPACTS OF RENEWABLES

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.