Integrated Resource Plan

for the

Water and Light Department
City of Columbia, Missouri

Project Number 46806

2008

Burns & McDonnell
SINCE 1898

Final Report
on the
Integrated Resource Plan

prepared for

Water and Light Department
City of Columbia, Missouri

September 2008

Project No. 46806

prepared by

Burns & McDonnell Engineering Company, Inc.
Kansas City, Missouri

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September 29, 2008

Mr. Mike Schmitz
Engineering Manager
CWL
105 East Ash St.
Columbia, MO 65205

CWL Integrated Resource Plan
Final Report of the Integrated Resource Plan
Project: 46806

Dear Mr. Schmitz:

The attached "Final Report on the CWL Integrated Resource Plan" is provided in accordance with the authorization provided by CWL for Burns & McDonnell to review its future power supply needs. The report provides the methodology of the analysis, assumptions used and the results of the analysis of the supply and demand side options considered germane to CWL.

APPROACH

Burns & McDonnell developed various supply and demand side options considered suitable for CWL to review as a means to meet the CWL forecast load obligations. The supply side options included:

- solar, wind and biomass options,
- local and remote coal-fired options,
- local gas-fired combustion turbine and engine generator options, including combined heat and power,
- pumped hydro storage option, and
- market purchases of capacity and energy

At the direction of the Task Force, nuclear energy was not considered viable as an option for CWL at this time. Fixed and variable operating costs, investment costs, operating characteristics and other assumptions necessary to model the option in the production cost models were developed by Burns & McDonnell. Fuel cost projections were developed for the various coal and gas resources. Projections of emission costs and rates, including estimates for carbon emissions, were also included. All of the assumptions considered in the analysis are provided in the report.

Carbon regulation in the integration phase was modeled based on the proposed Warner-Lieberman Bill. The regulation was assumed to begin in 2015 with an initial carbon credit cost of $30 per ton.

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The demand-side options included the following major categories of programs:

- HVAC modifications
- Lighting
- Appliances
- Thermal envelope

The demand side options were considered for the residential, commercial and industrial sectors. Residential properties were reviewed for single family homes, duplexes, apartments and mobile homes. Commercial buildings were reviewed by type, such as banks, restaurants, etc. The current programs offered by CWL were also included.

The assumptions for the options were taken from a variety of sources including Department of Energy databases, the Statewide Saturation Study, Burns & McDonnell's experience as an energy services provider and CWL. The options were analyzed in the resource optimization model alongside the optimum supply side case. This provided detailed consideration of the program impacts as compared to the benefits to reductions in supply side costs as determined using the load forecast with no additional DSM activities other than those currently pursued by CWL.

SUMMARY OF RECOMMENDATIONS

Based on the conclusions discussed in the report, the analysis of CWL's system and Burns & McDonnell's knowledge of the electric utility industry, the following recommendations are offered to CWL for consideration. Burns & McDonnell recommends that CWL should:

1. Pursue the future outlined in the regulated carbon future with DSM. The cost for this future is not significantly different than a future without carbon legislation in the first several years.
2. Work with the City to improve building code standards for commercial and residential structures that have a minimum energy consumption goal of an Energy Star rating. Programs to encourage higher Energy Star ratings should be developed using information provided herein.
3. Implement the demand side management programs as outlined. Add staff as necessary at CWL to aggressively pursue these programs and work through the existing building stock over the next ten years. Increase the data gathering for end-use inventories, ages of appliances, use per consumer, and other information needed to refine the evaluation of DSM programs through energy audits on the majority of existing residential and commercial facilities. Increase the verification process for the programs to make sure they are on track to meet the projected demand and energy reductions.

4. Continue its aggressive pursuit of demand side involvement by the deployment of time of use metering and pricing structure to customers. Industrial and commercial customers should be the first to be moved to time of use pricing followed by residential. This metering can also be used in the further deployment of a Smart Grid.
5. Prepare in early 2010 to install two engine sets of approximately 8MW each for a commercial operating date of 2012 should the economics reviewed herein remain as studied.
6. Determine if there is sufficient interest from other utilities in the state to develop the biomass repowering project at CWL's local power plant. Should the renewable referendum being considered by Missouri become law, this type of option could hold significant benefit for other Missouri utilities.
7. Acquire additional wind energy (or equivalently priced other renewable energy) in the quantities and on the time line as shown in the regulated carbon future with DSM.
8. Pursue the transmission projects with AECI necessary to improve the firm import capability.
9. Update the integrated resource plan in 2012 to 2013. This should be sufficient time to determine the success of the demand side programs, have better clarity about the legislation regarding carbon and more knowledge about the advances in renewable energy technologies.

We look forward to meeting with the Task Force and the public to discuss the analysis of the supply side and demand side options and the recommended portfolio of demand and supply side activities to meet CWL's future load obligations. Should you have any questions or comments, please do not hesitate to call.

Sincerely,

Jeff Greig
General Manger

Kiah Harris, PE
Project Manager

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LIST OF ABBREVIATIONS AND ACRONYMS

AC	Air Conditioner
ACH	Air Changes per Hour
AECI	Associated Electric Cooperative, Inc.
AHU	Air Handling Unit
Burns & McDonnell	Burns & McDonnell Engineering, Inc.
BOC	Building Operators Certification
BPU	Board of Public Utilities
CCGT	Combined Cycle Gas Turbine
CFB	Circulating Fluidized Bed
CFL	Compact Fluorescent Light/Bulb
CHP	Combined Heat and Power
COD	Commercial Operating Date
CSP	Concentrating Solar Power
CWL	City of Columbia, Missouri, Water and Light Department
DLC	Direct Load Control
DOE	Department of Energy (U.S.)
DSM	Demand Side Management
EIA	Energy Information Agency (Department of Energy)
EPA	Environmental Protection Agency (U.S. Government)
EPC	Engineer Procure Construct
EUI	Energy Use Intensity
FCTTC	First Contingency Total Transfer Capacity
GT	Gas Turbine
HRSG	Heat Recovery Steam Generator

HVAC	Heating, Ventilation, and Air Conditioning
IDC	Interest During Construction
IGCC	Integrated Gasification Combined Cycle
IRP	Integrated Resource Plan
KCP&L	Kansas City Power and Light Company
kW	Kilowatt
kWh	Kilowatt Hour
LEED	Leadership in Energy & Environmental Design (U.S. Green Building Council)
LGS	Large General Service
LMP	Locational Marginal Pricing
MEF	Modified Energy Factor
MISO	Midwest Independent Transmission System Operator, Inc.
MJMEUC	Missouri Joint Municipal Electric Utility Commission
MMBtu	Million British Thermal Units
MW	Megawatt
MWh	Megawatt Hour
NPV	Net Present Value
NREL	National Renewable Energy Laboratory
O&M	Operations and Maintenance
PC	Pulverized Coal
PPA	Power Purchase Agreement
PRB	Powder River Basin
PSEC	Prairie State Energy Campus
PV	Photovoltaic (solar collector)
RPS	Renewable Portfolio Standard
RTU	Roof Top Units

SCPC	Super Critical Pulverized Coal
SEER	Seasonal Energy Efficiency Ratio
SGS	Small General Service
TES	Thermal Energy Storage

EXECUTIVE SUMMARY

EXECUTIVE SUMMARY

Burns & McDonnell Engineering Company, Inc. (Burns & McDonnell) was retained by the City of Columbia, Missouri, Water and Light Department (CWL) to perform an Integrated Resource Plan (IRP or Study) that evaluates the potential development of supply side and demand side resources to meet the future load requirements of Columbia, Missouri. The outline of the study included discussion of the major findings from the separate supply side and demand side analyses prior to the final integration phase. This report presents an overview of the separate supply and demand side analyses and the final integration of the supply side and demand side options.

ES.1 DESCRIPTION OF CWL

CWL is a municipal utility that provides electric and water services to customers within the city boundaries of Columbia, Missouri. CWL began providing service to the residents of Columbia in 1904. The approximate service territory of CWL is indicated on Figure 1-1. As of December 2007, CWL served approximately 44,000 residential, commercial, and large commercial/industrial customers.

ES.2 LOAD FORECAST

The load forecast used in the analysis was based on a load forecast provided by CWL. The combined system energy requirements are projected to grow at an average annual rate of 1.8 percent during the time period. The load factor is projected to remain steady at 50 percent over the study period. Demand is expected to grow at the same percentage (1.8 percent) as the annual energy growth. The combined base energy and demand requirements forecast for the CWL load are shown in Table ES-1.

A utility is also required to maintain reserves to meet unit outages and planning uncertainties due to weather impacts. Prudent utilities also use reserves to meet economic growth larger than expected. CWL operates in the Midwest Independent Transmission System Operator, Inc. (MISO) region. MISO requires that members maintain a 14 percent reserve level above peak load less firm purchases.

Table ES-1: CWL Demand and Energy Forecast

Year	Coincident Peak Demand (MW)	Annual Growth (percent)	Total Energy (MWh)	Annual Growth (percent)	Load Factor (percent)
2008	278.0	-	1,220,976	-	50.00
2009	284.0	2.16	1,243,920	1.88	50.00
2010	289.0	1.76	1,265,820	1.76	50.00
2011	295.0	2.08	1,292,100	2.08	50.00
2012	300.0	1.69	1,317,600	1.97	50.00
2013	306.0	2.00	1,340,280	1.72	50.00
2014	311.0	1.63	1,362,180	1.63	50.00
2015	317.0	1.93	1,388,460	1.93	50.00
2016	322.0	1.58	1,414,224	1.86	50.00
2017	328.0	1.86	1,436,640	1.59	50.00
2018	333.0	1.52	1,458,540	1.52	50.00
2019	339.0	1.80	1,484,820	1.80	50.00
2020	344.0	1.47	1,510,848	1.75	50.00
2021	350.0	1.74	1,533,000	1.47	50.00
2022	357.0	2.00	1,563,660	2.00	50.00
2023	364.0	1.96	1,594,320	1.96	50.00
2024	371.0	1.92	1,629,432	2.20	50.00
2025	378.0	1.89	1,655,640	1.61	50.00
2026	385.0	1.85	1,686,300	1.85	50.00
2027	392.0	1.82	1,716,960	1.82	50.00
2028	399.0	1.79	1,752,408	2.06	50.00
Total Average:		1.82		1.82	

The forecast as provided by CWL includes projections of historical levels of demand side program acceptance by the CWL customers.

ES.3 EXISTING RESOURCES

CWL receives energy from a variety of existing generation resources, which include jointly and wholly owned coal-fired steam units, combustion turbines, wind, and landfill gas facilities. In addition to these generation resources, CWL has executed a contract to purchase baseload capacity and energy from Ameren (Union Electric), which is expected to be available through the end of May 2011. Table ES-2 lists the existing generation resources and their capacities available to CWL. A description of each of the existing CWL resources is provided in Section 2 of the report.

Table ES-2: Existing CWL Generation Resources

Unit	Description	Net Unit Capacity (MW)
Bluegrass Ridge[1]	Wind	6.3
Columbia & Ameresco	Landfill Gas	5.2
Distributed Gen[2]	Diesel Gen	8.5
Columbia Energy Center	Combustion Turbine	72.0
CWL Turbine 5[3]	Coal-Fired Steam	16.5
CWL Turbine 6	Combustion Turbine	12.5
CWL Turbine 7[3]	Coal-Fired Steam	22.0
CWL Turbine 8	Gas-Fired Steam	35.0
Iatan II[4]	Coal-Fired Steam	20.0
Nearman Creek	Coal-Fired Steam	20.0
Prairie State[5]	Coal-Fired Steam	50.0
Sikeston	Coal-Fired Steam	66.0
	Total:	**333.5**

[1]Nameplate Capacity.
[2] Standby Rating
[3]CWL Turbines 5 and 7 Retired in 2015.
[4]COD for Iatan II is expected in 2010.
[5]COD for Prairies State is expected in 2013.

In November 2004, the City of Columbia approved a renewable energy ordinance (RPS Ordinance) for the city's power supply portfolio. The ordinance mandates CWL to purchase increasing levels of energy from renewable resources starting in 2008. In response to the RPS Ordinance, CWL has secured contracts from several qualifying renewable generating resources for wind and landfill gas energy. CWL has a long-term purchase agreement with AECI to acquire the energy from three wind turbines (6.3 MW net capacity) at the Blue Grass Ridge Wind Farm in Gentry County, Missouri. The amount of electricity Columbia will receive each year is variable, depending on the amount of wind. CWL also has long-term purchase agreements to receive landfill gas from facilities in Jefferson City and Columbia. The energy from these qualifying renewable resources amounts to nearly 5 percent of CWL energy requirements in 2008.

ES.4 TRANSMISSION ISSUES

CWL imports energy into its service territory via transmission facilities owned and operated by other utilities. Direct interconnections are made with Ameren and AECI at substations around the CWL service area. These interconnections are made at the 161kV and 69kV level. The system is or will be used to import power from the following CWL resources:

- Sikeston
- Nearman
- Columbia Energy Center
- Prairie States Energy Center
- Iatan II
- Bluegrass Wind Farm
- Ameresco Landfill Gas Project

In addition, future development of landfill projects in the area will require use of the transmission system. CWL pays for use of the transmission system under transmission agreements with AECI and the Midwest ISO.

The transfer capacity of a system is identified as the First Contingency Total Transfer Capacity (FCTTC). The FCTTC identifies the maximum transfer capacity that is allowed before a system violation occurs, such as a thermal overload or a bus voltage dropping below limits, when a component of the system is removed. The process used to identify the FCTTC is to increase the power being transmitted into an area, remove system elements one at a time and then determine if there any violations. When a violation occurs, the power being transferred establishes the FCTTC.

The FCTTC capability of the existing transmission system CWL uses to import its power is approximately 270 MW. For the projected 2027 load curve, if the system were totally dependent on the transmission system to provide the power to the city, there would be approximately 1008 hours per year that the system would be exposed to being unable to support the full load above a level of 270 MW if the limiting outages occurred. Use of internal generation and system improvements discussed in Section 2 would provide a firm load-serving level of approximately 405 MW.

ES.5 SUPPLY SIDE ANALYSIS

The development of a power resource analysis requires creation of a mix of resources to evaluate. Section 3 of the report describes the options reviewed, costs for the options, and the detailed analysis performed on the selected options. Please refer to Appendix A for a complete summary of the assumptions used for the supply side analysis. The following general assumptions are applicable to the supply side analysis:

- The study period covers the years 2008 through 2027.
- CWL must maintain a reserve margin of 14 percent above peak load throughout the study period.
- CWL retires Units 5 and 7 at the Local Power Plant in 2015.
- The 2007 hourly load was used as the basis for the load growth projections provided by CWL.
- Budgets and forecasts associated with the current CWL assets were escalated at their historical trend or inflation over the study horizon.
- The CWL discount rate for financing terms was 5.5 percent, with longer term resources financed over 30 years, and shorter term resources financed over 20 years.

The supply options considered in this Study include:

- Local coal-fired circulating fluidized bed (CFB) facility
- Local CFB Biomass facility
- Participation in a remote super critical, pulverized coal (SCPC) facility
- Local gas-fired combined cycle gas turbine (CCGT) facility
- Local coal-fired integrated gasification combined cycle (IGCC) facility
- Local simple cycle facility
- Local combined heat and power (CHP) facility
- Market power purchase agreements (PPA)
- Participation in a remote wind farm
- Local rooftop solar photovoltaic (PV)
- Hydro-pumped storage facility

The final integration of resource options was modeled and simulated using the Strategist resource optimization software. The model used the assumptions of the resources as described in Section 3 of this report to determine the optimal portfolio of resources to meet the energy needed. Scenarios for the final integration were run under the following circumstances:

- Different resource capacities
- Different pool of resources to select from
- No CO_2 tax
- \$30/ton CO_2 tax on resources starting in 2015, with credits for CO_2 allowances modeled under the America's Climate Security Act of 2007 (also commonly referred to as the Lieberman-Warner Bill)

In cases that included a CO_2 tax scenario, the spot market price of energy was also increased in order to account for the increase in the cost of generation across the market. In the $30/ton tax case, off-peak market prices were increased by $30/MWh, and on-peak market prices were increased by $15/MWh starting in 2015. After 2015, the CO_2 and corresponding increase to market prices was escalated at 3 percent annually through the study period.

ES.6 DEMAND SIDE ANALYSIS

Demand Side Management (DSM) has been used by utilities since the late 1970s to try to influence the consumption of demand and energy by customers. Utilities have, for example, installed systems that allow control of appliances during peak load conditions to reduce the demand and shift the energy consumption to more off-peak times. Direct control of air conditioners and water heaters by utilities is also an example of this type of DSM program. Other programs have targeted upgrades to more efficient appliances to provide energy savings. Enticing customers to use compact fluorescent lighting (CFL) instead of incandescent lighting is an example.

The analysis of demand side management potential for a utility requires a significant amount of customer data that includes, but is not limited to:

- The number of existing end-use applications specific to the utility customer base and pertinent information (for example the number of central air conditioners broken down by age, efficiency rating and size)
- The demand and energy impacts to the utility of moving to higher efficiency applications of each of the end uses on the system
- The cost of moving to these higher efficiency applications
- The pace at which the existing appliances could be replaced with higher efficiency options
- The benefit of investing in these applications as compared to other approaches to meeting the customer service required

CWL has a customer base of approximately 44,000 meters. Considering the diversity and number of end-use devices at each of these meters, the data requirements for a DSM analysis are extensive. Since most utilities do not have extensive end-use analysis of their loads, numerous assumptions are required to attempt the modeling of the DSM impacts.

The process to evaluate DSM programs requires a logical progression of developing information about the benefits and costs of the various DSM options considered beneficial for a utility to pursue. The major steps for this process are described in Section 4.

The DSM assessment included an evaluation of a variety of different load management and conservation programs that were directed at reducing the overall peak demand and energy consumption of CWL customers. The programs considered included the existing programs of CWL. The background, assumptions, analysis and results of the analysis are discussed in Section 4.

ES.6.1 Residential

CWL residential building stock can be divided into four main types. These residential building stock types are listed below:

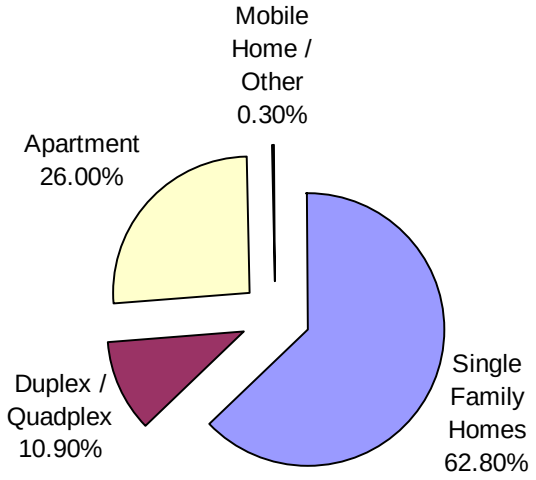
- Single Family Home
- Duplex / Quadplex
- Apartment
- Mobile Home and Other

These types are further broken down into owned and rented residential properties. The residential building stock information provided to Burns & McDonnell by CWL is based on the county assessors 2006 land use database. A summary of the types of residential building stock is presented in Table ES-3.

Table ES-3: CWL Residential Building Stock

Residential Building Type	Owned	Rented	Total
Single Family Homes	15,725	2,059	17,784
Duplex / Quadplex	-	5,156	5,156
Apartment		14,231	14,231
Mobile Home / Other	-	79	79
Total	15,725	21,525	37,250
Percent of Total	42.21%	57.79%	100.00%

Figure ES-1: CWL Total Residential Energy Consumption

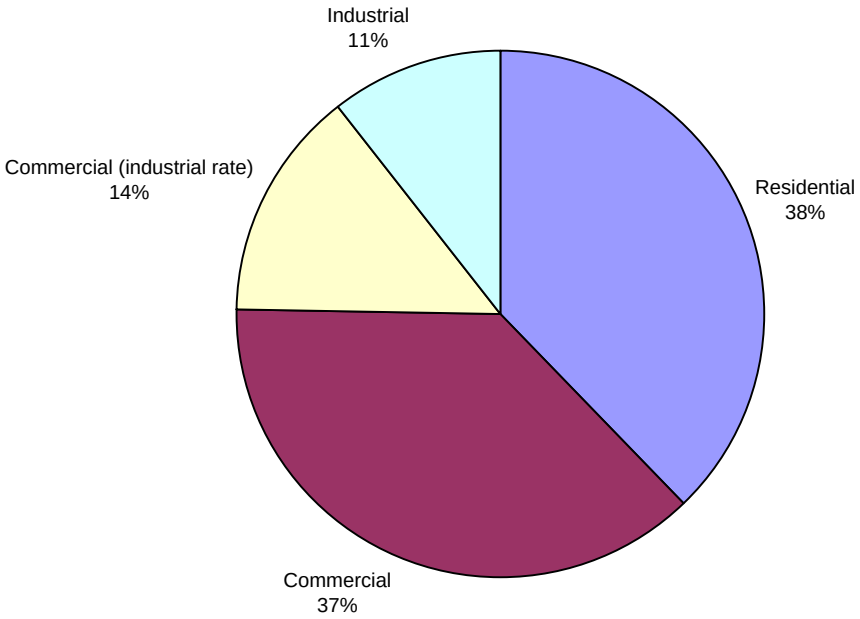


The CWL end-use residential DSM inventory is based on data provided in the 2006 Missouri Statewide Residential Lighting and Appliance Efficiency Saturation Study (Saturation Study), which is provided in Appendix H, and CWL residential building stock data presented previously. The Saturation Study, completed by RLW Analytics, included residential end-use inventory survey data for AmerenUE, Kansas City Power & Light (KCP&L), Aquila, Independence Power & Light, Empire District Electric Co., City Utilities of Springfield, and CWL. CWL has not conducted an in-depth independent survey of its residential customers. Therefore, Burns & McDonnell and CWL agreed that the Saturation Study results would serve as the basis for the residential portion of this study. Prior to using the Saturation Study information, CWL and Burns & McDonnell reviewed the information and adjusted it where it was deemed necessary.

ES.6.2 Commercial/Industrial

An analysis of Demand Side Management (DSM) opportunities for the existing commercial and industrial set of CWL customer base was developed and discussed in Section 4. This assessment included Small General Service (SGS) and Large General Service (LGS). It also included large commercial accounts that are classified under industrial rates due to their size but do not have traditional industrial operations. The following chart shows the breakdown of energy provided by CWL during FY2006 for residential, commercial, commercial with industrial rates, and industrial accounts. Note that the commercial and commercial with industrial rates accounts for 51 percent of the total electrical energy provided by CWL.

Figure ES-2: Distribution of CWL Customers Electrical Use by Rate Class



As discussed above, CWL was a participant in a statewide saturation survey for residential customers. These data have proven quite valuable in the residential DSM analysis. No such survey has been conducted for the commercial customer base. The analysis team decided to use information from the DOE Energy Information Agency (EIA) along with the ENERGY STAR building ranking program of the Environmental Protection Agency in order to benchmark typical buildings in the CWL customer base. Based on these benchmarks, target levels of DSM potential by building type were developed along with the amount of electric use reduction required to meet these goals. Parallel to this effort, various DSM measures were analyzed to determine demand and energy savings along with implementation costs. Extensive assessment of the different CWL building stock was developed and is described in Section 4.

The set of manufacturing type industrial rate customers in the CWL service territory is small and accounts for only 12 of the 32 industrial rate accounts. The other industrial rate accounts include large retail such as malls and public authority buildings such as schools. These more commercial accounts are included in the commercial analysis. The pool of manufacturing customers includes 2 food processing, 7 light manufacturing, 1 chemical product, 1 piping product and a rock quarry. The total estimated electric consumption for this group of customers is 182,387,680 kWh per year. In order to estimate the distribution of electric use within these plants, EIA data were reviewed to determine the average percent by end use and representative load factors.

ES.7 INTEGRATION RESULTS

The integration analysis used the supply and demand side options as developed in Sections 3 and 4, respectively. The first step in the integration analysis was to perform an optimization run selecting from only supply side resources. This was done in order to establish a benchmark net present value of production costs that can then be compared to an optimization run that selects from both supply and demand side options. The analysis in the base case was performed with no costs for carbon regulations included. A sensitivity analysis including a carbon cap and trade scenario based on the parameters of the proposed Lieberman-Warner Bill was also performed. Assumptions for the analysis are included in Appendix A.

The demand side management portfolios that were developed and included in the integrated analyses are presented in Table ES-4. The options were grouped into portfolios of 10 based on their individual benefit / cost ratios. The 10 programs resulting with the greatest portfolio benefit / cost ratio were selected and grouped into Portfolio A which has a Utility Test benefit cost ratio of 16.63. The next 10 best programs were then selected and grouped into Portfolio B which has a benefit cost ratio of 7.68. This same process was repeated for Portfolio C which had a benefit cost ratio of 3.62. The remaining options were also grouped and loaded into various portfolios; however they did not have a portfolio Utility Test benefit cost ratio greater than 1.0. Each of the remaining six DSM programs was evaluated in the integrated analysis on an individual basis.

Table ES-4: Integrated Analysis DSM Portfolio Definition

	Potential Situation	Improvement
Portfolio A		
1.0	Low Evaporator Airflow B	Increase blower speed
2.0	Refrigerator early retirement	Purchase Energy Star Refrigerator
3.0	Oversized AC Units B (Replace)	Size AC units to 100% of Manual J
4.0	Inefficient Industrial Lighting	Install New Industrial Lighting
5.0	Phantom Electric Loads	Install Power Strips with Auto Shutoff
6.0	Inefficient Commercial Lighting	Install New Commercial Lighting
7.0	Single Pane Window B	Install Low E double pane window 2904
8.0	No low flow shower heads	Install low flow shower heads
9.0	NO E&W Window Shading A	Add solar screens to E&W sides
10.0	House infiltration = 0.8 ACH	Reduce infiltration to 0.35 ACH
Portfolio B		
1.0	AC Refrigerant over charged	Remove refrigerant
2.0	No Compact Florescent Lamps	Use 3 more CFLs throughout the house
3.0	AC Refrigerant under charged	Add refrigerant
4.0	Electric water heater not wrapped	Wrap electric water heater
5.0	Inefficient Industrial HVAC	Install New Industrial HVAC
6.0	Inefficient Industrial Machine Drive	Install New Industrial Machine Drive
7.0	No programmable thermostat	Install New programmable thermostat
8.0	Oversized AC Units A (New)	Size AC units to 100% of Manual J
9.0	Low Evaporator Airflow A	Increase duct sizes or add new ducts
10.0	Home has 13 SEER Heat Pump	Install Heat Pump SEER = 16
Portfolio C		
1.0	High Duct Leakage (25%)	Reduce duct leakage to 5%
2.0	Exterior Lighting Replacement	Install Solar Powered Lights
3.0	Attic Insulation = R-11	Add another R-19 attic insulation
4.0	Dishwasher to be replaced	Purchase Energy Star dishwasher
5.0	Inefficient Commercial HVAC	Install New Commercial HVAC
6.0	Home has electric strip heat	Install Heat Pump SEER = 16
7.0	Gas Heat and 13 SEER AC	Install AC SEER = 16
8.0	Exposed Walls not insulated	Add R-11 wall insulation
9.0	Clothes washer to be replaced	Purchase Energy Star clothes washer
10.0	One Inch insul. On ducts in attic	Add two more inches of insulation

ES.7.1 Base Case Results

Supply Side Only Analysis

As described previously, the integration process requires a production cost benchmark to compare integrated resource portfolios against. After incorporating all of the updated assumptions and supply option boundaries, an optimal supply only resource portfolio over the study period was created and is shown compared to the optimal integrated resource portfolio in Table ES-5.

Integrated Analysis

After establishing the supply only benchmark, the supply and DSM options were evaluated together to create an integrated resource selection portfolio. The demand side management options selected in the integration consisted of various residential, commercial and industrial options. Options were selected and then included in portfolios based on their respective benefit / cost ratios. The portfolios were developed in order to group several DSM programs with a net benefit / cost ratio of greater than one together. It was assumed that DSM programs in a portfolio with a benefit / cost ratio of greater than one would likely be selected either individually or within the defined portfolio. In this manner, 30 of the 37 individual DSM programs were grouped into three different portfolios of 10 programs each. The portfolio building process was optimized through Strategist with the portfolios ranked based on the portfolio benefit / cost ratio. This approach was necessary due to the fact that Strategist combines thousands of various supply side and demand side combinations in order to determine which combination has the lowest overall net present value production cost, and there were too many DSM programs to evaluate each one individually.

Table ES-5: Base Case Supply Only and Integrated Portfolio Comparison

Case:	Supply Only Resource (MW)	Integrated Resource (MW)
2008		Load Management[1]
2009	Market(1)	DSM Portfolio A[1]
		DSM Portfolio B[1]
		DSM Portfolio C[1]
2010		
2011	Wartsila(17)	Wartsila(17)
	CHP(5)	CHP(5)
	Market(36)	Market(16)
2012	Market(42)	Market(19)
2013		
2014		
2015	SCPC(25)	SCPC(25)
	Wartsila(17)	
2016	Market(5)	
2017	Market(11)	
2018	Wartsila(17)	
2019	Market(6)	Market(4)
2020	Market(11)	Market(9)
2021	Market(17)	Wartsila(17)
2022	Market(20)	Market(1)
2023	Market(28)	Market(9)
2024	Market(35)	Market(16)
2025	Market(43)	Market(24)
2026	Market(50)	Market(31)
2027	Market(58)	Market(39)
20-Year NPV @ 5.5%:	$1,229,845	$1,187,254
20-Year CO2 Emission[2] Total (Tons):	22,587,409	22,012,456

[1]DSM program has varying peak characteristics over time.
[2]Total CO_2 emissions include theoretical market emissions.

Figure ES-3 shows the impact of the selected DSM programs on the base peak demand forecast. The impacts are shown as a band to reflect the uncertainty associated with demand reduction accruing from existing programs that may already be present in the CWL forecast. Figure ES-4 shows the BLR for the lowest cost resource portfolio.

Figure ES-3: Base Demand Forecast Impact From Selected DSM Programs

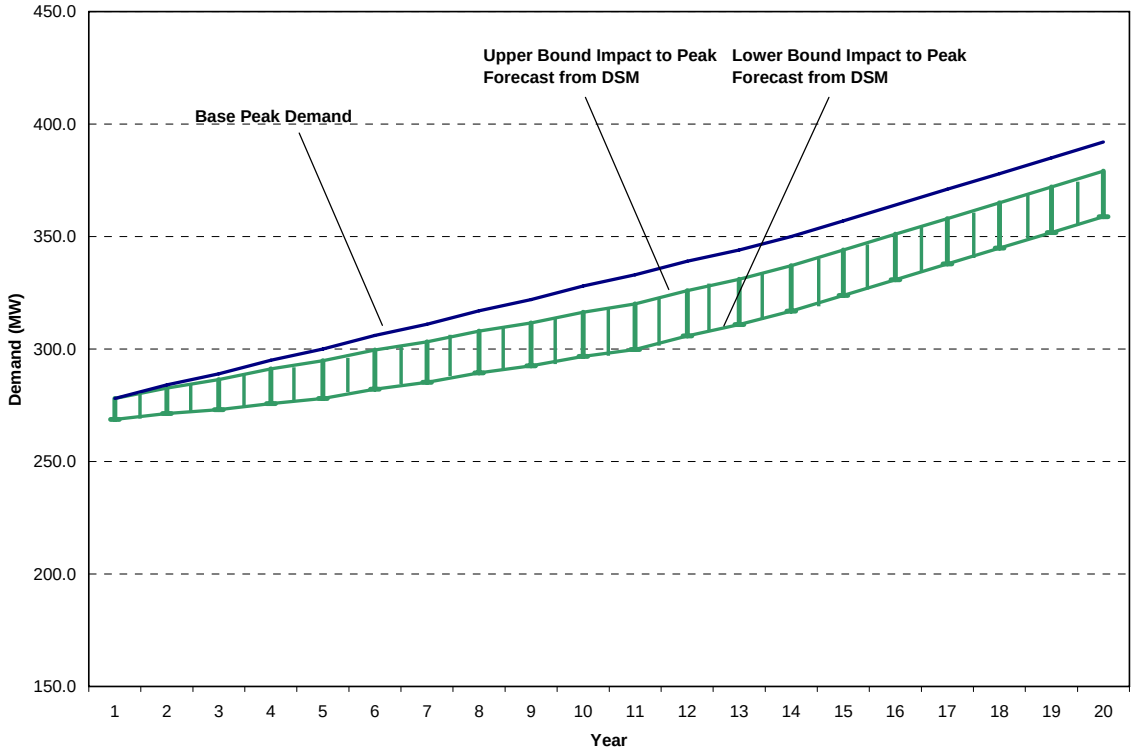
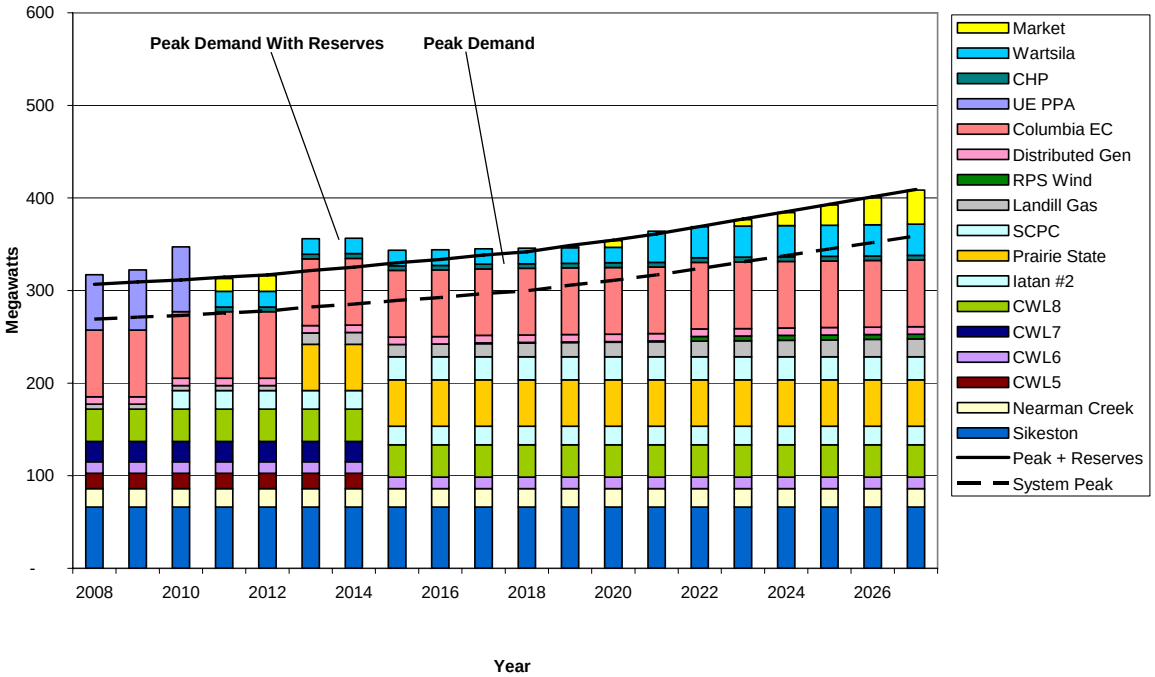


Figure ES-4: Base Case BLR Based on Integrated Portfolio, 2008-2027[1]



[1]BLR based on lower bound for DSM impacts.

ES.7.2 CO_2 Cap and Trade Case Results

Supply Side Only Analysis

As described previously, the integration process requires a production cost benchmark to compare integrated resource portfolios against. All of the updated assumptions and supply option boundaries, as well as the carbon cost parameters as determined through interpretation of the Lieberman-Warner Bill were incorporated in the supply only optimization for the cap and trade sensitivity case. The resulting optimal supply only resource portfolio over the study period is shown compared to the optimal integrated resource portfolio in Table ES-6.

Integrated Analysis

As was done in the Base Case analysis, after establishing the supply only benchmark, supply and DSM options were evaluated together to create an integrated resource selection portfolio. Under the CO_2 Cap and Trade Case, the optimal resource selection portfolio contained the same mixture of DSM programs, Portfolios A, B, and C as well as the Load Management program, with none of the other individual DSM programs selected. In addition to the DSM programs, supply resources selected included market capacity, Wartsila engines, and 200 MW of wind spread out over several years of the study period. A comparison of the optimal resource portfolios for the supply only and integrated cases under the CO_2 Cap and Trade Scenario is shown in Table ES-6.

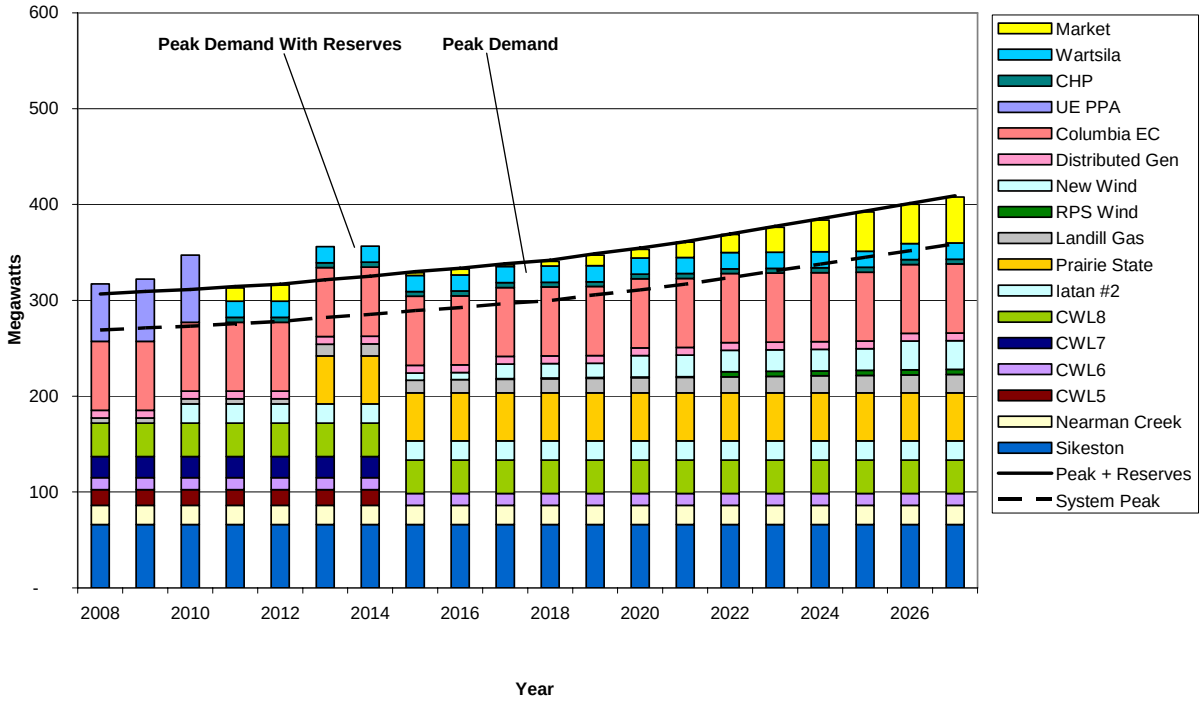
Table ES-6: CO_2 Cap and Trade Case Supply Only and Integrated Portfolio Comparison

Case:	Supply Only Resource (MW)	Integrated Resource (MW)
2008		Load Management[1]
2009	Market(1)	DSM Portfolio A[1]
		DSM Portfolio B[1]
		DSM Portfolio C[1]
2010		
2011	Wartsila(17)	Wartsila(17)
	CHP(5)	CHP(5)
	Market(36)	Market(16)
2012	Market(42)	Market(19)
2013		
2014		
2015	Wartsila(17)	WIND(50)
	WIND(50)	Market(5)
	Market(18)	
2016	Market(23)	Market(8)
2017	WIND(50)	WIND(50)
	Market(21)	Market(4)
2018	Market(26)	Market(7)
2019	Market(32)	Market(14)
2020	WIND(50)	WIND(50)
	Market(30)	Market(11)
2021	Market(37)	Market(18)
2022	Market(40)	Market(21)
2023	Market(47)	Market(28)
2024	Market(54)	Market(35)
2025	Market(62)	Market(43)
2026	WIND(50)	WIND(50)
	Market(62)	Market(43)
2027	Market(70)	Market(51)
20-Year NPV @ 5.5%:	$1,419,511	$1,369,104
20-Year CO2 Emission[2] Total (Tons):	17,361,060	16,658,524

[1]DSM program has varying peak characteristics over time.
[2]Total CO_2 emissions include theoretical market emissions.

Because the same DSM programs are selected in the integrated CO_2 Cap and Trade Case as in the integrated Base Case, the impact of the selected DSM programs on the base peak demand forecast is the same as that shown in Figure ES-3. Figure ES-5 shows the BLR for the lowest cost resource portfolio in the CO_2 Cap and Trade Case.

Figure ES-5: CO_2 Case BLR Based on Integrated Portfolio, 2008-2027[1]



[1]BLR based on lower bound for DSM impacts.

ES.8 CONCLUSIONS

Burns & McDonnell has reviewed the information provided by CWL on its existing system and expected changes. Based on the analysis of the current and expected load requirements of CWL, its available resources and potential impacts on the amount of capacity available to CWL, and the issues affecting the utility industry, Burns & McDonnell has developed the following conclusions.

ES.8.1 Supply Side Conclusions

1. Considering the existing load forecast provided by CWL, significant capacity deficits will occur in 2012 and grow to approximately 145MW in 2027 assuming the Units 5 and 7 at the local power plant are retired and expected new resources are available as anticipated herein.
2. CWL has 70MW of base load resources coming on line between 2010 and 2013 from the Iatan Unit II and Prairie State. These are coal based resources. When these units come on line, CWL will be in an approximate energy balance between its peak, intermediate and base load resources. With the current mix of resources, the load forecast, and the assumptions used in the Base future analysis, base load energy is not needed until approximately 2015.

3. The current capital and fuel costs for all types of traditional fossil and nuclear generating resources are increasing. In addition, legislation regulating carbon emissions is anticipated to occur during the next few years which will further impact the cost of electricity produced by units fired on fossil fuels. CWL has approximately five years to observe how these issues unfold before needing to make a final decision on its next base load resource.
4. There are advances being made in renewable energy resources that are reducing the rate of escalation of their average energy costs. Advances in research in solar, wind, small hydro and biomass generation options are occurring with the continuing increases in average energy costs from traditional resources. These advances will increase the locations that are found to be economically viable for renewable options.
5. CWL's participation in the MISO market reduces the concern of being able to participate in remote projects (either renewable or traditional) and have the transmission capacity available to deliver the energy for the benefit of CWL customers.
6. Only supply side resources of reciprocating engines, wind and market capacity and energy are selected in the future with a projected cost of $30 per ton of carbon credit cost and a carbon regulation program beginning in 2015.
7. CWL has been approached by parties interested in developing biomass fuels. CWL has an opportunity to repower units at its local power plant using an approximately 73MW boiler that could be designed to use a substantial quantity of biomass fuel. It may be possible for CWL to develop a joint project with other utilities in the state and reserve a portion of the biomass capacity for its use. Participation by others could be through equity participation or through long term power purchase agreements.
8. Although nuclear energy is potentially reappearing as a resource option, there are no specific options for consideration by CWL. Should a real option present itself, it is not likely that the commercial date will be before 2020. CWL would have time during its next update of the integrated resource plan for consideration should such a nuclear option present itself.
9. The delivery capability of the transmission system used by CWL in the immediate area could be improved. This would increase the firm import capability across Associated and Ameren's systems.

ES.8.2 Demand Side Conclusions

1. The projections of supply side resource costs results in the selection of numerous demand side options prior to the selection of supply side resources.

2. Pursuit of current and additional DSM programs can reduce the amount of demand and energy forecast to be required by the customers of CWL. Programs reviewed in this study have projected demand reductions from the existing forecast of approximately 5 to 10 percent over the next ten years.
3. Without more stringent building code standards, it will be difficult for CWL to see significant changes in the future average demand and energy required for residential and commercial buildings. Continuation of current standards will also continue the approach whereby CWL is constantly trying to entice owners of buildings that were constructed to lower standards to increase their efficiency. Retrofit costs are almost always more costly than incorporating efficiency into the initial construction.
4. Current appliance efficiency standards are expected to, over time, provide a natural increase in the efficiency of existing appliances installed on the CWL system. These benefits have not been directly incorporated into the reductions of demand and energy projections.
5. Demand reductions through load control have been found beneficial to CWL. The primary device for load control on the CWL system is the central air conditioner. The mandated efficiency improvements to higher SEER units will gradually increase the number of dual compressor units to be controlled on the system. Burns & McDonnell is not aware of studies that have reviewed the impacts, if any, of the average kW per point reductions seen from controlling dual compressor units versus the older single compressor units. Therefore, the assumptions for ongoing benefits of direct load control may not apply for these type units.
6. Time of use pricing allows customers to make better economic decisions regarding demand side management investments, renewable energy deployment, energy storage devices, and energy consumption throughout the day than average rate pricing. As a member of MISO, CWL has a ready access to the price of energy at its city gate as it varies throughout the day.

ES.9 RECOMMENDATIONS

Based on the above conclusions, the analysis of CWL's system and Burns & McDonnell knowledge of the electric utility industry, the following recommendations are offered to CWL for consideration. Burns & McDonnell recommends that CWL should:

1. Pursue the future outlined in the regulated carbon future with DSM. The cost for this future is not significantly different than a future without carbon legislation in the first several years. Should carbon regulation not be legislated, then CWL could move to the lower evaluated cost power supply futures without carbon regulation.

2. Work with the City to improve building code standards for commercial and residential structures that have a minimum energy consumption goal of an Energy Star rating. Programs to encourage higher Energy Star ratings should be developed. The information provided in Appendix F can be used to establish the Energy Star levels, rebate levels, modeling analysis and submittal process to CWL.
3. Implement the demand side management programs as outlined in section Appendix E. Add staff as necessary at CWL to aggressively pursue these programs and work through the existing building stock over the next ten years. Increase the data gathering for end use inventories, ages of appliances, use per consumer, and other information needed to refine the evaluation of DSM programs through energy audits on the majority of existing residential and commercial facilities. Increase the verification process for the programs to make sure they are on track to meet the projected demand and energy reductions.
4. Develop a pilot for measuring the effects of controlling dual compressor air conditioners. Compare the results with the expected results as measured in the past by CWL and as assumed in this analysis. If necessary, adjust the load control program in accordance with the results.
5. Continue its aggressive pursuit of demand side involvement by the deployment of time of use metering and pricing structure to customers. The MISO pricing for CWL can be used to provide day ahead hourly price signals. This will allow the most valid economic basis for decisions to be made regarding renewable and demand side investments by consumers and CWL. Industrial and commercial customers should be the first to be moved to time of use pricing followed by residential. This metering can also be used in the further deployment of a Smart Grid.
6. Continue to balance the costs of market capacity and energy versus the cost of installing and operating the reciprocating engines reviewed in this study. Prepare in early 2010 to install two engine sets of approximately 8MW each for a commercial operating date of 2012 should the economics reviewed herein remain as studied. Site selection, permitting, design and construction can be done within a 12 to 18 month period. Engine delivery is the largest unknown due to the demand for this type of resource. Current deliveries are at two years from the date of commitment.
7. Determine if there is sufficient interest from other utilities in the state to develop the biomass repowering project at CWL's local power plant. Should the renewable referendum being considered by Missouri become law, this type of option could hold significant benefit for other Missouri utilities.
8. Acquire additional wind energy (or equivalent priced other renewable energy) in the quantities and on the time line as shown in the regulated carbon future with DSM.

9. Pursue the transmission projects with AECI necessary to improve the firm import capability.
10. Update the integrated resource plan in 2012 to 2013 This should be sufficient time to determine the success of the demand side programs, have better clarity about the legislation regarding carbon and more knowledge about the advances in renewable energy technologies.

* * * * *

SECTION 1.0

INTRODUCTION

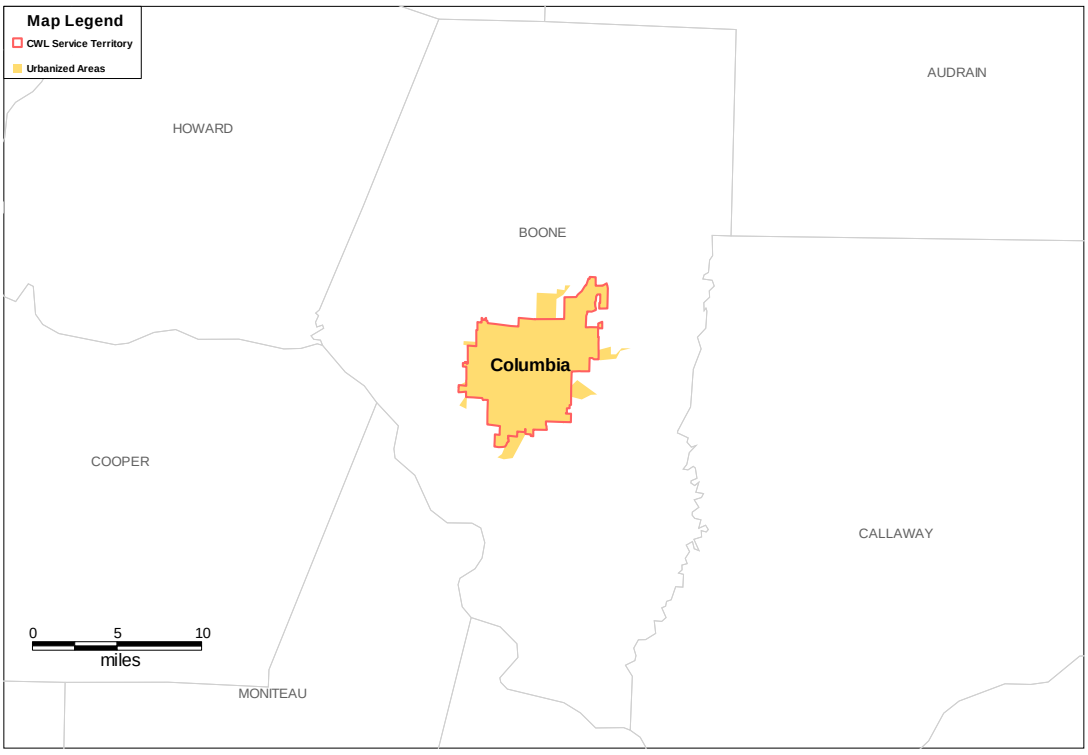
1.0 INTRODUCTION

Burns & McDonnell Engineering Company, Inc. (Burns & McDonnell) was retained by the City of Columbia, Missouri, Water and Light Department (CWL) to perform an Integrated Resource Plan (IRP or Study) that evaluates the potential development of supply side and demand side resources to meet the future load requirements of Columbia, Missouri. This introduction presents a brief description of CWL, the purpose of the Study, an overview of the methodology, and Study considerations.

1.1 DESCRIPTION OF CWL

CWL is a municipal utility that provides electric and water services to customers within the city boundaries of Columbia, Missouri. CWL began providing service to the residents of Columbia in 1904. The approximate service territory of CWL is indicated on Figure 1-1. As of December 2007, CWL served approximately 44,000 residential, commercial, and large commercial/industrial customers.

Figure 1-1: Approximate CWL Service Territory



During FY2007, CWL customers set a demand peak of 265 MW and consumed approximately 1203 GWh of electricity. Although the energy consumed in 2007 was slightly higher than in 2006, the peak was approximately 7 MW less. CWL obtains the majority of its energy from shares of traditional supply side resources powered by coal and gas, power purchase agreements and market spot energy. Increasing amounts of renewable energy are also being acquired. Section 2 discusses the existing resources available to CWL in meeting its supply obligations.

1.1.1 Renewable Portfolio Standard

The citizens of Columbia voted on November 4, 2004 to implement a Renewable Portfolio Standard (RPS) for CWL. The RPS requires CWL to obtain a portion of its power supply from qualified renewable resources. The RPS includes the following requirements:

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

(1) Two (2) percent of electric retail sales (kWhs) by December 31, 2007;

(2) Five (5) percent of electric retail sales (kWhs) by December 31, 2012;

(3) Ten (10) percent of electric retail sales (kWhs) by December 31, 2017; and

(4) Fifteen (15) percent of electric retail sales (kWhs) by December 31, 2022.

(b) This renewable energy shall be added up to these kilowatt hour levels only to the extent that it is possible without increasing electric rates more than three (3) percent higher than the electric rates that would otherwise be attributable to the cost of continuing to generate or purchase electricity generated from one hundred (100) percent non-renewable sources (including coal, natural gas, nuclear energy and other nonrenewable sources).

(c) Eligible renewable energy generation may be provided by wind power, solar energy, bio-energy sources or other renewable sources which meet the environmental criteria approved by the city council after review by the environment and energy commission and the water and light advisory board. Electricity purchased from on-site renewable energy systems owned by Columbia Water and 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.

CWL currently is acquiring energy from wind and landfill projects. It is actively developing solar projects with its customers and other landfill projects in the area. Based on projections, CWL is ahead of the RPS energy requirements.

1.1.2 Demand Side Management

CWL also operates an active demand side management (DSM) service for its customers. A variety of programs are offered to its residential, commercial and industrial customers. These programs include, but are not limited to, education, active load control and load shedding, appliance and lighting rebates and loan programs, energy audits, and tree planting.

1.1.3 Transmission Interconnections

The majority of CWL energy is provided to its load via transmission lines from supply sources external to the City. These lines are owned and operated by AmerenUE (Union Electric) and Associated Electric (AECI). CWL interconnects with AECI at 161kV at the Boone and Bolstad substations. A single interconnect with AmerenUE exists at 161kV at the Perche substation. Future system improvements include new ties to the 161kV system at McBaine, Grindstone, Perche and the Local Power Plant.

CWL operates within the Midwest ISO as a market participant. This provides CWL access to network transmission service within the Midwest ISO and allows the purchase and sale of energy into the Midwest ISO at the nodal locational marginal price established at CWL load and generation nodes, respectively. CWL also maintains a control area that requires CWL to meet certain energy balancing requirements for its generation and load. CWL acquires energy for its load from the Midwest ISO market at the CWLD.CWLD node. AECI does not operate within the Midwest ISO market, while Ameren does. Therefore, CWL is on the border of the Midwest ISO market.

1.2 PURPOSE OF STUDY

CWL periodically analyzes its projection of load to be served as compared to its sources available to satisfy its load obligations. This study was commissioned to provide the condition assessment. The overall objective of the analysis was to determine the more attractive supply and demand side options in meeting CWL forecasted demand and energy requirements.

1.3 STUDY APPROACH

The first step in the approach to the study was to review the information available from CWL. This data included the load forecast, various studies on its supply side resources, RPS requirements, existing demand side programs, transmission studies, etc. The load projections were then combined with the available resources to determine if and when the existing resources would be inadequate to meet the load projections. A review of both the capacity (MW) capabilities and the energy (MWh) sources to meet projections was considered.

Assumptions on a variety of inputs to the analysis were developed and provided for review by CWL. This included fuel and market energy price forecasts, operation and maintenance costs for existing resources, financial parameters, demand side impacts from a variety of programs, etc. Burns & McDonnell developed supply and demand side resource options for consideration and reviewed the projected capital, operations, maintenance, rebate, and program costs with CWL.

An analysis of potential supply side resources to meet the load projections was performed. This analysis was done to establish the attractive future considering the load forecast being met with supply side resources while meeting the RPS requirements. Demand side options were developed for residential, commercial and industrial loads. These options were evaluated against the avoided cost created through the traditional supply side analysis to determine the benefit cost ratio. Those options that had a benefit cost ratio greater than one were selected for further analysis.

The traditional supply side future was then integrated with the attractive demand side options to provide an integrated demand and supply side analysis.

1.3.1 Task Force

The project included a Task Force appointed by the City Council. Members of the task force included the members of the Utility Advisory Board and other citizens from the community. Burns & McDonnell met with the task force periodically. Meeting topics included:

- Describe the IRP process,
- Review supply and demand side assumptions,
- Review comments from the first public meeting
- Review results from isolated demand and supply side analysis
- Review integrated results

1.3.2 Public Meetings

Three meetings with the public were held. The first was to provide an overview of the process and to solicit comments from the public on any issues they would like to see included. The second meeting provided the initial results from the analysis. The third meeting provided the overall results of the study.

1.3.3 Sources of Data

Information considered germane to this study was provided by CWL. This information included reports on previous analyses that had been performed. This information included:

Demand and Energy Load Forecast from CWL
"Power Supply Options Study Final Report", Black & Veatch, March 1, 2006
"Prairie States Coal Station Evaluation", R.W. Beck, July 1, 2004
"Emission Compliance Strategy Study", Stanley Consultants, January 2007
"Power Plant Rehabilitation/Expansion Study", Stanley Consultants, May 2005
"2006 Missouri Statewide Residential Lighting and Appliance Efficiency Saturation Study", RLW Analytics, November 15, 2006

1.4 ANALYSIS METHODOLOGY

Burns & McDonnell prepared the assumptions required for modeling the power supply futures considered for CWL. The resource expansion planning model, Strategist, was used to analyze the supply and demand side options in order to arrive at the more attractive alternatives for consideration by CWL. Strategist is a probabilistic resource expansion planning software package. The measurement of "best" is based on lowest net present value (NPV) of the costs of the futures. The analysis covered a twenty year period, 2008 to 2027.

1.4.1 Supply

Supply side options were selected for consideration by Burns & McDonnell based on its experience with current available options. CWL system capacity requirements were considered with allowance of a reserve margin of 14 percent of peak load less firm purchases. The resource options were developed considering the expected deficits of capacity for CWL and typical sizing for the options.

For supply side options, Strategist is used to select the MW amount and timing of resource options to add and satisfy the utility's annual requirements over the study period. The program iterates to arrive at optimal portfolios for the options considered. The analysis included existing and potential environmental restrictions being discussed on power plant emissions. Certain options were also modeled in an hourly chronological model, PROMOD, to identify characteristics that were not suited for modeling in Strategist.

1.4.2 Demand

The existing DSM programs being offered by CWL were reviewed. The load forecast provided by CWL included the effects of ongoing DSM programs which were considered to continue at their historic levels. New DSM activities were developed using the "2006 Missouri Statewide Residential Lighting and Appliance Efficiency Saturation Study" as a basis for the inventory of appliances in CWL. This report was supplemented by additional discussion with CWL and analysis by Burns & McDonnell specific to Columbia. Other utilities' DSM programs were also reviewed to provide a level of comparison to CWL program offerings.

Burns & McDonnell developed a range of building types for analysis of a variety of DSM options. This analysis allowed the expected impact on the hourly load to be considered for major activities such as air conditioner change outs to more efficient models. The initial use of Strategist for analyzing demand side options was to evaluate the individual options using the Utility Cost and Total Resource Cost benefit cost tests. These tests were performed using an optimal supply side portfolio as the avoided demand and energy cost.

1.5 STUDY CONSIDERATIONS

In the development of any power supply study, there are a variety of uncertainties that confront the utility and its customers. The major issues confronting utilities today on supply side options are the rapidly escalating costs of resource options, fuel availability and cost, dealing with the aspects of carbon legislation and the advances in technology. For the demand side, the major uncertainty is reliance on consumers accepting the programs offered, achieving the estimated reductions, and retaining the reductions once implemented. Therefore, a consideration in this study was the ability for CWL to react to changing conditions and still meet its load-serving obligations in a cost effective, reliable manner.

In the preparation of this report, the information provided by CWL was used by Burns & McDonnell to make certain assumptions with respect to conditions which may exist in the future. While Burns & McDonnell believes the assumptions made are reasonable for the purposes of this report, it makes no representation that the conditions assumed will, in fact, occur. In addition, while Burns & McDonnell has no reason to believe that the information provided by CWL, and on which it has relied, is inaccurate in any material respect, Burns & McDonnell has not independently verified such information and cannot guarantee its accuracy or completeness. To the extent that actual future conditions differ from those assumed herein or from the information provided to Burns & McDonnell, the actual results will vary from those forecasted.

In addition, estimates and projections prepared by Burns & McDonnell relating to construction costs and schedules, operation and maintenance costs, equipment characteristics and performance, and operating results are based on Burns & McDonnell's experience, qualifications and judgment as a professional consultant. The estimates and projections contained herein prepared by Burns & McDonnell reflect screening level assumptions about the facilities and fuels represented. While the estimates are considered suitable for use in production cost modeling analyses to select preferable resource options to pursue, Burns & McDonnell has no control over economic conditions, specific site issues, competitive bidding or market conditions and other factors affecting actual costs should any of the facilities included herein be pursued. Therefore, Burns & McDonnell does not guarantee that actual costs, performance, schedules, and operations will not vary from the estimates and projections prepared for purposes of this planning study by Burns & McDonnell.

1.5.1 Allowance for Flexible Future

Flexibility for a utility, for purposes of this study, is considered the ability of the utility to avoid becoming so invested in its resources that it cannot manage its costs due to increasing or decreasing load, new technologies, or anticipated regulations. An important aspect of flexibility for a utility requires that the investment made in an asset is such that the asset is not obsolete prior to recovery of the investment.

1.5.2 Energy Act 2007

The Energy Act of 2007 (Act) was enacted on December 19, 2007. The Act includes requirements for efficiency enhancements to appliances, lighting and other end-use devices. One of the more interesting aspects of the Act is the significant increase in efficiencies required for incandescent lighting. The anticipated effect of this legislation is to reduce energy consumption. Although the end-use efficiency of certain appliances, such as air conditioners, has increased in the past several years due to regulated efficiency standards mandated by the government, the average energy use per consumer has continued to increase for CWL and other Midwest utilities. Whether this phenomenon will continue with the new Energy Act is uncertain. For purposes of this analysis, the assumption considered by Burns & McDonnell is that the impacts of certain DSM programs will impact the load growth until full market saturation is achieved. Once the saturation is achieved, the load will then grow at the current projected rate forecasted by CWL.

1.5.3 Carbon Legislation

Significant debate on the approach to legislating limitations to carbon emissions is ongoing in state and federal legislatures. The two major approaches considered for limiting electric utility emissions are to

levy a carbon tax on the emissions or to provide a cap and trade system, similar to the method used to control sulfur dioxide. In the interim study analysis, the approach of a varying carbon tax was used as a proxy to capture the expected cost impacts to fossil fuel fired resources. The final integrated analysis used the parameters of the America's Climate Security Act of 2007 (also commonly referred to as the Lieberman-Warner Bill) to analyze the effects of a carbon cap and trade scenario to capture the cost impacts to fossil fuel fired resources.

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SECTION 2.0

EXISTING CONDITIONS

2.0 EXISTING CONDITIONS

The service territory for CWL primarily serves municipal load within the city limits of Columbia, Missouri. The utility has a mixture of traditional and renewable supply side resources to meet these load requirements. These resources include self-owned generation as well as power purchase contracts. In addition to the supply side resources, CWL has numerous demand side load management and conservation programs that it offers its customers to reduce demand and energy consumption. This section of the report describes the load projection and the existing supply and demand side resources CWL has available.

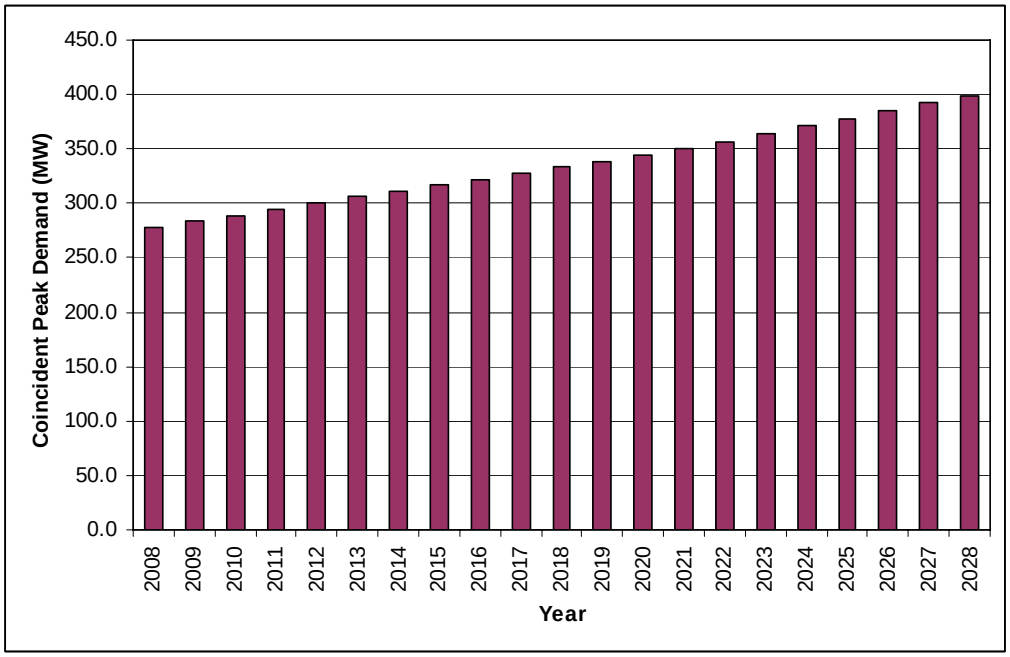
2.1 LOAD FORECAST

The load forecast used in the analysis was based on a load forecast provided by CWL. The combined system energy requirements are projected to grow at an average annual rate of 1.8 percent during the time period. The load factor is projected to remain steady at 50 percent over the study period. Demand is expected to grow at the same percentage (1.8 percent) as the annual energy growth. The combined base energy and demand requirements forecast for the CWL load are shown in Table 2-1. Figure 2-1 is a graphical representation of the base demand forecast.

Table 2-1: CWL Demand and Energy Forecast

Year	Coincident Peak Demand (MW)	Annual Growth	Total Energy (MWh)	Annual Growth	Load Factor
2008	278.0	-	1,220,976	-	50.00%
2009	284.0	2.16%	1,243,920	1.88%	50.00%
2010	289.0	1.76%	1,265,820	1.76%	50.00%
2011	295.0	2.08%	1,292,100	2.08%	50.00%
2012	300.0	1.69%	1,317,600	1.97%	50.00%
2013	306.0	2.00%	1,340,280	1.72%	50.00%
2014	311.0	1.63%	1,362,180	1.63%	50.00%
2015	317.0	1.93%	1,388,460	1.93%	50.00%
2016	322.0	1.58%	1,414,224	1.86%	50.00%
2017	328.0	1.86%	1,436,640	1.59%	50.00%
2018	333.0	1.52%	1,458,540	1.52%	50.00%
2019	339.0	1.80%	1,484,820	1.80%	50.00%
2020	344.0	1.47%	1,510,848	1.75%	50.00%
2021	350.0	1.74%	1,533,000	1.47%	50.00%
2022	357.0	2.00%	1,563,660	2.00%	50.00%
2023	364.0	1.96%	1,594,320	1.96%	50.00%
2024	371.0	1.92%	1,629,432	2.20%	50.00%
2025	378.0	1.89%	1,655,640	1.61%	50.00%
2026	385.0	1.85%	1,686,300	1.85%	50.00%
2027	392.0	1.82%	1,716,960	1.82%	50.00%
2028	399.0	1.79%	1,752,408	2.06%	50.00%
Total Average:		1.82%		1.82%	

Figure 2-1: CWL Demand Forecast



The forecast as provided by CWL includes projections of historical levels of demand side program acceptance by the CWL customers.

2.2 CURRENT DSM PROGRAMS

The Utility Services Division was created in the early 1980s. Since that time numerous programs have been designed and implemented to help customers conserve energy and water as well as educational and public awareness initiatives to deliver energy conservation information. In addition, there are specific programs in place to reduce peak demands and save CWL purchasing peaking power and associated on-peak energy. The programs listed below are arranged in the categories of Control, Efficiency and Education. When available the participation levels for years 2001 – 2007 are provided along with kWh savings and peak load reductions. CWL estimates of current program benefits are summarized in Appendix A.

2.2.1 Control

These are a number of load management programs that provide some level of demand control. Brief descriptions of these follow:

Load Shedding: This is a voluntary program limited to industrial rate customers with a minimum 250 kW load. Upon notice from CWL these customers agree to shed load during critical high demand periods. The customers are provided incentives based on the level of load shed. At present there are 19 customers participating which account for a savings of 8 MW during peak.

Load Management: This is another voluntary program available to residential, commercial and industrial customers. Under this program a control switch is installed on air conditioner compressors. The intent is to turn the compressor off for 7.5 minutes per hour. By rotating customers on the load management program CWL is able to reduce maximum peak demand. In 2006 there were 14,000 load management devices installed which accounted for a savings of 7.8 MW or approximately 0.55kW per switch. By the middle of 2007 there were 16,000 units installed. The incentive to the customer is a reduction in their utility bill.

High Load Factor Rate Plan: This program provides a time of use discount rate during the hours from midnight to 6:00 am.

Thermal Storage Rider: This rider is available to customers who use thermal storage that conforms to the utility load shedding program. The customer is assessed no demand charges for the period from 10:00 pm to 10:00 am to encourage use of the thermal storage and thus reduce the CWL peak load.

Interruptible Program: This voluntary program is available for customers who have at least 500 kW of load that can be interrupted by CWL. These loads are separately metered. At present there are 2 customers in the program that can provide a 2 MW reduction.

2.2.2 Efficiency

A number of programs are available which could be classified under the efficiency category. Brief descriptions of these follow.

Energy Audits: No-cost energy audits are available to all CWL customers. They include but are not limited to the review of utility bills, an interior and exterior evaluation, the review of equipment efficiencies and operation as well as a cost benefit analysis of retrofit opportunities. Approximately 250 residential and 10 commercial customer audits are performed per year.

Energy Conservation Loans: These loans are available to residential and commercial customers for measures such as insulation, high efficiency air conditioning units, furnaces and heat pumps. Solar water heaters have been added for systems that provide 50 percent or more of the total need. There have been 275 loans between 2001 to 2007 with a total value of over $2 million.

Rebates: Rebate programs exist for high efficiency air conditioners and heat pumps, solar water heaters, and photovoltaic systems. The AC and heat pump rebates are based on the system size and efficiency. Solar water heater rebates are fixed with an additional incentive to convert to electric water heater back up. The photovoltaic rebates are based on the installed capacity.

Infrared Thermography and Ultrasonic Leak Detection: These programs use specialized equipment to detect problems in facilities that are not apparent to the casual observer. Infrared scans are able to provide visual images of the temperature distribution of objects. They can be used to detect failing motor bearings, overloaded circuits, hot spots, etc. The results are valuable for preventative maintenance and thermal diagnostics. These audits are normally performed at industrial sights. The ultrasonic leak detector surveys are most often used on compressed air systems in industrial setting. Compressed air

systems can be major users of electricity. Multiple leaks can seriously degreed system efficiency. CWL has performed 5 leak detection surveys between 2005 and 2007.

Change a Light – Change the World Campaign: This program provided an instant rebate for the purchase of Compact Fluorescent Lamps (CFL). The program facilitated the purchase of approximately 20,000 CFL between 2004 and 2007.

Lighting Incentive Program: This program is available to commercial and industrial rate customers who pay demand charges. The retrofit must produce at least a 10 kW reduction in demand.

Tree Power: This program provides a free assessment from CWL of the benefits of planting a tree to provide shade on the home and thus reduce the cooling load. If a suitable site is found a coupon is provided the customer which can be used to purchase a shade tree.

2.2.3 Education

The CWL Utility Services Division has instituted a number of educational programs to provide awareness on energy conservation. These efforts include Weatherization workshops, broadcasting conservation tips on the Columbia Channel, presentations at civic groups, radio and other media releases. Announcement and program advertisement is sometime printed on the bill envelope. Another significant education outreach from CWL is the Building Operators Certification (BOC) program. This is a professional development course for operations and maintenance staff working in public, institutional and commercial buildings. CWL offers a series of courses on the energy and resource efficient operation of buildings. Knowledge gained from completing the BOC program provides low to no-cost methods that improve energy savings.

2.3 EXISTING GENERATION RESOURCES

CWL receives energy from a variety of existing generation resources, which includes jointly and wholly owned coal-fired steam units, combustion turbines, wind, and landfill gas facilities. In addition to these generation resources, CWL has executed a contract to purchase baseload capacity and energy from AmerenUE (Union Electric), which is expected to be available through the end of May, 2011. Table 2-2 lists the existing generation resources and their capacities available to CWL. A description of each of the existing CWL resources is provided in the following paragraphs.

Table 2-2: Existing CWL Generation Resources

Unit	Description	Net Unit Capacity (MW)
Bluegrass Ridge[1]	Wind	6.3
Columbia & Ameresco	Landfill Gas	5.2
Distributed Gen	Diesel Gen	8.0
Columbia Energy Center	Combustion Turbine	72.0
CWL Turbine 5[2]	Coal-Fired Steam	16.5
CWL Turbine 6	Combustion Turbine	12.5
CWL Turbine 7[2]	Coal-Fired Steam	22.0
CWL Turbine 8	Gas-Fired Steam	35.0
Iatan II[3]	Coal-Fired Steam	20.0
Nearman Creek	Coal-Fired Steam	20.0
Prairie State[4]	Coal-Fired Steam	50.0
Sikeston	Coal-Fired Steam	66.0
	Total:	**333.5**

[1]Nameplate Capacity.
[2]CWL Turbines 5 and 7 Retired in 2015.
[3]COD for Iatan II is expected in 2010.
[4]COD for Prairies State is expected in 2013.

2.3.1 Local Power Plant

CWL has three operable boilers and a combustion turbine at its local power plant. The boilers are connected to a common steam header which operates at 850 psig and 900°F. Turbines 5 and 7 are Kentucky coal-fired steam turbines rated at 16.5 and 22, MW, respectively. Turbine 8, a gas-fired steam turbine rated at 35 MW, is the newest of the three steam turbines at the plant, installed in 1970. These turbines are normally used only during the summer and winter peaks. For study purposes, it was considered that turbines 5 and 7 were retired at the end of 2015, as identified in earlier studies CWL has performed on the plant. Turbine 6, installed in 1963, is a gas and oil-fired combustion turbine rated at 12.5 MW. Turbine 6 is normally run only during daytime hours at peak load times.

2.3.2 Sikeston

The Sikeston power facility is owned and operated by the City of Sikeston, Missouri and has a net unit capacity of 222 MW and a net unit heat rate of 11,084 Btu/kWh. CWL has a long-term power purchase agreement (PPA) with Sikeston to acquire 66 MW of capacity and associated energy from the Sikeston facility. Under the terms of the agreement, CWL is required to take delivery during each contract year of a minimum amount of energy which is partly based on the load factor of the CWL electric utility system.

Power costs are based on the costs of debt service, operation, maintenance, administration and general expenses over the contract year. .

2.3.3 Nearman Creek

The Nearman Creek Unit is owned and operated by the Kansas City, Kansas, Board of Public Utilities (BPU). The facility is a steam turbine with 235 MW of capacity using low-sulfur Powder River Basin (PRB) coal. CWL has a long-term PPA with BPU to acquire 20 MW of capacity and associated energy from the Nearman Creek facility. Under the terms of the agreement, CWL is responsible for paying 1.05 times the average fuel cost per kilowatt-hour (kWh). Fixed operation and maintenance (O&M) is considered to be 70 percent of the annual forecasted O&M expenses for Nearman Creek, with the remaining 30 percent considered variable O&M. CWL is responsible for all power and energy losses occasioned on its respective side of the point of delivery.

2.3.4 Iatan Unit II

Kansas City Power & Light (KCP&L) currently operates a PRB coal-fired unit at Iatan station and is expanding the facility through the construction of an additional 850 MW unit. The facility is expected to be commercially available in 2010 and will be a high efficiency, coal-fired power plant using emission control equipment designed to meet current clean air requirements. Because the site is located at an existing power plant facility, operational efficiencies will help lower ongoing operating costs. Columbia has a long-term PPA with the Missouri Joint Municipal Electric Utility Commission (MJMEUC) to acquire 20 MW of capacity and associated energy from the Iatan II facility once it comes online.

2.3.5 Prairie State Energy Campus

Prairie State Energy Campus (PSEC) is a 1,500 MW electric generation facility under construction in southern Illinois that will be fueled by coal produced from an adjacent underground mine. The project was developed by Peabody Energy and is expected to be commercially available by 2013. Because the facility is a mine mouth unit, it will provide a low-cost fuel option for future CWL energy requirements and is expected to include emission control technologies that meet federally mandated requirements. CWL has a long-term PPA with MJMEUC to acquire 50 MW of capacity and associated energy from the PSEC facility once it comes online.

2.3.6 Renewable Resources

In November 2004, the City of Columbia approved a renewable energy ordinance for the city's power supply portfolio. The ordinance mandates CWL to purchase increasing levels of energy from renewable resources starting in 2008. In response to the RPS Ordinance, CWL has secured contracts from several qualifying renewable generating resources for wind and landfill gas energy. CWL has a long-term purchase agreement with AECI to acquire the energy from three wind turbines (6.3 MW net capacity) at the Blue Grass Ridge Wind Farm in Gentry County, Missouri. The amount of electricity Columbia will receive each year is variable, depending on the amount of wind. CWL also has long-term purchase agreements to receive landfill gas from facilities in Jefferson City and Columbia. The energy from these qualifying renewable resources amounts to nearly 5 percent of CWL energy requirements in 2008.

The future RPS standards were also taken into account through the anticipated acquisition of more landfill gas and wind energy. A planned future landfill gas project that CWL may try to participate in was used as a proxy for one potential source of additional renewable energy. While the final capacity and energy costs are unknown, it was assumed that this energy would be priced similar to existing CWL landfill gas energy purchase agreements. It was assumed that all other renewable energy requirement shortfalls would be covered through future wind energy. Table 2-3 shows the future renewable energy requirements based on the CWL energy forecast and the RPS ordinance.

Table 2-3: CWL Energy and RPS Requirements

Year	Total Energy (GWh)	RPS Ord. Energy (%)	RPS Ord. Energy (GWh)	Bluegrass Energy (GWh)[1]	Ameresco LF Energy (GWh)	Columbia LF Energy (GWh)	Future LF Energy (GWh)	Total RPS Energy (GWh)	Surplus/ (Shortage) (GWh)	Added Wind (GWh)	New Wind (MW)
2008	1,220.98	2.00%	24.42	17.94	25.12	17.01	0	60.07	35.65	0.00	0
2009	1,243.92	2.00%	24.88	17.94	25.12	17.01	0	60.07	35.19	0.00	0
2010	1,265.82	2.00%	25.32	17.94	25.12	17.01	0	60.07	34.76	0.00	0
2011	1,292.10	2.00%	25.84	17.94	25.12	17.01	0	60.07	34.23	0.00	0
2012	1,317.60	5.00%	65.88	17.94	25.12	17.01	0	60.07	(5.81)	0.00	0
2013	1,340.28	5.00%	67.01	17.94	25.12	17.01	55.47	115.54	48.53	0.00	0
2014	1,362.18	5.00%	68.11	17.94	25.12	17.01	59.43	119.50	51.39	0.00	0
2015	1,388.46	5.00%	69.42	17.94	25.12	17.01	63.39	123.46	54.04	0.00	0
2016	1,414.22	5.00%	70.71	17.94	25.12	17.01	67.35	127.43	56.72	0.00	0
2017	1,436.64	10.00%	143.66	17.94	25.12	17.01	71.32	131.39	(12.28)	14.24	5
2018	1,458.54	10.00%	145.85	17.94	25.12	17.01	75.28	135.35	(10.50)	14.24	5
2019	1,484.82	10.00%	148.48	17.94	25.12	17.01	79.24	139.31	(9.17)	14.24	5
2020	1,510.85	10.00%	151.08	17.94	25.12	17.01	83.20	143.27	(7.81)	14.24	5
2021	1,533.00	10.00%	153.30	17.94	25.12	17.01	87.16	147.24	(6.06)	14.24	5
2022	1,563.66	15.00%	234.55	17.94	25.12	17.01	91.13	151.20	(83.35)	99.69	35
2023	1,594.32	15.00%	239.15	17.94	25.12	17.01	95.09	155.16	(83.99)	99.69	35
2024	1,629.43	15.00%	244.41	17.94	25.12	17.01	99.05	159.12	(85.29)	99.69	35
2025	1,655.64	15.00%	248.35	17.94	25.12	17.01	103.01	163.08	(85.26)	99.69	35
2026	1,686.30	15.00%	252.95	17.94	25.12	17.01	106.97	167.05	(85.90)	99.69	35
2027	1,716.96	15.00%	257.54	17.94	25.12	17.01	110.94	171.01	(86.54)	99.69	35
2028	1,752.41	15.00%	262.86	17.94	25.12	17.01	114.90	174.97	(87.89)	99.69	35

[1]ALL Wind Energy was assumed to have a ~33% capacity factor.
[2]Future Landfill Project Energy was assumed to have the same capacity factor as the Ameresco Energy.
[3]Existing Landfill Gas Energy taken from the 2007renewableenergyreport.pdf document.
[4]RPS Energy shortfall in 2012 assumed to be made up through purchase of temporary renewable energy credits.

2.3.7 Columbia Energy Center

The Columbia Energy Center is owned and operated by Ameren Generating Company and consists of four simple cycle, 48 MW combustion turbines (192 MW net capacity) located within Columbia city limits. CWL currently has a long-term PPA through 2023 to acquire 72 MW of generating capacity from the Columbia Energy Center. For purposes of the study, it was assumed that this capacity would be extended throughout the entire study period. Under the terms of the agreement, CWL is responsible for associated fuel and maintenance costs when the units are dispatched for CWL needs. Columbia Energy Center is typically dispatched only during peak hours.

2.3.8 Other Resources

CWL leases or owns capacity shares in several other generating units amounting to 8.5 MW of diesel generators. It is assumed that these generation resources are available to CWL throughout the study period.

2.3.9 Union Electric PPA

CWL has a contract with AmerenUE (Union Electric) for the sale of capacity and associated energy over the period ranging from June 1, 2008 through May 31, 2011. The contracted capacity starts at 60 MW and grows by 5 MW each year, capping out at 70 MW from June 2010 through the end of the contract.

2.3.10 Market Capacity and Energy

The interconnection CWL has with AmerenUE (Union Electric) permits it to access the MISO utility energy market outside of its own service territory. This market access permits CWL to purchase standby reserves, maintenance energy, firm and non-firm capacity and also permits energy sales and economy energy transactions. These transactions permit CWL to optimize the use of its electrical generation.

In addition to the above economy type transactions, CWL can contract for capacity and associated energy with another party. These arrangements are called bilateral contracts. Bilateral transactions in the MISO market are delivered over the MISO transmission system. The delivery cost for the bilateral energy is priced as the difference between the injection node and the CWL load node. The market will allow transactions of the energy from the resource to the value of the resource that is deemed deliverable through the MISO market deliverability tests.

Contracts with entities located outside of the MISO area must have transmission delivery arranged across the systems between the selling entity and CWL. This involves requesting the service from the respective

utility. The utilities involved would perform analyses to determine if transmission capacity is available for delivery of the requested capacity and energy. Should improvements be necessary to the transmission system for delivery of the requested contract, then CWL would potentially be responsible for paying for the cost of the upgrades.

2.4 BALANCE OF LOADS AND RESOURCES

The CWL service territory is located within the MISO reliability region. According to CWL, MISO requires a 14 percent reserve margin above the peak demand of the utility. Following this guideline, reserve requirements for the purposes of this study were calculated as being 14 percent of peak load less firm contract purchases.

2.4.1 Demand/Capacity Balance

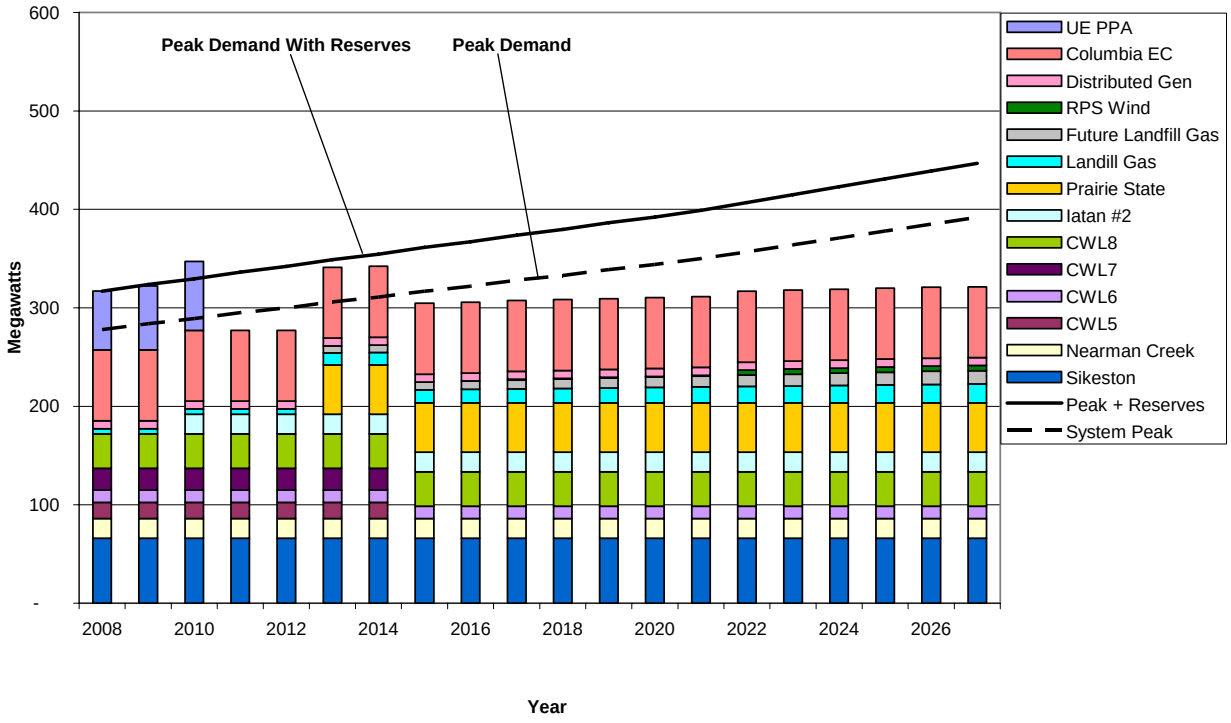
Table 2-4 shows a balance of loads and resources for the CWL system using the previously described load forecast and existing generation and purchase resources assuming 15 percent accredited capacity of nameplate wind. A utility is also required to maintain reserves to meet unit outages and planning uncertainties due to weather impacts. Prudent utilities also use reserves to meet economic growth larger than expected. CWL operates in the Midwest Independent Transmission System Operator, Inc. (MISO) region. MISO requires that members in the CWL area maintain a 14 percent reserve level above peak load less firm purchases.

As indicated in this table, the CWL system is projected to have a capacity deficiency beginning in 2012 with its existing mix of power supply resources, with the deficiency projected to grow over time. The balance of loads and resources is also shown graphically in Figure 2-2.

Table 2-4: CWL Balance of Loads and Resources

Year	Peak Demand (MW)	Peak + 14percent Reserves (MW)[1]	Total Generation (MW)	Reserve Surplus/(Deficit) (MW)
2008	278.0	316.9	318.1	1.2
2009	284.0	323.8	323.1	(0.6)
2010	289.0	329.5	348.1	18.7
2011	295.0	336.3	348.1	11.8
2012	300.0	342.0	278.1	(63.9)
2013	306.0	348.8	335.1	(13.7)
2014	311.0	354.5	335.6	(18.9)
2015	317.0	361.4	336.1	(25.2)
2016	322.0	367.1	298.1	(68.9)
2017	328.0	373.9	299.4	(74.5)
2018	333.0	379.6	299.9	(79.7)
2019	339.0	386.5	300.4	(86.1)
2020	344.0	392.2	300.9	(91.3)
2021	350.0	399.0	301.4	(97.6)
2022	357.0	407.0	306.4	(100.6)
2023	364.0	415.0	306.9	(108.1)
2024	371.0	422.9	307.4	(115.5)
2025	378.0	430.9	307.9	(123.0)
2026	385.0	438.9	308.4	(130.5)
2027	392.0	446.9	308.9	(138.0)
2028	399.0	454.9	309.4	(145.5)

Figure 2-2: CWL Balance of Loads and Resources, 2008-2027



2.4.2 Energy Sources

A load duration curve for the CWL system based on its projected load factor of 50 percent was developed for the projected peak demand in the years 2010 and 2020. The energy available from existing resources was also graphed with the load duration curve based on historical availability records. Both the 2010 and 2020 load duration curves are based on the existing resources as indicated in Figure 2-2. The 2010 load duration curve is shown in Figure 2-3 with a 289 MW peak demand and the 2020 load duration curve is shown in Figure 2-4 with a 344 MW peak demand. As illustrated in the graphs, there is a need for additional RPS energy and peaking capacity in the 2020 time frame.

Figure 2-3: Approximate 2010 Load Duration Curve and Available Energy

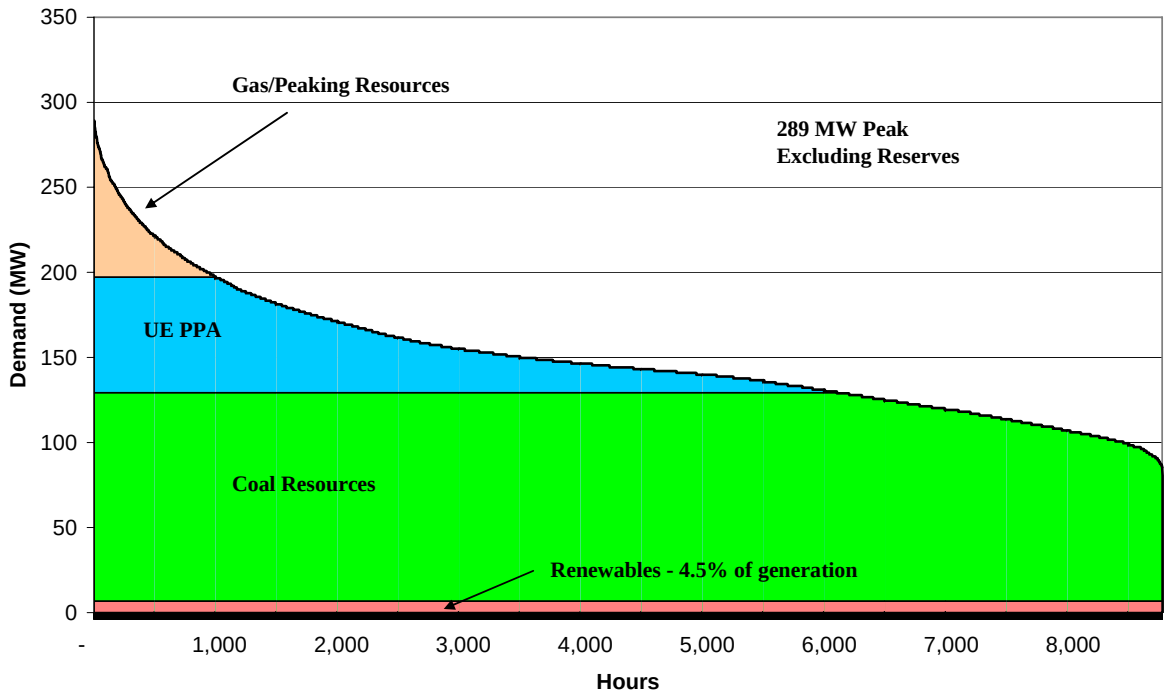
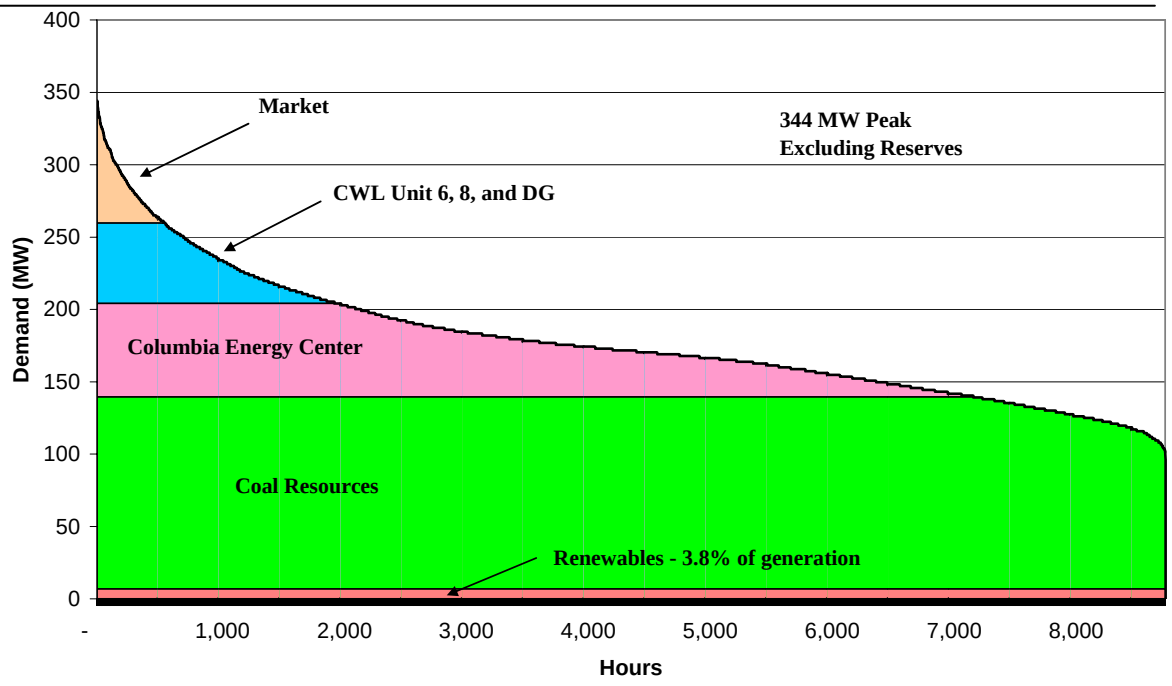


Figure 2-4: Approximate 2020 Load Duration Curve and Available Energy



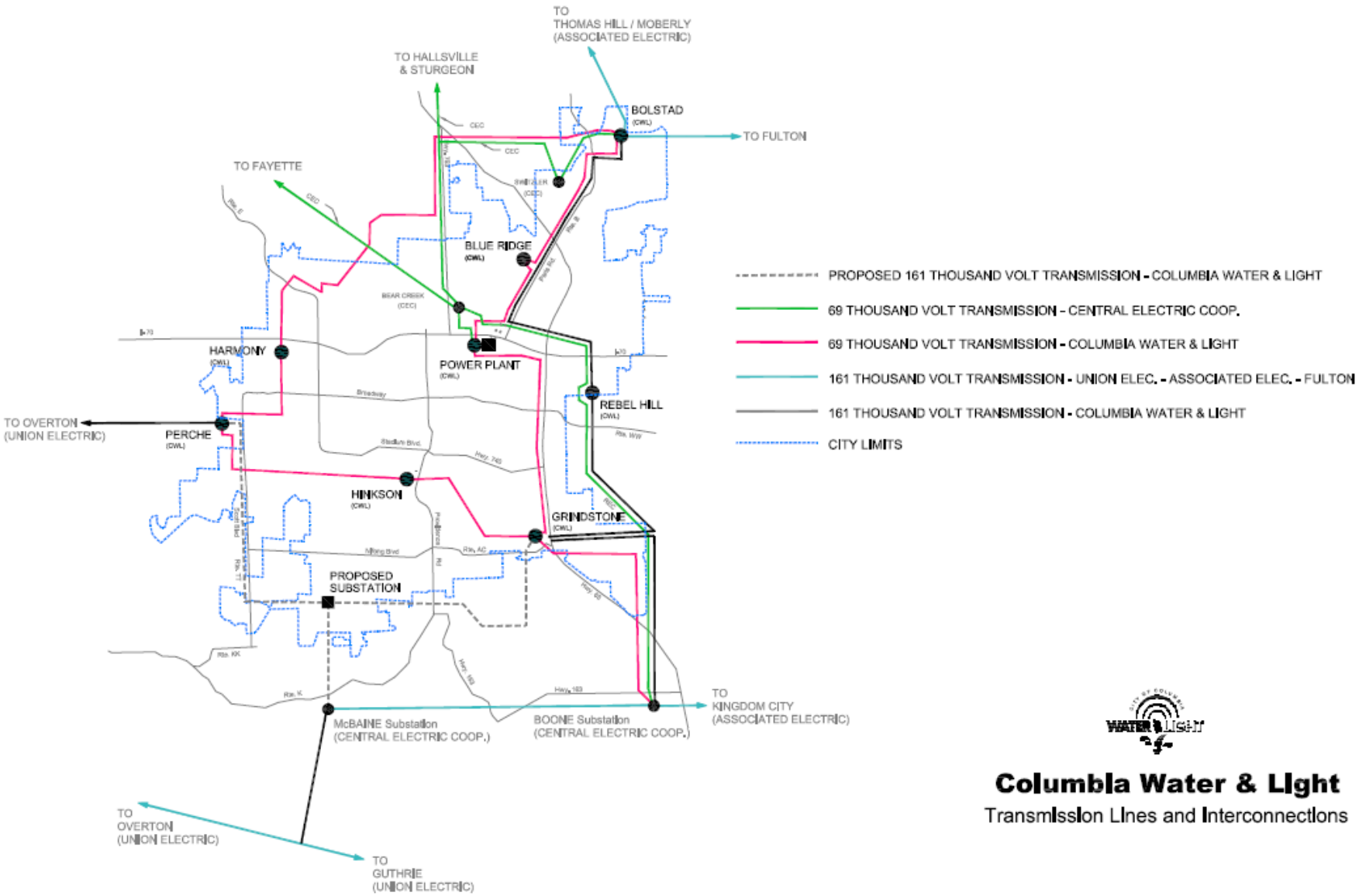
2.5 TRANSMISSION ISSUES

CWL imports energy into its service territory via transmission facilities owned and operated by other utilities. Direct interconnections are made with Ameren and AECI at substations around the CWL service area. These interconnections are made at the 161kV and 69kV level. Figure 2-5 provides an overview of the system and the major interconnection locations. The system is or will be used to import power from the following CWL resources:

- Sikeston
- Nearman
- Columbia Energy Center
- Prairie States Energy Center
- Iatan 2
- Bluegrass Wind Farm
- Ameresco Landfill Gas Project

In addition, future development of landfill projects in the area will require use of the transmission system. CWL pays for use of the transmission system under transmission agreements with AECI and the Midwest ISO.

Figure 2-5: CWL Transmission System



2.5.1 Import Limits

The transmission system has limits on the amount of power that can be transferred across it. The overall planning responsibility for the system lies with each of the owners, AECI and Ameren. CWL has the ability to provide input to the process to provide the owners with expected usage of the system. Analysis of the import capability has been performed by CWL and the owners to identify the limits of the system with its current components and their ratings.

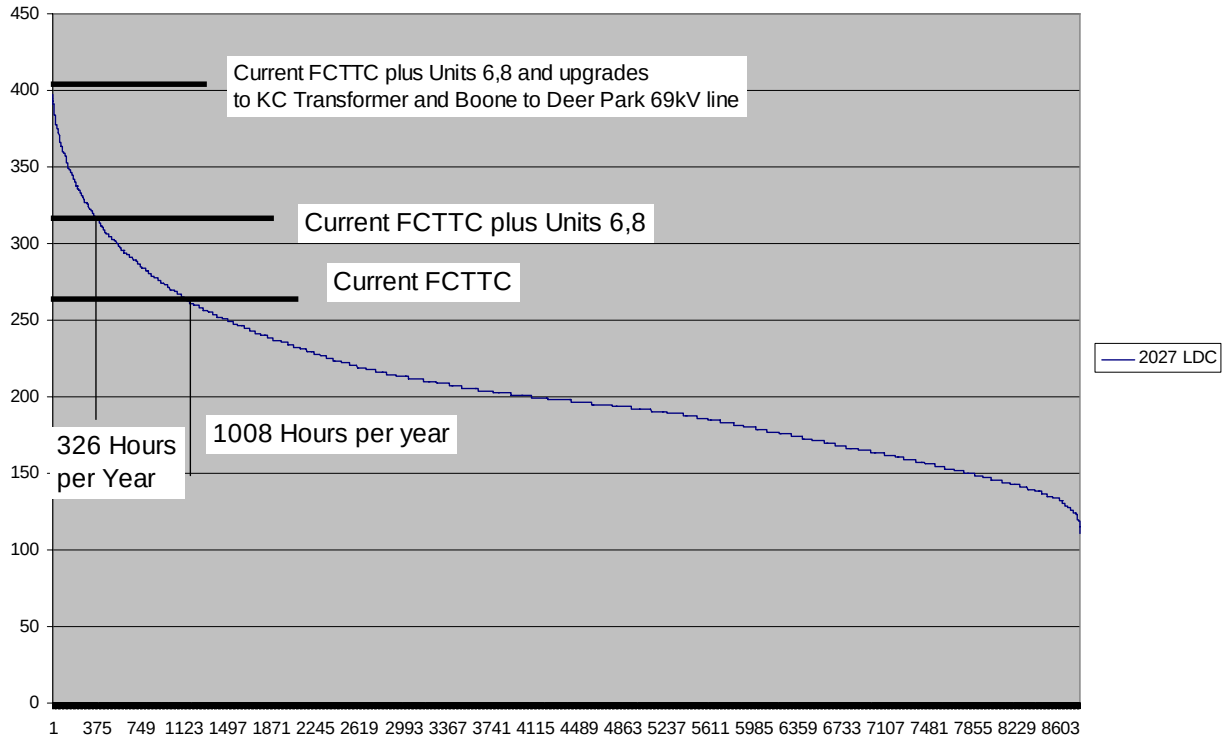
The transfer capacity of a system is identified as the First Contingency Total Transfer Capacity (FCTTC). The FCTTC identifies the maximum transfer capacity that is allowed before a system violation occurs, such as a thermal overload or a bus voltage dropping below limits, when a component of the system is removed. The process used to identify the FCTTC is to increase the power being transmitted into an area, remove system elements one at a time and then determine if there any violations. When a violation occurs, the power being transferred establishes the FCTTC.

Figure 2-6 provides a representation of the FCTTC capabilities of the existing transmission system CWL uses to import its power. The FCTTC limits are plotted against the estimated load duration curve for 2027. The line marked current FCTTC indicates that the current import limitation is approximately 270 MW. For the projected 2027 load curve, if the system were totally dependent on the transmission system to provide the power to the city, there would be approximately 1008 hours per year that the system would be exposed to being unable to support the full load above a level of 270 MW if the limiting outages occurred.

Since CWL has generation internal to its service territory, this generation could be used to provide support to the transmission system should the outages occur when the load is above the 270 MW. Adding the support that could be provided by Units 6 and 8 to the FCTTC yields a level of approximately 320 MW. This level of capability would expose the CWL to an inability to serve the total expected 2027 load for approximately 326 hours.

There are two system elements that have been identified by previous transfer studies as the primary cause to limit the FCTTC. These elements are the 161kV/69kV transformer at the Kingdom City substation and the Boone to Deer Park 69kV line. Increasing the capacity of these elements could provide approximately 85 MW additional FCTTC. The third line indicates what the total capability would be to serve firm load in the city with these modifications made and the use of the internal generation of Units 6 and 8. As shown on the graph, these improvements would provide coverage across all hours of the year.

Figure 2-6: Load Serving Capability of Area Transmission System to CWL



2.5.2 Expansion Potential

The expansion of the bulk power system outside of the CWL service territory is primarily the responsibility of the respective transmission owners. To the degree that CWL would require additional import capacity, CWL would have to work with other the transmission owners to modify their systems. The extent to which CWL would have to bear the cost of any improvements would be a subject of negotiations with the owners. For instance, replacement of the Kingdom City transformer or upgrading of the Boone to Deer Park 69kV line may also allow improved capabilities to AECI and/or Ameren. Therefore, cost sharing in these improvements may be warranted with other parties.

These improvements to local transmission facilities have been shown to increase the FCTTC for CWL. However, CWL may wish to pursue acquisition of resources at some distance from its system. The ability to move power from a distant resource to CWL depends on the capability of the transmission system between the resource and the CWL service area.

Resources located on the MISO system would be usable by CWL if they were able to deliver full capacity to the MISO market. The determination of whether a resource can achieve this is made through an

analysis performed by the MISO, the Generator Market Deliverability Test. If a resource is deemed deliverable, then CWL could purchase capacity and energy from the resource. If a resource was not deemed fully deliverable, then improvements would have to be made to the MISO system by the generator to remove the limitation. Should CWL schedule energy from the resource for delivery to the CWL system when the resource was deemed fully deliverable, CWL would then be charged the difference in the LMP between the CWL load node and the generator commercial pricing node to compensate the MISO for losses and congestion charges for use of the resource's energy. CWL would pay transmission charges based on MISO's network service tariff.

For resources not located on the MISO system, the process would be different. The generator would be required to have an interconnection study performed to determine what improvements would be needed to allow the generation to connect to the system. Then, if CWL wanted to procure capacity and energy from such a resource, CWL would participate in system studies that would determine the improvements necessary to provide firm delivery to the CWL system. CWL would be charged by the affected transmission owners for the necessary system improvements or would pay a transmission tariff that allowed recovery of the investment. CWL would also have the option to take the capacity and energy on a non-firm basis. This would subject any schedule established for the energy to be impacted should the system be unable to deliver the full amount.

As an example of a non-MISO resource purchase, CWL may desire to procure energy from a resource being developed in western Kansas.

* * * * *

SECTION 3.0

SUPPLY SIDE ANALYSIS

3.0 SUPPLY SIDE ANALYSIS

The development of a power resource analysis requires creation of a mix of resources to evaluate. This part of the report describes the options reviewed, costs for the options, and the detailed analysis performed on the selected options. A summary of the major assumptions used in the study can be found in Appendix A.

3.1 GENERAL ASSUMPTIONS

The supply side analysis began with the development of the assumptions for the various resources considered as applicable for CWL. The following general assumptions are applicable to the supply side analysis:

- The study period covers the years 2008 through 2027.
- CWL must maintain reserves of 14 percent above peak load throughout the study period.
- CWL retires Units 5 and 7 at the Local Power Plant in 2015.
- The 2007 hourly load was used as the basis for the load growth projections provided by CWL.
- Budgets and forecasts associated with the current CWL assets were escalated at their historical trend or inflation over the study horizon.
- The discount rate for CWL for financing terms was 5.5 percent, with longer term resources financed over 30 years, and shorter term resources financed over 20 years.

3.2 FUEL CONSIDERATIONS/FORECASTS

Many of the generating resources considered in the supply side analysis require an associated fuel for power generation. The analysis utilized gas, coal, and spot market pricing to help determine production costs for each of the various supply alternatives considered. The following paragraphs discuss each of the various fuel forecasts used in this analysis.

3.2.1 Coal

There were two coal forecasts used in the analysis. One forecast was for low-sulfur coal from the PRB region, to be used as the fuel cost basis for a new super critical pulverized coal supply option. The PRB coal forecast was developed based on fuel cost estimates from other similar projects in the Midwest region. The PRB coal forecast was $1.79/MMBtu in 2008$, subject to 2 percent annual escalation after 2008. The other forecast was eastern bituminous coal, to be used as the fuel cost basis for the existing

coal-fired boilers in Columbia's Local Power Plant and the circulating fluidized bed (CFB) and biomass alternative considered at the same location. The bituminous coal forecast was $3.57/MMBtu in 2008$, subject to 2 percent annual escalation after 2008.

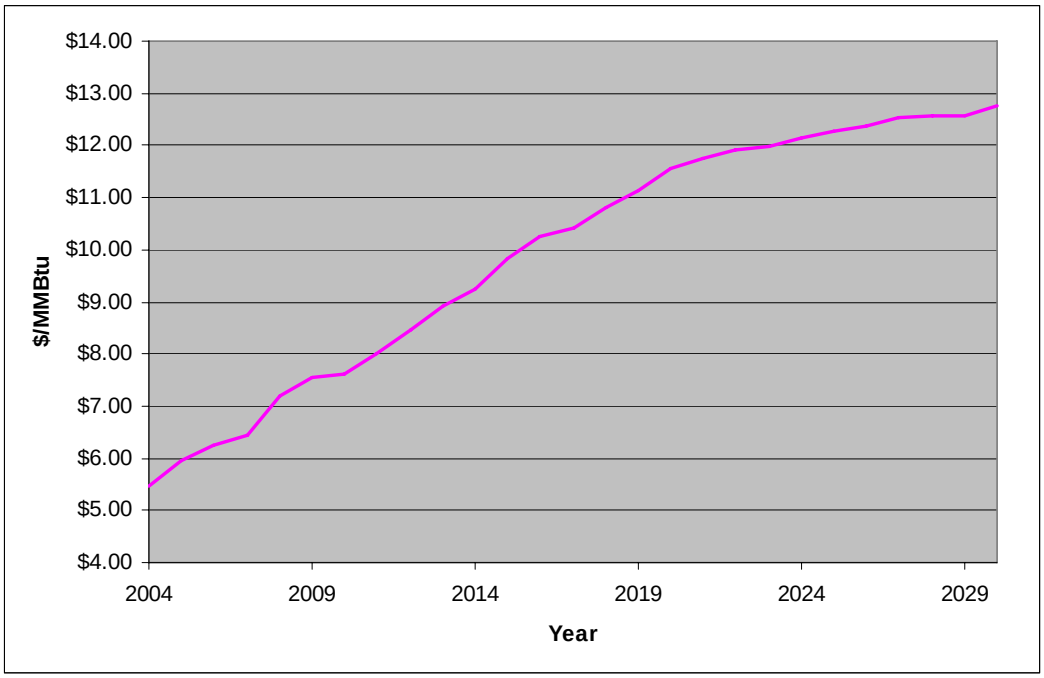
3.2.2 Biomass Fuel

For the consideration of a biomass facility at the CWL Local Power Plant, a tire derived fuel (TDF) was used as a basis for half of the blended fuel cost. The biomass facility was assumed to burn half TDF and half coal. The TDF forecast was $2.27/MMBtu in 2008$, subject to 3 percent annual escalation after 2008.

3.2.3 Natural Gas

Natural gas has seen severe price fluctuations over the past decade, due to natural disasters such as Hurricane Katrina and increasing geopolitical tensions. For a base natural gas price forecast, the study relied on Energy Information Administration's (EIA) annually published long-term natural gas forecast for Electric Power Producers. This annual forecast is published in real dollars by the U.S. Department of Energy and runs through 2030. Applying the assumed study inflation rate of 3 percent, the study forecast is shown in Figure 3-1. This forecast was used as the base natural gas price for all resource alternatives that required the use of natural gas as a fuel.

Figure 3-1: EIA Natural Gas Forecast



3.2.4 Nuclear

At the request of CWL, a nuclear resource option was not considered due to regulatory and cost uncertainty. Therefore, no nuclear cost or fuel forecasts were prepared or used in this study.

3.2.5 Market

The spot market energy price forecast was developed using the hourly day-ahead LMP pricing of the CWLD.CWLD node in MISO from January through December 2007. On and Off-peak energy prices for 2008 and beyond were projected using the same underlying annual escalation as the EIA natural gas forecast throughout the study period. Table 3-1 summarizes the prices used for select years. The entire market price forecast can be found in the study assumptions found in Appendix A.

Table 3-1: Study Spot Market Price Forecast

Month	Peak ($/MWh)	OffPeak ($/MWh)	Month	Peak ($/MWh)	OffPeak ($/MWh)	Month	Peak ($/MWh)	OffPeak ($/MWh)
Jan-07	$47.86	$26.52	Jan-09	$55.92	$30.98	Jan-11	$59.42	$32.92
Feb-07	$67.00	$46.30	Feb-09	$78.28	$54.11	Feb-11	$83.19	$57.50
Mar-07	$55.51	$32.46	Mar-09	$64.86	$37.93	Mar-11	$68.93	$40.31
Apr-07	$61.98	$34.52	Apr-09	$72.42	$40.34	Apr-11	$76.96	$42.87
May-07	$67.80	$28.59	May-09	$79.22	$33.40	May-11	$84.19	$35.50
Jun-07	$62.28	$28.89	Jun-09	$72.77	$33.75	Jun-11	$77.33	$35.87
Jul-07	$56.03	$30.06	Jul-09	$65.47	$35.12	Jul-11	$69.57	$37.32
Aug-07	$74.22	$34.12	Aug-09	$86.73	$39.87	Aug-11	$92.16	$42.37
Sep-07	$49.54	$25.58	Sep-09	$57.89	$29.89	Sep-11	$61.52	$31.76
Oct-07	$55.23	$28.72	Oct-09	$64.53	$33.56	Oct-11	$68.57	$35.66
Nov-07	$55.78	$26.53	Nov-09	$65.17	$31.00	Nov-11	$69.26	$32.95
Dec-07	$52.53	$34.79	Dec-09	$61.38	$40.65	Dec-11	$65.22	$43.19
Jan-08	$53.30	$29.53	Jan-10	$56.48	$31.30	Jan-12	$62.88	$34.84
Feb-08	$74.61	$51.57	Feb-10	$79.08	$54.65	Feb-12	$88.03	$60.84
Mar-08	$61.82	$36.15	Mar-10	$65.52	$38.32	Mar-12	$72.94	$42.66
Apr-08	$69.02	$38.45	Apr-10	$73.15	$40.75	Apr-12	$81.44	$45.36
May-08	$75.51	$31.84	May-10	$80.03	$33.74	May-12	$89.09	$37.56
Jun-08	$69.36	$32.17	Jun-10	$73.51	$34.09	Jun-12	$81.83	$37.95
Jul-08	$62.40	$33.48	Jul-10	$66.13	$35.48	Jul-12	$73.62	$39.50
Aug-08	$82.66	$38.00	Aug-10	$87.60	$40.27	Aug-12	$97.53	$44.83
Sep-08	$55.17	$28.49	Sep-10	$58.47	$30.19	Sep-12	$65.10	$33.61
Oct-08	$61.50	$31.98	Oct-10	$65.18	$33.89	Oct-12	$72.56	$37.73
Nov-08	$62.12	$29.55	Nov-10	$65.83	$31.32	Nov-12	$73.29	$34.87
Dec-08	$58.50	$38.74	Dec-10	$62.00	$41.06	Dec-12	$69.02	$45.71

3.3 TRADITIONAL OPTIONS

Many traditional resource options were considered in this study, including typical baseload, intermediate, and peaking generation alternatives. The assumptions used to evaluate each alternative in the context of this study are provided in the following paragraphs.

3.3.1 Local CFB

As described in Section 2.3.1, CWL currently owns and operates a power plant Columbia. A local baseload resource alternative considered in this study included the addition of a new CFB boiler at the existing power plant location. CWL previously hired a consultant to look at this option and the cost and performance estimates used in this study were based on those findings.

3.3.1.1 Constructability and Permitting

For purposes of this study, construction of a new CFB power plant adjacent to the existing Local Power Plant would have a commercial operation date (COD) of no earlier than 2015 due to permitting and construction. This new generation facility would be constructed at an existing power plant which should minimize development challenges typical of new, greenfield power plants.

A new coal-fired CFB facility would be equipped with emission control technology to meet currently required emission regulations, including mercury. However, continued operation of the existing coal-fired boilers at the Local Power Plant will likely require upgraded emission control technology and/or switching to cleaner burning fuel. The following are the assumed emission rates of criteria pollutants for this supply alternative:

- NO_X: 0.10 lbs/MMBtu
- SO_2: 0.04 lbs/MMBtu
- CO_2: 214 lbs/MMBtu
- Hg: 0.72 lbs/TBtu

3.3.1.2 Performance and Cost Assumptions

A local eastern bituminous coal-fired CFB option adjacent to the existing Local Power Plant was assumed to have a net electrical output of 108.5 MW and an operational heat rate of 9,646 Btu/kWh. In 2008$, variable and fixed O&M for this alternative was assumed to be $3.53/MWh and $31.52/kW-yr, respectively. Assuming a 2015 COD and 2015$, the total project costs, including Owner's and Interest

During Construction (IDC), was an estimated $3,710/kW. Please refer to Appendix A for a complete summary of assumptions used for all of the supply options considered in this study.

3.3.2 Local Biomass

As described in Section 2.3.1, CWL currently owns and operates a power plant in Columbia. A local baseload and renewable resource alternative considered in this study included the addition of a new CFB boiler at the existing power plant location to repower the existing steam turbines 5, 7, and 8. In general, the CFB technology is well suited to burn fuels with large variability in constituents. Therefore, in addition to coal, a biomass fuel was considered for this supply option. CWL previously hired a consultant to look at this option and the cost and performance estimates used in this study were based on those findings.

3.3.2.1 Constructability and Permitting

For purposes of this study, construction of a new CFB boiler to repower turbines 5, 7, and 8 at the existing Local Power Plant would have a COD of no earlier than 2015. This new boiler would replace two existing boilers at the Local Power Plant and should minimize development challenges typical of new, greenfield power plants.

A coal and biomass-fired CFB facility would be equipped with emission control technology to meet currently required emission regulations, including mercury. For purposes of this study, it was assumed that the new boiler would fire half and half on coal and a tire-derived biomass fuel (TDF). The following are the assumed emission rates of criteria pollutants for this supply alternative:

- NO_X: 0.11 lbs/MMBtu
- SO_2: 0.05 lbs/MMBtu
- CO_2: 118 lbs/MMBtu
- Hg: 1.89 lbs/TBtu

3.3.2.2 Performance and Cost Assumptions

A CFB boiler repowering the existing steam turbines at the Local Power Plant was assumed to have the same net electrical output - 73.5 MW (net of all three turbines) - as before the repower, and an operational heat rate of 11,085 Btu/kWh. In 2008$, variable and fixed O&M for this alternative was assumed to be $3.53/MWh and $31.52/kW-yr, respectively. Assuming a 2015 COD and 2015$, the total project costs,

including Owner's and IDC, was an estimated $2,940/kW. Please refer to Appendix A for a complete summary of assumptions used for all of the supply options considered in this study.

3.3.3 Local Combined Cycle

The basic principle of a combined cycle gas turbine (CCGT) plant is to utilize natural gas to produce power in a gas turbine (GT) and also use the hot exhaust gases from the GT to produce steam in a Heat Recovery Steam Generator (HRSG). The use of both gas and steam turbine cycles: Brayton and Rankine, in a single plant to produce electricity results in high conversion efficiencies and low emissions. This study used a 1 x 1 power block as the basis for a combined cycle resource option, which is typically composed of one GT, one HRSG, and one steam turbine.

3.3.3.1 Constructability and Permitting

For purposes of this study, construction of a CCGT resource would have a COD of no earlier than 2012. It was assumed that any combined cycle capacity constructed would be located at a site within the CWL service territory.

Natural gas-fired generation resources would be equipped with emission control technology to meet currently required emission regulations. The following are the assumed emission rates of criteria pollutants for this supply alternative:

- NO_X: 0.007 lbs/MMBtu
- SO_2: 0.0051 lbs/MMBtu
- CO_2: 118 lbs/MMBtu

3.3.3.2 Performance and Cost Assumptions

A local natural gas-fired CCGT option within the CWL service territory was assumed to have a net electrical output of 125 MW and an operational heat rate of 7,965 Btu/kWh. In 2008$, variable and fixed O&M for this alternative was assumed to be $4.89/MWh and $20.60/kW-yr, respectively. Assuming a 2012 COD and 2012$, the total project costs, including Owner's and IDC, was an estimated $1,740/kW. Please refer to Appendix A for a complete summary of assumptions used for all of the supply options considered in this study.

3.3.4 Local IGCC

In consideration of potential future emissions restrictions and/or costs, a newer technology which has lower emission rates for most pollutants compared to conventional coal-fired power plants, Integrated Gasification Combined Cycle (IGCC), was considered in this analysis. Gasification technology is used to produce a low calorific value syngas from coal or solid waste that can be fired in a conventional CCGT. The gasification process is a proven technology used for chemical production of products such as synthetic natural gas, liquid fuels, ammonia, acetyl chemicals, and other chemical products. Utilizing coal as a solid feedstock to a gasifier represents a link between solid fossil fuels such as coal and existing gas turbine technology. Integrating proven gasifier technology with gas turbine combined cycle technology is fairly new and continues to improve at U.S. Department of Energy (DOE) jointly funded power plants. This study was performed based on a 1 x 1 IGCC configuration which consists of four EPIC gasifiers, one General Electric (GE) 7EA GT, one HRSG, and one steam turbine.

3.3.4.1 Constructability and Permitting

Most IGCC studies and operating experience is based on eastern bituminous coal with low moisture content, thus it is expected that a coal source similar to that which already supplies the CWL Local Power Plant would be used in a new IGCC facility. There are only two IGCC facilities in operation in the U.S. today. Therefore, construction and operating risk are higher with this supply alternative than many of the other conventional generation resources considered in this study. For purposes of this study, construction of an IGCC resource would have a COD of no earlier than 2015.

Because gasification-based power generation is a relatively new technology, its unique operating features and its environmental performance capability are not well known. However, a benefit of this developing technology is the ability to burn a relatively cheap fuel resource in a cleaner fashion similar to natural gas. The following are the assumed emission rates of criteria pollutants for this supply alternative:

- NO_X: 0.03 lbs/MMBtu
- SO_2: 0.016 lbs/MMBtu
- CO_2: 205 lbs/MMBtu
- Hg: 0.65 lbs/TBtu

3.3.4.2 Performance and Cost Assumptions

A local coal-fired IGCC option within the CWL service territory was assumed to have a net electrical output of 148 MW and an operational heat rate of 9,300 Btu/kWh. In 2008$, variable and fixed O&M for this alternative was assumed to be $5.18/MWh and $33.18/kW-yr, respectively. Assuming a 2015 COD and 2015$, the total project costs, including Owner's and IDC, was an estimated $2,830/kW. Please refer to Appendix A for a complete summary of assumptions used for all of the supply options considered in this study.

3.3.5 Local Simple Cycle

Typically, simple cycle gas turbines provide peaking power due to their fast load ramp rates and relatively low capital costs. Simple cycle gas turbine generation is a widely used and mature technology. These units are typically fired using natural gas as the primary fuel with oil backup. The gas turbine (Brayton) cycle is one of the most efficient cycles for conversion of gaseous fuels to mechanical power or electricity. However, the units typically have high heat rates compared with combined cycle and coal-fired technologies. With the capacity additions of Iatan II and Prairie State Energy Campus over the next five to six years, CWL does not face severe capacity deficits until the 2016 timeframe. Therefore, peaking resources offering dispatch flexibility and capacities at or below 50 MW were considered the best alternatives for peaking resources to be evaluated in this study. Both a 50 MW combustion turbine based on the Pratt and Whitney FT8 Twin Pac (FT8) as well as an 8.4 MW Wartsila reciprocating engine were considered for peaking capacity options to be constructed by CWL in this analysis.

3.3.5.1 Constructability and Permitting

The current generation market is seeing increased construction of peaking facilities, resulting in increased construction cost and lead times. It was assumed that any simple cycle capacity constructed would be located at a site within the CWL service territory. For purposes of this study, construction of a simple cycle resource would have a COD of no earlier than 2011.

Natural gas-fired generation resources would be equipped with emission control technology to meet currently required emission regulations. The following are the assumed emission rates of criteria pollutants for the FT8 and Wartsila supply alternatives:

<u>Assumed FT8 emission rates</u>

- NO_X: 0.10 lbs/MMBtu
- SO_2: 0.0051 lbs/MMBtu

- CO_2: 133 lbs/MMBtu

Assumed Wartsila emission rates

- NO_X: 0.02 lbs/MMBtu
- SO_2: 0.0051 lbs/MMBtu
- CO_2: 125 lbs/MMBtu

3.3.5.2 Performance and Cost Assumptions

A local natural gas-fired simple cycle option within the CWL service territory was assumed to have a net electrical output of 55 MW for the FT8 option and 8.4 MW per engine for the Wartsila option. The operational heat rates of the FT8 and Wartsila units are 10,346 Btu/kWh and 8,642 Btu/kWh, respectively. In 2008$, variable and fixed O&M for the FT8 alternative was assumed to be $1.53/MWh and $12.50/kW-yr, respectively. In 2008$, variable and fixed O&M for the Wartsila alternative was assumed to be $8.18/MWh and $8.08/kW-yr, respectively. Assuming a 2011 COD and 2011$, the total project costs, including Owner's and IDC, was an estimated $850/kW for the FT8 alternative and $950/kW per engine for the Wartsila alternative. Please refer to Appendix A for a complete summary of assumptions used for all of the supply options considered in this study.

3.3.6 Remote Unit Participation

CWL currently participates in a number of baseload facilities remotely as discussed in Section 2 of this report. Coal plants are typically economical above a 250 MW capacity level. The economies of scale improve significantly above 500 MW. The coal units estimated for this study are assumed to be fired on PRB fuel. Due to the technology status of new coal units and the need for the highest efficiency possible, only super critical units were considered for remote participation. The study assumes the units would be configured as pulverized coal units, which is a mature and reliable energy producing technology used around the world.

3.3.6.1 Constructability and Permitting

For purposes of this study, participation in an area coal plant with a COD of 2015 was considered the earliest option for a baseload facility. Several recent coal-fired projects across the country have been cancelled and/or postponed due to uncertainty regarding future CO_2 regulations and rising construction costs. There is the risk that this supply option may not be available based on the recent project cancellations.

It was assumed that a new supercritical coal-fired facility would be equipped with emission control technology to meet currently required emission regulations, including mercury. The following are the assumed emission rates of criteria pollutants for this supply alternative:

- NO_X: 0.04 lbs/MMBtu
- SO_2: 0.03 lbs/MMBtu
- CO_2: 216 lbs/MMBtu
- Hg: 0.72 lbs/TBtu

3.3.6.2 Performance and Cost Assumptions

CWL participation in an area coal-fired super critical pulverized coal option was assumed to be in 25 MW increments and have an operational heat rate of 8,980 Btu/kWh. In 2008$, variable and fixed O&M for this alternative was assumed to be $7.91/MWh and $36.05/kW-yr, respectively. Assuming a 2015 COD and 2015$, the total project costs, including Owner's and IDC, was an estimated $3,340/kW. Please refer to Appendix A for a complete summary of assumptions used for all of the supply options considered in this study.

3.3.7 Combined Heat and Power

Combined Heat and Power (CHP), also known as cogeneration, was a supply alternative considered in this study. CHP is a form of distributed generation that strategically places generating unit(s) near customer facilities that require large amounts of energy on-site. CHP offers an enhancement over traditional distributed generation by providing simultaneous production of thermal and electrical energy. CHP systems can include a variety of generating resources, but, for purposes of this study, a gas turbine was considered the basis for analysis.

3.3.7.1 Constructability and Permitting

The study analysis assumes that no more than three potential CHP projects are available within the CWL service territory, and it assumes that construction of a CHP resource would have a COD of no earlier than 2011. A natural gas-fired generation resource was selected to model the CHP for this analysis. The CHP would be equipped with emission control technology to meet currently required emission regulations. The variable cost assumed for the CHP is assumed to include any costs for emissions of criteria pollutants.

3.3.7.2 Performance and Cost Assumptions

A local CHP option within the CWL service territory was assumed to have a net electrical output of 5 MW and an operational heat rate of 5,500 Btu/kWh. This low heat rate is an approach for the utility to capture a portion of the cogeneration benefits. In 2008$, combined variable and fixed O&M for this alternative was assumed to be $15.45/MWh. Assuming a 2011 COD and 2011$, the total project costs, including Owner's and IDC, was an estimated $1,880/kW. Burns & McDonnell is actively engaged in the CHP market and has found the economics to be very site specific. Please refer to Appendix A for a complete summary of assumptions used for all of the supply options considered in this study.

3.4 POWER PURCHASE AGREEMENTS

Utilities can purchase capacity and energy in firm and non-firm contracts or purchase long-term capacity in generation facilities, similar to CWL contracts for several existing and planned resources. Both of these options depend on the availability of excess capacity in the area. For CWL, capacity should be located within the CWL or MISO control area to reduce the costs of delivery and potential for system constraints.

The current market for capacity purchases does not command any premium on a demand cost basis. Prices for capacity are currently at a cost below the financing cost necessary for construction of combustion turbines and other peaking units. Therefore, additional capacity is assumed to be available from the market. Energy associated with this capacity would be procured at the market price projections of energy.

3.5 RENEWABLE

Renewable resource options considered in this study include wind, solar photovoltaic, and biomass power alternatives. The assumptions used to evaluate each alternative in the context of this study are provided in the following paragraphs.

3.5.1 Wind

Wind energy relies on the renewable power of the wind and is one of the fastest growing generation resources in the U.S. Wind power must compete with conventional generation resources on a cost basis, which makes the location of wind farms particularly important. Wind farm sites must be located in areas with high wind energy to make them cost competitive. Because of this, wind farm sites are often located in remote locations, requiring transmission access over long distances.

3.5.1.1 Constructability and Permitting

The current generation market is seeing increased construction of wind farms, resulting in increased construction cost and lead times. It was assumed that any wind capacity would be located at a remote site relative to the CWL service territory. For purposes of this study, participation in a wind resource would have a COD of no earlier than 2010.

Wind energy is fueled by the wind rather than combustion of fossil fuels, so it is a clean fuel resource. Therefore, wind energy supply alternatives considered in this study had no criteria pollutants associated with them.

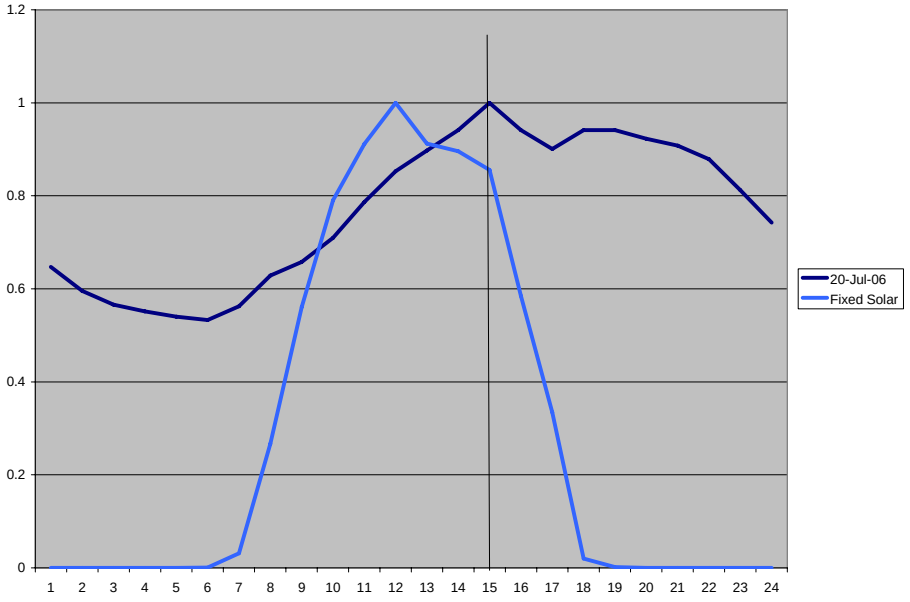
3.5.1.2 Performance and Cost Assumptions

A major challenge of using wind energy is that the wind is intermittent and typically does not produce peak electrical output during times of peak electrical usage. Modern, horizontal axis wind turbines generally have a net electrical output of 2.1 MW per turbine. However, the actual output of the turbine is dependant upon the wind speeds at the site of the turbine. For purposes of this study, it was assumed that the annual capacity factor of a wind resource would have a capacity factor of nearly 33 percent. This capacity factor is consistent with historical output of other wind farms in the region. Using a long-term fixed contract approach similar to the CWL arrangement at the Blue Grass Ridge Wind Farm, it was assumed that a new wind resource would have a fixed energy charge including transmission of $68.55/MWh in 2008$. This energy charge would be escalated to the in-service date and then fixed at that price for a 20 year contract, and takes into account construction and long-term lease payments of the resource. Please refer to Appendix A for a complete summary of assumptions used for all of the supply options considered in this study.

3.5.2 Solar

Solar energy relies on the renewable power of the sun and is available in a variety of different energy systems today. Solar power systems today are available in concentrating solar power (CSP), photovoltaic (PV), solar heating, and solar lighting technologies. Rooftop PV was used as the basis for analysis of a solar power resource in this study. Figure 3-2 provides a normalized comparison of a fixed solar array output as compared to the CWL peak day in 2006. As shown, the solar array output is declining during the CWL peak hours.

Figure 3-2: Fixed Solar Array Output and CWL Peak Demand



3.5.2.1 Constructability and Permitting

Considerable research and development efforts have gone into enhancing the efficiency and output of PV devices. It was assumed that fixed axis PV solar arrays would be placed on commercial building rooftop space within the CWL service territory and have an in-service date no earlier than 2009. CWL estimates that there is approximately 17.3 million square feet of rooftop space on commercial buildings within its service territory. Of this space, it was assumed that less than half could be used for fixed axis PV arrays due to space constraints, shading issues, and customer acceptance.

Solar power is fueled by energy from the sun rather than combustion of fossil fuels, so it is a clean fuel resource. Therefore, the solar power supply alternative, as considered in this study, had no criteria pollutants associated with it.

3.5.2.2 Performance and Cost Assumptions

Like wind energy, a major challenge of using solar power is that the energy availability is intermittent and dependent on many outside factors including the weather and surrounding environment. The net electrical output of a solar array is also determined based on the number of PV cells available. For purposes of this study, it was assumed that CWL could add up to 10 MW of PV energy resources within its service territory. However, the actual output of a solar powered resource is dependant upon the level

of interference between the sun's energy and the PV cells. For purposes of this study, the annual capacity factor of a solar power resource would have a capacity factor of nearly 15 percent. This capacity factor was based on research from the National Renewable Energy Laboratory (NREL) of the typical hourly output of a fixed axis solar array in Columbia, MO. No fixed or variable O&M was assigned to the resource, and the capital cost of installation was assumed to be $4,000/kW in 2009$. This capital cost estimate does not take into account any tax credits or other benefits that may be available for the construction of renewable resources such as solar power. Please refer to Appendix A for a complete summary of assumptions used for all of the supply options considered in this study.

3.6 STORAGE

Energy storage systems are a form of generation that can be used to offset electrical peak loads through potential energy storage created during low (valley) energy usage times. Typical energy storage technologies available today that can provide MW levels of storage include pumped hydro and compressed air energy storage (CAES). Thermal or ice storage systems can also be used on a smaller basis. The hydro and compressed air systems require suitable geology before the systems can be economically applied. Burns & McDonnell developed the only CAES system in operation in the US. The storage cavern for this system used a sluiced salt dome that approached a mile in diameter. Pumped hydro systems require large upper reservoirs to provide the transfer of potential energy to kinetic energy as the water flows through a hydro turbine. An equivalent lower reservoir is needed to receive the water for later pumping back to the upper reservoir.

Hydro pumped storage was the basis for analysis in this study, but it was assumed that this could also serve as a proxy for other kinds of energy storage available to CWL.

3.6.1 Hydro Pumped Storage

Hydro pumped storage utilizes an upper and lower reservoir to store energy for generation during peak demand times. When the price for energy is low, a pumped storage facility stores energy by pumping water from a lower reservoir to an upper reservoir. During times of peak demand or high market price, the stored water is released back into the lower reservoir to produce electricity.

3.6.1.1 Constructability and Permitting

The DOE defines large hydropower facilities as those with capacity of greater than 30 MW. A large 60 MW storage reservoir, which was the basis for analysis in this study, would require significant amounts of space near a suitable water resource and would have a COD of no earlier than 2015. According to

DOE research, there is 30,000 MW of undeveloped hydroelectric power resources across the U.S., and approximately 400 MW of undeveloped hydroelectric power resources in the state of Missouri. However, the DOE projects that hydropower's share of total electric generation for all utilities will decline over the next decade due to environmental issues, regulatory complexity, and energy economics.

Hydroelectric energy is fueled by water rather than combustion of fossil fuels, so it is a clean fuel resource. Therefore, the hydro pumped storage supply alternative, as considered in this study, had no criteria pollutants associated with it.

3.6.1.2 Performance and Cost Assumptions

A local hydro pumped storage option near the CWL service territory was assumed to have a net electrical output of 60 MW per hour of generation, with the ability to generate no more than four hours before pumping to recharge the upper reservoir would be required. In 2008$, fixed O&M for the pumped storage alternative was assumed to be $6.18/kW-yr. Variable O&M associated with the cost of pumping water to the upper reservoir was based on the hourly spot market price of energy, which averaged $31.29/MWh during off-peak hours in 2007 at the CWL MISO node. Assuming a 2015 COD and 2015$, the total project costs, including Owner's and IDC, was an estimated $4,740/kW. Please refer to Appendix A for a complete summary of assumptions used for all of the supply options considered in this study.

3.7 PRODUCTION COST ANALYSIS

Burns & McDonnell has acquired a license for the Strategist and PROMOD production cost analysis suite of software tools developed by New Energy Associates. This part of the report describes the methodology for the production cost analysis using this suite of analysis software. Burns & McDonnell used Strategist and PROMOD production cost modeling software to model the CWL system for the years 2008 to 2027. Once an optimal resource portfolio was determined in Strategist, more detailed hourly production costs of the different supply scenarios were compared using PROMOD. This analysis was performed on an incremental cost basis. Therefore the costs that remained the same between cases, such as administration costs, were not included in the production cost model. Both existing and future resources were input for each case to determine the most cost-effective method of meeting future power supply needs.

3.8 STRATEGIST ANALYSIS

This part of the report addresses the various resource planning scenarios that were developed and analyzed using Strategist and describes the results of the analysis. The Strategist model is a resource portfolio optimization model that allows an analysis of several different resources with a variety of characteristics. The model selects the lowest cost combination of capacity amounts and in-service dates based on the performance and construction costs provided. In developing the scenarios, consideration was given to the existing resources discussed in Section 2 as well as various new resource options discussed previously in this section.

3.8.1 Portfolio Selection

The resource scenarios were modeled and simulated using the Strategist resource optimization software. The model used the assumptions of the resources as described previously in this section to determine the optimal portfolio of resources to meet the energy needed. In addition to the supply resources outlined previously in this section, when the supply resources were not available or economical, a market capacity resource was used to maintain reserve margins throughout the study period. This market capacity resource was modeled as a temporary supply resource, expiring at the end of each year. The model provided a net present value of costs for thousands of portfolio options. Scenarios were run under a variety of circumstances including:

- Different resource capacities
- Different pool of resources to select from
- No CO_2 tax
- Flat \$10/ton CO_2 tax on all resources, starting in 2015
- Flat \$30/ton CO_2 tax on all resources, starting in 2015

In cases that included a CO_2 tax scenario, the spot market price of energy was also increased in order to account for the increase in the cost of generation across the market. In the \$10/ton tax case, off-peak market prices were increased by \$10/MWh, and on-peak market prices were increased by \$5/MWh. In the \$30/ton tax case, off-peak market prices were increased by \$30/MWh, and on-peak market prices were increased by \$15/MWh. Under each CO_2 tax case, it was assumed that the tax and market price increase started in 2015. In both the \$10/ton and \$30/ton tax case the type and amount of supply resources remained the same. However, the in-service date of the resources moved around based on economics.

In order to evaluate the economic impacts of certain resources, Burns & McDonnell forced the model to accept certain generating resources in some scenarios. The scenarios reviewed, including the resources available and any special constraints placed on the model, are shown in Table 3-2. The results of the Strategist analysis include thousands of portfolio combinations. The associated 2008$ NPV of the lowest cost portfolio for each scenario is also included in Table 3-2.

Table 3-2: Strategist Scenarios Analyzed

Run	Resource Options Available Option_COD(MaxCapacity)	NPV ($MM)
1	CCGT_2012(125MW) [2 Max] FT8_2011(55MW) [4 Max] CFB_2015(110MW) [1 Max] SCPC_2015(110MW) [1 Max] IGCC_2015(148MW) [1 Max] CHP_2011(5MW) [3 Max]	$1,236.90
2	Wartsila_2011(8.4MW) [6 Max]	$1,230.70
3	CCGT_2012(125MW) [2 Max] FT8_2011(55MW) [4 Max] CFB_2015(110MW) [1 Max] SCPC_2015(50MW) [1 Max] IGCC_2015(148MW) [1 Max] CHP_2011(5MW) [3 Max]	$1,225.60
4	FT8_2011(55MW) [4 Max] SCPC_2015(25MW) [2 Max]	$1,229.80
5	Wartsila_2011(16.8MW) [3 Max] SCPC_2015(25MW) [2 Max]	$1,225.40
6 CO_2 Tax $10/ton	CCGT_2012(125MW) [1 Max] FT8_2011(55MW) [2 Max] CFB_2015(110MW) [1 Max] SCPC_2015(25MW) [2 Max] IGCC_2015(148MW) [1 Max]	$1,321.40
7 CO_2 Tax $10/ton	Wartsila_2011(16.8MW) [3 Max] SCPC_2015(25MW) [2 Max]	$1,314.20
8 CO_2 Tax $30/ton	CCGT_2012(125MW) [1 Max] FT8_2011(55MW) [3 Max] CFBR_2015(74MW) [1 Max] SCPC_2015(25MW) [2 Max] IGCC_2015(148MW) [1 Max]	$1,526.90
9 CO_2 Tax $30/ton Force CFB	CCGT_2012(125MW) [1 Max] FT8_2011(55MW) [3 Max] CFBR_2015(74MW) [1 Max] SCPC_2015(25MW) [2 Max] IGCC_2015(148MW) [1 Max]	$1,557.30
10 CO_2 Tax $30/ton Force CFB	CCGT_2012(125MW) [1 Max] FT8_2011(55MW) [3 Max] CFBR_2015(74MW) [1 Max] SCPC_2015(25MW) [2 Max] IGCC_2015(148MW) [1 Max] CHP_2011(5MW) [1 Max]	$1,557.70

A sample selection of the portfolio of resources selected in the lowest NPV case is included in Appendix B. A complete listing of all portfolios for each scenario run in Strategist is included in Appendix H. The portfolio of resources representing the lowest cost NPV for each scenario is shown in Table 3-3. In the

table, MKT represents capacity purchases from the market. These purchases were allowed in 10 MW increments. Run 5 is the lower cost NPV and is referred to in the following discussion as the "optimal" Strategist case.

Table 3-3: Optimal Strategist Scenario Portfolio Summaries

Strategist Run:	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Plan Year	RESOURCE(Capacity)									
2008										
2009	MKT(10)	MKT(10)	MKT(10)	MKT(10)	MKT(10)	MKT(10)	MKT(10)	MKT(10)	MKT(10)	MKT(10)
2010										
2011	MKT(10) FT8(55)	MKT(30) WART(34)	MKT(70)	MKT(10) FT8(55)	MKT(30) WART(34)	MKT(10) FT8(55)	MKT(30) WART(34)	MKT(10) FT8(55)	MKT(10) FT8(55)	MKT(10) FT8(55)
2012	MKT(20)	MKT(40)	MKT(70)	MKT(20)	MKT(40)	MKT(20)	MKT(40)	MKT(10)	MKT(10)	MKT(10)
2013			MKT(20)							
2014			MKT(30)							
2015	MKT(20)	MKT(20) WART(17)	SCPC(50) MKT(20)	SCPC(25)	SCPC(25) MKT(10)	SCPC(25)	SCPC(25) MKT(10)	SCPC(25)	CFB(74)	CFB(74)
2016	MKT(20)	MKT(30)	MKT(30)		SCPC(25)		SCPC(25)			
2017	MKT(30)	MKT(30)	MKT(30)					MKT(10)		
2018	MKT(30)	MKT(40)	MKT(40)	MKT(10)		MKT(10)		MKT(10)		
2019	MKT(40)	MKT(40)	MKT(40)	MKT(10)	MKT(10)	MKT(10)	MKT(10)	SCPC(25)	MKT(10)	MKT(10)
2020	MKT(40)	MKT(50)	FT8(55)	SCPC(25)	MKT(20)	SCPC(25)	WART(17)		MKT(10)	MKT(10)
2021	MKT(50)	MKT(60)			MKT(20)		MKT(10)	MKT(10)	MKT(20)	MKT(20)
2022	MKT(50)	MKT(60)			MKT(30)		MKT(10)	MKT(10)	MKT(20)	MKT(20)
2023	MKT(60)	MKT(70)	MKT(10)	MKT(10)	MKT(30)	MKT(10)	MKT(20)	MKT(20)	MKT(30)	MKT(30)
2024	MKT(70)	MKT(70)	MKT(20)	MKT(20)	MKT(40)	MKT(20)	MKT(20)	MKT(30)	MKT(40)	MKT(40)
2025	MKT(80)	MKT(80)	MKT(30)	MKT(30)	MKT(50)	MKT(30)	MKT(30)	MKT(30)	MKT(50)	MKT(50)
2026	MKT(80)	MKT(90)	MKT(30)	MKT(30)	MKT(60)	MKT(30)	MKT(40)	MKT(40)	MKT(50)	MKT(50)
2027	MKT(90)	MKT(100)	MKT(40)	MKT(40)	MKT(60)	MKT(40)	MKT(50)	MKT(50)	MKT(60)	FT8(55) CHP(5)
NPV UTILITY COST (@ 5.5%)										
PLANNING PERIOD ($000)	$1,236,948	$1,230,704	$1,225,603	$1,229,824	$1,225,378	$1,321,385	$1,314,240	$1,526,907	$1,557,303	$1,557,707
Resource Totals										
Gas (MW)	55	50	55	55	34	55	50	55	55	115
Coal (MW)	0	0	50	50	50	50	50	50	74	74
Max Market (MW)	90	100	70	40	60	40	50	50	60	50

3.8.2 PROMOD Analysis

After the optimal portfolio of supply resources was determined through each of the scenarios analyzed in Strategist, the optimal Strategist portfolio was modeled against other resource options in PROMOD. This step was taken in order to compare the portfolio against other supply resources, such as pumped storage and solar PV, which require more detailed hourly production cost analysis. The following supply resource cases were evaluated on an NPV basis against the optimal Strategist case:

- **Base Case**: CWL adds NO supply resources and relies on market capacity for its load and reserve capacity requirements.
- **Storage Case**: CWL adds a pumped storage facility, and does not install any of the supply resources identified in the optimal Strategist scenario, but relies on market capacity for the balance.
- **Wind-Replace All Case**: CWL replaces the coal energy from all of its resources with wind energy at the current energy price of Blue Grass Ridge Wind Farm.
- **Wind-Replace New Case**: CWL replaces the coal energy from the new resources identified in the optimal Strategist scenario with wind energy at the current energy price of Blue Grass Ridge Wind Farm. Wind energy price is escalated 3 percent annually until the in-service date of the new coal resources identified in Strategist.
- **Biomass Case**: CWL adds biomass energy by repowering turbines 5, 7, and 8 at the Local Power Plant rather than participate in a new remote coal resource. CWL installs only two of four Wartsila engines recommended in the optimal Strategist scenario to compensate for the additional energy supplied by the biomass resource.
- **Biomass Plus Solar Case**: CWL adds biomass energy by repowering turbines 5, 7, and 8 at the Local Power Plant rather than participate in a new remote coal resource. CWL also installs 10 MW of solar generation on existing commercial buildings in Columbia. CWL installs only one of four Wartsila engines recommended in the optimal Strategist scenario to compensate for the additional energy supplied by the biomass and solar resources.

Table 3-4 provides a summary of the estimated 2008 year net present values from the production cost models for each of the cases specified above. Appendix B contains the detailed annual production costs and balance of loads and resources of the Strategist Case Run 5, which has the lowest NPV of all the cases analyzed.

Table 3-4: PROMOD Net Present Value Analysis Results

NPV Rank Total	Case	NPV ($MM)	percent Diff.
1	Strategist	$1,232,108	-
2	Base	$1,241,177	0.74percent
3	Wind-ReplaceNEW	$1,272,441	3.27percent
4	Biomass	$1,286,328	4.40percent
5	Biomass plus Solar	$1,313,601	6.61percent
6	Storage	$1,315,262	6.75percent
7	Wind-ReplaceALL	$1,595,299	29.48percent

3.8.3 Carbon Tax Sensitivities

One of the potential major uncertain costs associated with generation is the resulting impacts from carbon legislation currently being debated in federal and state legislatures. An approximation of the range of costs associated with potential carbon legislation was modeled as a carbon tax applied to energy from existing and new resources and market energy as determined by the production cost analysis. Cases were reviewed in both Strategist and PROMOD.

A sensitivity factor was used to determine the impact of a $10/ton CO_2 tax to certain PROMOD cases reviewing the impacts on remote versus local constructed resources. The CO_2 tax sensitivity cases were run against the optimal Strategist case, the Biomass case, and the Biomass plus solar case. Table 3-5 provides a summary of the estimated 2008 year net present values from the production cost models for each of the sensitivity cases performed in PROMOD.

Table 3-5: PROMOD Net Present Value Sensitivity Analysis Results for Local/Remote Units

NPV Rank Total	Case	Old NPV ($MM)	New NPV ($MM)	% Diff.
1	Strategist-CO_2 Tax($10/ton)	$1,232,108	$1,326,387	7.65%
2	Biomass-CO_2 Tax($10/ton)	$1,286,328	$1,382,172	7.45%
3	Biomass plus Solar-CO_2 Tax($10/ton)	$1,313,601	$1,409,890	7.33%

The percent difference indicated in Table 3-5 is compared to the NPV of the same scenario run under the original case assumptions. The declining difference in NPV of the Biomass and Biomass plus Solar Case is due to the lower exposure to CO_2 emissions that those supply resources represents.

An uncertainty of the application of any carbon legislation is how it is applied to existing versus new resources. In past emission programs, the impact of the cost is felt first by the new units and more gradually by the existing units. In order to estimate this effect on the portfolios reviewed, the carbon tax was only applied to the energy from new resources. Table 3-6 summarizes the comparison of this tax applied in this manner against portfolios that assume all of the new energy is replaced with wind energy. Also provided is a comparison of the case where the tax is applied to all CWL energy versus the replacement of the CWL coal energy with wind.

Table 3-6 Net Present Value Sensitivity of Different Applications of Carbon Tax on Resources

Case	NPV ($MM)	Difference (%)
Tax Applied to New Unit Energy		
Strategist	$1,232,108	0
Strategist CO2 New $10	$1,256,443	2.0
Wind Replace New	$1,272,441	3.3
Strategist CO2 New $30	$1,305,113	6.0
Tax Applied to All Unit Energy		
Strategist	$1,232,108	0
Strategist CO2 $10	$1,326,387	7.7
Strategist CO2 $30	$1,514,945	23.0
Wind Replace All	$1,595,299	29.5

From the above comparisons, it appears that if the carbon tax was only applied to the new unit energy, then the value of carbon tax would be slightly above $10 per ton that would make the use of wind in place of the new energy an indifferent choice to CWL. As shown on the above table and discussed in the Strategist analysis and shown in Tables 3-2 and 3-3, with a $30 per ton carbon tax applied to all energy the coal resource was selected as the lower evaluated portfolio.

3.9 UPDATED ASSUMPTIONS USED IN INTEGRATED ANALYSIS

Since the issuance of the interim report, market conditions in the industry have changed significantly enough to warrant an update to several of the assumptions used in the final integrated analysis. Updated assumptions were needed for fuel, market energy, and capital cost assumptions used in the interim analysis.

3.9.1 Fuel Price Assumption Updates

The most dramatic changes to the assumptions previously used in the interim report were made in the area of fuel costs. A comparison was made of the monthly 2008 natural gas forecast prices to current futures priced at Henry Hub on the New York Mercantile Exchange (NYMEX). This comparison showed an increase of approximately 25 percent in the monthly price of natural gas compared to the forecast used in the interim analysis. Based on this, the natural gas forecast was updated by increasing the average monthly prices by 25 percent in 2008 and then continuing to escalate at the long-term rate forecast by the EIA. In addition to natural gas, coal has seen a recent uptick in pricing due to higher global demand and limited transportation facilities to deliver the fuel. To account for the assumed higher prices over the long-term for coal, an annual escalation rate of 2.8 percent was used, rather than the 2 percent annual escalation used in the interim analysis. A complete listing of all the assumptions used in this analysis, including all updated assumptions, can be found in Appendix A.

3.9.2 Market Price Assumption Updates

As previously explained, the market energy was based on the historical day-ahead LMP pricing at the CWL node for the 2007 calendar year. As fuel prices increase, it is expected that market energy prices will increase as well. A comparison was made of more recent monthly 2008 average on and off-peak market energy pricing at the CWL node compared to the average price forecast in the interim analysis. This comparison showed that the average monthly energy prices were also nearly 25 percent higher than what was forecast in the interim analysis. Based on this, the average 2008 monthly on and off-peak market energy prices were escalated 25 percent and then escalated beyond 2008 using the same escalation as was assumed for natural gas. A complete listing of all the assumptions used in this analysis, including all updated assumptions, can be found in Appendix A.

3.9.3 Capital Cost Assumption Updates

Many recent power projects have seen construction costs escalate at high rates. In order to fairly evaluate new supply alternatives compared to demand-side management alternatives, an adjustment to the cost estimates used for the integrated analysis was made. Project costs for nearly every supply alternative considered were increased based on Burns & McDonnell industry knowledge and experience. These updated cost estimates as well as a complete listing of all the assumptions used in this analysis can be found in Appendix A.

* * * * *

SECTION 4.0

DEMAND SIDE ANALYSIS

4.0 DEMAND SIDE ANALYSIS

4.1 METHODOLOGY

Demand Side Management (DSM) has been used by utilities since the late 1970's to try to influence the consumption of demand and energy by customers. Various programs have been developed to change out appliances to more efficient types to provide energy savings. Enticing customers to use compact fluorescent lighting instead of incandescent is an example. Utilities have also installed systems that allow control of appliances during peak load conditions to reduce the demand and shift the energy consumption to more off-peak times. Direct control of air conditioners and water heaters by utilities is an example of this type of DSM program.

Utilities typically review the projected demand and energy requirements of their systems in order to develop the benefits that DSM programs could provide. For instance, a utility that was experiencing peak demand growth would possibly find that the installation of a direct control system would be beneficial. A utility that was experiencing high energy growth that might force the utility into a new base load resource would possibly find energy efficiency programs to be of benefit.

The analysis of demand side management potential for a utility requires a significant amount of customer data to be mined that includes, but is not limited to:

- The number of existing end-use applications specific to the utility customer base and pertinent information (for example the number of central air conditioners broken down by age, efficiency rating and size)
- The demand and energy impacts to the utility of moving to higher efficiency applications of each of the end uses on the system
- The cost of moving to these higher efficiency applications
- The pace at which the existing appliances could be replaced with higher efficiency options
- The benefit of investing in these applications as compared to other approaches to meeting the customer service required

CWL has a customer base of approximately 44,000 meters. Considering the diversity and number of end-use devices at each of these meters, the data requirements for a DSM analysis are extensive. Since most

utilities do not have extensive end-use analysis of their loads, numerous assumptions are required to attempt the modeling of the DSM impacts.

4.1.1 Sequence of Processes

The process to evaluate DSM programs requires a logical progression of developing information about the benefits and costs of the various DSM options considered beneficial for a utility to pursue. The major steps for this process include:

1. Identify the end-use inventory for the utility
2. Identify the types of DSM options that could be considered to influence the demand and energy of the inventory.
3. Identify the estimated demand and energy savings per end-use type and option applicable to the system if the options were used
4. Identify the total demand and energy savings based on the end-use inventory.
5. Identify the direct change out cost of the options and program management costs of the utility
6. Identify the avoided supply side cost to the utility from pursuit of the program
7. Identify the expected total customers who would accept the program and the length of time it would take to replace the end uses with the new options
8. Develop the benefit/cost ratios for the options
9. Develop the programs for moving ahead with the beneficial options.

The above process was pursued by Burns & McDonnell for the customer base of CWL. Burns & McDonnell used the following data sources in order to arrive at the assumptions herein:

- Columbia 2006 land use database
- State Saturation Study
- eQUEST Analysis Software
- DOE Energy Star Websites

4.2 RESIDENTIAL ASSESSMENT

The residential DSM assessment included an evaluation of a variety of different load management and conservation programs that were directed at reducing the overall peak demand and energy consumption of

CWL residential customers. The background, assumptions, analysis and results of the analysis are discussed in the following sections.

4.2.1 Types of Residential Building Stock

CWL residential building stock can be divided into four main types. These residential building stock types are listed below:

- Single Family Home
- Duplex / Quadplex
- Apartment
- Mobile Home and Other

These types are further broken down into owned and rented residential properties. The residential building stock information provided to Burns & McDonnell by CWL is based on the county assessors 2006 land use database. A summary of the types of residential building stock is presented below in Table 4-1.

Table 4-1: CWL Residential Building Stock

Residential Building Type	Owned	Rented	Total
Single Family Homes	15,725	2,059	17,784
Duplex / Quadplex	-	5,156	5,156
Apartment		14,231	14,231
Mobile Home / Other	-	79	79
Total	15,725	21,525	37,250
Percent of Total	42.21%	57.79%	100.00%

As shown in Table 4-1, CWL residential customers are comprised of approximately 58 percent rental units and 42 percent owned units. It should be noted however that the rental units' average energy consumption on a per unit basis is considerably smaller than a single family home unit and thus does not have as great of a contribution to the overall CWL system demand and energy requirements as do the single family homes. Due to the lack of integration between the CWL billing database and 2006 land use database, CWL was not able to query the energy sales by residential building type. As a proxy, Burns & McDonnell conducted market research to determine the average energy consumption by type of housing unit. Table 4-2 presents the Average U.S. Total Electric Consumption per household by type. These

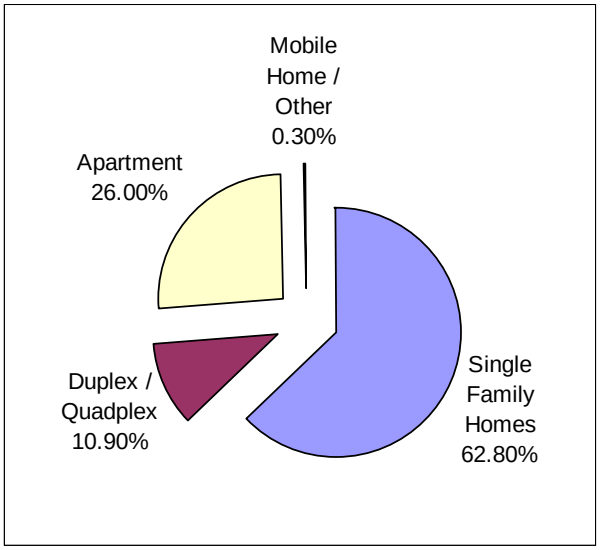
values are from the U.S. Energy Information Administration 2001 Residential Energy Consumption Survey and can be found at www.eia.doe.gov.

Table 4-2: Average U.S. Household Electric Energy Consumption

	Type of Housing Unit			
	Single Family Home	Apartments in Buildings (2-4 Units)	Apartments in Buildings (5 or More Units)	Mobile Homes
Average U.S. Total Electric Consumption per Household (kWh)	11,965	7,176	6,204	12,469

It is assumed that the apartments in buildings with 2 to 4 units are representative of duplexes and quadplexes while apartments in buildings with 5 or more units are representative of Columbia's apartment units. Based on the residential building stock in Table 4-1 and average electrical consumption in Table 4-2, Burns & McDonnell estimated the CWL residential electrical consumption breakdown by type of residential building which is shown in Figure 4-1. This shows that approximately 62.80 percent of residential energy consumption is from single family homes and 26.00 percent is from apartments with the remaining consumption mostly from duplexes and quadplexes.

Figure 4-1: CWL Total Residential Energy Consumption



4.2.2 End-use Inventory

The CWL end-use residential DSM inventory is based on data provided in the 2006 Missouri Statewide Residential Lighting and Appliance Efficiency Saturation Study (Saturation Study), which is provided in Appendix H, and CWL residential building stock data presented previously. The Saturation Study, completed by RLW Analytics, included residential end-use inventory survey data for AmerenUE, KCP&L, Aquila, Independence Power & Light, Empire District Electric Co., City Utilities of Springfield, and CWL. CWL has not conducted an in-depth independent survey of its residential customers. Therefore, Burns & McDonnell and CWL agreed that the Saturation Study results would serve as the basis for the residential portion of this study. Prior to using the Saturation Study information, CWL and Burns & McDonnell reviewed the information and adjusted it where it was deemed necessary. The end-use DSM inventory assumptions and summary of results for residential Single Family Homes, Duplexes and Quadplexes, Apartments and Mobile Homes and Other are presented in the following sections.

4.2.2.1 Single Family Homes

CWL Single Family Homes are comprised of approximately 15,725 owned units and 2,059 rented units. These unattached single family home units are assumed to be of a similar size, type, age and configuration as those homes surveyed in the Saturation Study. Given this assumption, Burns & McDonnell utilized the raw potential estimates from the Saturation Study for each DSM option developed to determine the maximum potential number applicable to the CWL residential single family home population.

As an example, the Saturation Study estimated that approximately 31.0 percent of single family unattached homes in Missouri have air conditioning systems that have an insufficient amount of refrigerant and could technically and economically add refrigerant to their system. This 31.0 percent was multiplied by the 17,784 single family home customers to arrive at a maximum potential inventory of 5,513 of which 4,875 were owned units and 638 were rented units. It should be noted that the raw potential estimates of each of the DSM options were reviewed and adjusted in some cases by both CWL and Burns & McDonnell staff to ensure they appeared reasonable and achievable in Columbia. A summary of the options and maximum potential inventory achievable in Columbia is presented in Table 4-3.

Table 4-3: Single Family Home End-Use DSM Inventory from Saturation Study

DSM Option Description			Single Family - Owned		Single Family - Rented	
Potential Situation	Improvement	Max Raw Potential	Number of Customers	Maximum Potential	Number of Customers	Maximum Potential
AC Refrigerant under charged	Add refrigerant	31.00%	15,725	4,875	2,059	638
AC Refrigerant over charged	Remove refrigerant	26.00%	15,725	4,089	2,059	535
Low Evaporator Airflow A	Increase duct sizes or add new ducts	60.00%	15,725	9,435	2,059	1,235
Low Evaporator Airflow B	Increase blower speed	12.00%	15,725	1,887	2,059	247
High Duct Leakage (25%)	Reduce duct leakage to 5%	66.00%	15,725	10,379	2,059	1,359
Oversized AC Units A (New)	Size AC units to 100% of Manual J	0.64%	15,725	101	2,059	13
Oversized AC Units B (Replace)	Size AC units to 100% of Manual J	4.70%	15,725	740	2,059	97
One Inch insul. On ducts in attic	Add two more inches of insulation	20.00%	15,725	3,145	2,059	412
Gas Heat and 13 SEER AC	Install AC SEER = 16	5.39%	15,725	848	2,059	111
Home has 13 SEER Heat Pump	Install Heat Pump SEER = 16	0.42%	15,725	66	2,059	9
Home has electric strip heat	Install Heat Pump SEER = 16	0.49%	15,725	77	2,059	10
No programmable thermostat	Install programmable thermostat	50.00%	15,725	7,863	2,059	1,030
Attic Insulation = R-11	Add another R-19 attic insulation	7.00%	15,725	1,101	2,059	144
Exposed Walls not insulated	Add R-11 wall insulation	6.00%	15,725	944	2,059	124
Floor over basement not insulate	Add R-19 wall insulation	10.00%	15,725	1,573	2,059	206
House infiltration = 0.8 ACH	Reduce infiltration to 0.35 ACH	40.00%	15,725	6,290	2,059	824
Single Pane Window B	Install Low E double pane window 2904	10.40%	15,725	1,635	2,059	214
NO E&W Window Shading A	Add solar screens to E&W sides	65.00%	15,725	10,221	2,059	1,338
NO E&W Window Shading B	Plant deciduous trees on E&W sides	48.75%	15,725	7,666	2,059	1,004
No Compact Florescent Lamps	Use 3 more CFLs throughout the house	60.00%	15,725	9,435	2,059	1,235
Refrigerator needs to be replaced	Purchase Energy Star Refrigerator	7.80%	15,725	1,227	2,059	161
Refrigerator early retirement	Purchase Energy Star Refrigerator	27.00%	15,725	4,246	2,059	556
Dishwasher to be replaced	Purchase Energy Star dishwasher	22.36%	15,725	3,516	2,059	460
Clothes washer to be replaced	Purchase Energy Star clothes washer	18.92%	15,725	2,975	2,059	390
No low flow shower heads	Install low flow shower heads	10.00%	15,725	1,573	2,059	206
Hot water pipes not insulated	Insulate hot water pipes	85.00%	15,725	13,366	2,059	1,750
Electric water heater not wrapped	Wrap electric water heater	50.00%	15,725	7,863	2,059	1,030
Gas water heater not wrapped	Wrap gas water heater	71.00%	15,725	11,165	2,059	1,462

In addition to the options provided in the Saturation Study, CWL requested that Burns & McDonnell evaluate several other DSM options. These options' estimated raw potential estimates were provided by CWL staff and are listed below in Table 4-4.

Table 4-4: Single Family Home End Use DSM Inventory from CWL

DSM Option Description			Single Family - Owned		Single Family - Rented	
Potential Situation	Improvement	Max Raw Potential	Number of Customers	Maximum Potential	Number of Customers	Maximum Potential
3 Ton 10 SEER AC	Replace With 3 Ton 16 SEER AC	9.06%	15,725	1,425	2,059	187
No Variable Speed Fan	Install Variable Speed Fan Unit	33.00%	15,725	5,189	2,059	679
Two Refrigerators in Home A	Recycle 2nd Refrigerator w/ Coolant	28.60%	15,725	4,497	2,059	589
Two Refrigerators in Home B	Recycle 2nd Refrigerator w/o Coolant	28.60%	15,725	4,497	2,059	589
Phantom Electric Loads	Install Power Strips with Auto Shutoff	90.00%	15,725	14,153	2,059	1,853
Exterior Lighting Replacement	Install Solar Powered Lights	50.00%	15,725	7,863	2,059	1,030

4.2.2.2 Duplexes and Quadplexes

CWL 5,156 Duplexes and Quadplexes are comprised only of rental units as provided in the county assessors' 2006 land use data base. Since detailed breakdowns between the number of Duplexes and Quadplexes were not available, Burns & McDonnell assumed that the majority of the 5,156 units were

duplexes. In the event there is a statistically significant amount of Quadplex units within the 5,156, it could be assumed that many of these units are served on a common meter.

Burns & McDonnell utilized the Single Family Home raw potential estimates from the Saturation Study for each DSM option developed to determine the maximum potential inventory in CWL residential Duplex and Quadplex population. The raw potential percentages for each option in the Saturation Study are assumed to be similar to the Single Family Homes' due to the fact that both Duplexes and Quadplexes exhibit many of the same features and configurations as a single family home but only half or a quarter of the size. Adjustments were made to the energy savings, demand savings and installation cost for each DSM option to account for this size difference and are described in the following sections. A summary of the options and maximum potential inventory achievable in Columbia is presented in Table 4-5.

Table 4-5: Duplex and Quadplex End Use DSM Inventory from Saturation Study

DSM Option Description			Duplexes - Owned		Duplexes - Rented	
Potential Situation	Improvement	Max Raw Potential	Number of Customers	Maximum Potential	Number of Customers	Maximum Potential
AC Refrigerant under charged	Add refrigerant	31.00%	0	0	5,156	1,598
AC Refrigerant over charged	Remove refrigerant	26.00%	0	0	5,156	1,341
Low Evaporator Airflow A	Increase duct sizes or add new ducts	60.00%	0	0	5,156	3,094
Low Evaporator Airflow B	Increase blower speed	12.00%	0	0	5,156	619
High Duct Leakage (25%)	Reduce duct leakage to 5%	66.00%	0	0	5,156	3,403
Oversized AC Units A (New)	Size AC units to 100% of Manual J	0.64%	0	0	5,156	33
Oversized AC Units B (Replace)	Size AC units to 100% of Manual J	4.70%	0	0	5,156	243
One Inch insul. On ducts in attic	Add two more inches of insulation	20.00%	0	0	5,156	1,031
Gas Heat and 13 SEER AC	Install AC SEER = 16	5.39%	0	0	5,156	278
Home has 13 SEER Heat Pump	Install Heat Pump SEER = 16	0.42%	0	0	5,156	22
Home has electric strip heat	Install Heat Pump SEER = 16	0.49%	0	0	5,156	25
No programmable thermostat	Install programmable thermostat	50.00%	0	0	5,156	2,578
Attic Insulation = R-11	Add another R-19 attic insulation	7.00%	0	0	5,156	361
Exposed Walls not insulated	Add R-11 wall insulation	6.00%	0	0	5,156	309
Floor over basement not insulate	Add R-19 wall insulation	10.00%	0	0	5,156	516
House infiltration = 0.8 ACH	Reduce infiltration to 0.35 ACH	40.00%	0	0	5,156	2,062
Single Pane Window B	Install Low E double pane window 2904	10.40%	0	0	5,156	536
NO E&W Window Shading A	Add solar screens to E&W sides	65.00%	0	0	5,156	3,351
NO E&W Window Shading B	Plant deciduous trees on E&W sides	48.75%	0	0	5,156	2,514
No Compact Florescent Lamps	Use 3 more CFLs throughout the house	60.00%	0	0	5,156	3,094
Refrigerator needs to be replaced	Purchase Energy Star Refrigerator	7.80%	0	0	5,156	402
Refrigerator early retirement	Purchase Energy Star Refrigerator	27.00%	0	0	5,156	1,392
Dishwasher to be replaced	Purchase Energy Star dishwasher	22.36%	0	0	5,156	1,153
Clothes washer to be replaced	Purchase Energy Star clothes washer	18.92%	0	0	5,156	976
No low flow shower heads	Install low flow shower heads	10.00%	0	0	5,156	516
Hot water pipes not insulated	Insulate hot water pipes	85.00%	0	0	5,156	4,383
Electric water heater not wrapped	Wrap electric water heater	50.00%	0	0	5,156	2,578
Gas water heater not wrapped	Wrap gas water heater	71.00%	0	0	5,156	3,661

4.2.2.3 Apartments

The 14,231 apartments within CWL service territory are comprised only of rental units as provided in the county assessors' 2006 land use database. The residential apartment building stock in Columbia is very diverse and includes a wide array of different building types. These building types range in size, number of dwellings per building and type of equipment installed on each site. Due to these issues, the heating, ventilation, and air conditioning (HVAC) and Thermal Envelope options from the Saturation Study were not used for the residential Apartment units' assessment. A summary of the options and maximum number of installations achievable in Columbia is presented in Table 4-6.

Table 4-6: Apartment End Use DSM Inventory from Saturation Study

DSM Option Description			Apartments - Owned		Apartments - Rented	
Potential Situation	Improvement	Max Raw Program Potential	Number of Customers	Maximum Number of Installs	Number of Customers	Maximum Number of Installs
No Compact Florescent Lamps	Use 3 more CFLs throughout the house	60.00%	0	0	14,231	8,539
Refrigerator needs to be replaced	Purchase Energy Star Refridgerator	7.80%	0	0	14,231	1,110
Refrigerator early retirement	Purchase Energy Star Refridgerator	27.00%	0	0	14,231	3,842
Dishwasher to be replaced	Purchase Energy Star dishwasher	22.36%	0	0	14,231	3,182
Clothes washer to be replaced	Purchase Energy Star clothes washer	18.92%	0	0	14,231	2,693
No low flow shower heads	Install low flow shower heads	10.00%	0	0	14,231	1,423
Hot water pipes not insulated	Insulate hot water pipes	85.00%	0	0	14,231	12,096
Electric water heater not wrapped	Wrap electric water heater	50.00%	0	0	14,231	7,116

4.2.2.4 Mobile Homes and Other

Based on the county assessors' 2006 land use data base that was provided to Burns & McDonnell there are an estimated 79 mobile homes in the CWL residential customer class. Assuming that these mobile homes have an electric consumption equal to the U.S. average of 12,469 kWh per year, they would consume approximately 985,000 kWh. This estimated 985 MWh per year contribution to CWL total system energy requirements of 1,220,976 MWh is approximately 0.08 percent. If CWL implemented options directed primarily at Mobile Home residential customers and was able to reduce consumption by even 50 percent, the overall impact to the system would still be negligible. As such, it is assumed that any options made available to single family homes, duplexes or apartments would also be available to the Mobile Home and Other residential customers.

4.2.3 HVAC Programs

The HVAC options assessed in this study are listed below in Table 4-7. Several of these options have already been implemented by CWL and have had a large amount of success in achieving demand and energy savings in Columbia.

The HVAC options' estimated demand and energy savings were provided in the Saturation Study. These estimates were reviewed by both CWL and Burns & McDonnell staff to ensure the estimates reflected reasonable and achievable results. In addition to reviewing the options Burns & McDonnell also developed an eQUEST model for a typical single family home in Columbia, MO and tested several of the options in the model. The specific options modeled were the Air Conditioner upgrade, and Heat Pump upgrade options. Results from the eQUEST model for upgrading a home from a 3 Ton 13 seasonal energy efficiency ratio (SEER) AC unit to a 3 Ton 16 SEER AC unit are provided in Table 4-8. Results from the eQUEST model for upgrading a home from a 3 Ton 10 Seer AC unit with electric resistance heat to a 3 Ton 16 Seer heat pump unit are provided in Table 4-9.

Table 4-7: Residential HVAC DSM Options from Saturation Study

DSM Option Description		Total kW Reduction /	Total kWh Reduction /	Differential Cost / Installation
Potential Situation	Improvement			
AC Refrigerant under charged	Add refrigerant	0.11	448	$ 250
AC Refrigerant over charged	Remove refrigerant	0.10	100	$ 100
Low Evaporator Airflow A	Increase duct sizes or add new ducts	0.75	757	$ 950
Low Evaporator Airflow B	Increase blower speed	0.56	630	$ 100
High Duct Leakage (25%)	Reduce duct leakage to 5%	0.42	533	$ 600
Oversized AC Units A (New)	Size AC units to 100% of Manual J	0.30	246	$ 314
Oversized AC Units B (Replace)	Size AC units to 100% of Manual J	0.78	738	$ 210
One Inch insul. On ducts in attic	Add two more inches of insulation	0.16	185	$ 600
Gas Heat and 13 SEER AC	Install AC SEER = 16	0.36	258	$ 840
Home has 13 SEER Heat Pump	Install Heat Pump SEER = 16	0.55	620	$ 750
Home has electric strip heat	Install Heat Pump SEER = 16	1.13	3,509	$ 4,800
No programmable thermostat	Install programmable thermostat	0.06	494	$ 200

Table 4-8: eQUEST Model Results – 3 Ton 13 SEER to 16 SEER Air Conditioner Upgrade

Base case is inefficient DX unit with gas heat operating 24/6

ENERGY (kWh)	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**TOTAL**
13SEER-24/7	432	385	418	390	477	585	751	707	501	401	392	422	5,859
16SEER-24/7	432	385	416	386	454	538	672	639	469	396	392	422	5,601
Savings (kWh)	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**TOTAL**
16SEER-24/7	0	0	2	5	22	47	79	68	32	5	0	0	**258**
Demand (kW)	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**TOTAL**
13SEER-24/7	1.1	1.1	1.3	1.5	1.8	2.0	2.5	2.5	2.0	1.4	1.1	1.1	19.4
16SEER-24/7	1.1	1.1	1.2	1.4	1.6	1.8	2.1	2.2	1.7	1.3	1.1	1.1	17.7
Savings	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**MAX**
16SEER-24/7	0.00	0.00	0.11	0.12	0.19	0.23	0.34	0.36	0.24	0.13	0.00	0.00	**0.36**

Table 4-9: eQUEST Model Results – 3 Ton 10 SEER to 16 SEER Heat Pump Upgrade

Base case is inefficient DX unit with electric resistance heat operating 24/6

ENERGY (kWh)	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**TOTAL**
10SEER-24/7	3,042	2,455	1,914	968	628	671	878	815	586	788	1,694	2,719	17,157
16SEER-24/7	2,624	2,023	1,500	700	516	523	630	603	475	618	1,238	2,197	13,647
Savings (kWh)	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**TOTAL**
16SEER-24/7	418	433	414	268	112	148	247	213	110	170	456	522	**3,509**
Demand (kW)	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**MAX**
10SEER-24/7	7.9	8.6	7.4	4.8	2.4	2.4	3.0	3.1	2.3	3.4	5.1	8.8	8.8
16SEER-24/7	7.9	8.6	7.0	4.1	1.5	1.7	1.9	2.0	1.6	2.9	4.6	8.9	8.9
Savings	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**MAX**
16SEER-24/7	-0.02	-0.01	0.43	0.68	0.83	0.73	1.06	1.13	0.73	0.58	0.53	-0.03	**1.13**

It should be noted that these results are highly dependent on the detailed parameters input into the eQUEST modeling software such as number of windows, home orientation, exterior wall thickness, number of rooms, etc. Changes in these assumptions will impact the results determined.

The results for the annual energy savings for these two upgrades were similar to those provided in the Saturation Study but the peak demand savings diverged considerably. For the AC unit upgrade from 13 SEER to SEER 16, the Saturation Study showed a coincident peak demand "increase" of approximately 0.18 kW per installation. The eQUEST model developed by Burns & McDonnell provided a peak demand "decrease" of approximately 0.36 kW per installation. This peak demand decrease in the eQUEST model's results is similar to the CWL internal rebate calculation model of 0.42 kW per installation. For the heat pump unit upgrade the Saturation Study showed a coincident peak demand "increase" of 0.54 kW per installation. The eQUEST model developed by Burns & McDonnell provided a peak demand "decrease" of approximately 1.13 kW per installation. Both of the eQUEST models' energy savings and demand savings from the upgrades also accounted for savings from auxiliary power sources such as vents, fans, pumps and other miscellaneous equipment.

In addition to the options provided in the Saturation Study, Burns & McDonnell assessed several additional HVAC options at the request of CWL. The options are presented below in Table 4-10.

Table 4-10: Residential HVAC DSM Options from CWL

DSM Option Description		Total kW Reduction /	Total kWh Reduction /	Differential Cost / Installation
Potential Situation	Improvement			
3 Ton 10 SEER AC	Replace With 3 Ton 16 SEER AC	0.95	670	$ 3,800
No Variable Speed Fan	Install Variable Speed Fan Unit	0.00	84	$ 700

The 3 Ton 10 Seer AC unit upgrade to a 3 Ton 16 Seer AC unit as presented in Table 4-11 was modeled in eQUEST by Burns & McDonnell and was found to have a significant amount of peak demand reduction and annual energy savings. The $3,800 total cost to complete a full AC replacement however was relatively high for the amount of peak demand savings it provided. This peak demand savings of $3,800 per kW can be compared to other CWL alternatives of peaking capacity such as the 50 MW FT8 Twinpac Simple Cycle gas turbine, which has an estimated capital cost of approximately $1,057 per kW ($2011). Based on information provided in the Saturation Study, the raw potential of upgrading all of the 3 Ton 10 Seer AC units in Columbia was approximately 9 percent. The results of the eQUEST model for this upgrade are presented in Table 4-11.

Table 4-11: eQUEST Model Results – 3 Ton 10 SEER to 16 SEER Air Conditioner Upgrade

Base case is inefficient DX unit with gas heat operating 24/7

ENERGY (kWh)	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**TOTAL**
10SEER-24/7	432	385	420	398	512	660	877	815	551	408	393	422	6,272
16SEER-24/7	432	385	416	386	454	538	672	639	469	396	392	422	5,601
Savings (kWh)	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**TOTAL**
16SEER-24/7	0	0	4	12	57	121	205	176	82	12	1	0	**670**
Demand (kW)	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**MAX**
10SEER-24/7	1.1	1.1	1.5	1.7	2.1	2.4	3.0	3.1	2.3	1.6	1.1	1.1	3.1
16SEER-24/7	1.1	1.1	1.2	1.4	1.6	1.8	2.1	2.2	1.7	1.3	1.1	1.1	2.2
Savings	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**MAX**
16SEER-24/7	0.00	0.00	0.28	0.32	0.50	0.60	0.88	0.95	0.61	0.32	0.07	0.00	**0.95**

The variable speed fan upgrade option assessed provided a relatively low level of energy savings for a high installation cost. Several HVAC contractors were contacted to determine if such an installation were feasible in a retrofit scenario. The two contractors contacted stated that such an upgrade could be completed but the cost to complete such an upgrade would be prohibitive and the purchaser would be better off to buy a new unit. In addition, most new AC units available today come with variable speed fans in the base line model so the utility would not have an incentive to provide funding for this option.

As discussed previously, these HVAC options' energy savings, demand savings and costs were reduced by 50 percent for the Duplex and Quadplex building types. This was assumed since the average duplex has approximately half the square footage of the average single family unattached home and that the usage of the space is similar in nature.

4.2.4 Thermal Envelope Programs

The Thermal Envelope options assessed in this study are listed below in Table 4-12. Of these options, only the tree option has been implemented by CWL.

Table 4-12: Residential Thermal Envelope DSM Options from Saturation Study

DSM Option Description		Total kW Reduction /	Total kWh Reduction /	Differential Cost / Installation
Potential Situation	Improvement			
Attic Insulation = R-11	Add another R-19 attic insulation	0.34	503	$ 809
Exposed Walls not insulated	Add R-11 wall insulation	0.57	2,517	$ 3,500
Floor over basement not insulated	Add R-19 wall insulation	-0.13	-225	$ 393
House infiltration = 0.8 ACH	Reduce infiltration to 0.35 ACH	0.41	1,041	$ 500
Single Pane Window B	Install Low E double pane window 2904	0.48	1,102	$ 350
NO E&W Window Shading A	Add solar screens to E&W sides	0.66	160	$ 258
NO E&W Window Shading B	Plant deciduous trees on E&W sides	0.13	327	$ 900

The Thermal Envelope options' demand and energy savings that were provided in the Saturation Study were reviewed by both CWL and Burns & McDonnell staff to ensure they appeared reasonable and achievable. Most of these options calculated demand and energy savings are highly dependent on the size, type, configuration and orientation of the base case and retrofit case models developed in the Saturation Study. As an example, adding solar screens to the east and west sides of a home depends greatly on how many windows are directly exposed to sunlight, the type of window used, the number of rooms in the house and the direction the house is oriented. Due to these factors, Burns & McDonnell and CWL staff made no adjustments to the demand, energy or cost assumptions for these improvements.

As discussed previously, these Thermal Envelope options' energy savings, demand savings and costs were reduced for the Duplex and Quadplex building types. The attic insulation and basement insulation were assumed to have 50.0 percent of the energy savings, demand savings and costs as a single family unattached home due to the fact that a duplex generally has about half as much roof and first floor square footage as a single family home.

The Thermal Envelope options associated with exterior wall surface area, such as adding exterior wall insulation or reducing air infiltration, were assumed to have 37.5 percent of the energy savings, demand

savings and costs as a single family unattached home. This is due to the fact that two duplex units have approximately the same amount of exterior wall space as one unattached single family home but one of their walls is shared.

4.2.5 Appliance Programs

The Appliance options assessed in this study are listed below in Table 4-13. Of these options, CWL has implemented only the CFL change a light option. It should be noted that this program has had a tremendous amount of success in Columbia with approximately 20,000 bulbs sold between 2004 and the middle of 2007.

Table 4-13: Residential Appliance DSM Options from Saturation Study

DSM Option Description		Total kW Reduction /	Total kWh Reduction /	Differential Cost / Installation
Potential Situation	Improvement			
No Compact Florescent Lamps	Use 3 more CFLs throughout the house	0.03	249	$ 45
Refrigerator needs to be replaced	Purchase Energy Star Refrigerator	0.01	61	$ 200
Refrigerator early retirement	Purchase Energy Star Refrigerator	0.08	646	$ 50
Dishwasher to be replaced	Purchase Energy Star dishwasher	0.06	74	$ 150
Clothes washer to be replaced	Purchase Energy Star clothes washer	0.11	150	$ 400
No low flow shower heads	Install low flow shower heads	0.00	125	$ 20
Hot water pipes not insulated	Insulate hot water pipes	0.00	61	$ 95
Electric water heater not wrapped	Wrap electric water heater	0.00	194	$ 60
Gas water heater not wrapped	Wrap gas water heater	0.00	0	$ 60

The Appliance options' demand and energy savings that were provided in the Saturation Study were reviewed by both CWL and Burns & McDonnell staff to ensure they appeared reasonable and achievable. In addition, Burns & McDonnell conducted independent research via the Energy Star website to estimate the annual energy savings for the large appliance upgrades such as refrigerators, dishwashers and clothes washers. As an example, average annual energy savings as provided on the Energy Star website for retiring old refrigerators is provided in Table 4-14.

Table 4-14: Residential Refrigerator Electric Energy Consumption

Size (ft^3)	AGE				
	Before 1980	1980-1989	1990-1992	1993-2000	2001-2006
Below 16.5	2,576	1,640	1,022	706	478
16.5-18.9	2,899	1,846	1,150	790	527
19.0-21.4	3,117	1,985	1,237	846	560
21.5-24.4	3,301	2,102	1,310	894	588
24.5-UP	3,724	2,371	1,478	1,004	652
Average (kWh) Reduction	3,123	1,989	1,239	848	561
Average (kW) Reduction	0.3566	0.2270	0.1415	0.0968	0.0640

These results show that the average unit in the early 1990s used approximately 1,239 kWh per year while the average unit manufactured from 2001 to 2006 consumed approximately 561 kWh per year for a difference of 678 kWh per year. These results are similar to the results from the Saturation Study results of 648 kWh of energy savings per year for the early retirement of a refrigerator option provided in the Saturation Study.

In addition to the options provided in the Saturation Study, Burns & McDonnell assessed several additional Appliance options at the request of CWL. The options are presented below in Table 4-15.

Table 4-15: Residential Appliance DSM Options from Saturation Study

DSM Option Description		Total kW Reduction /	Total kWh Reduction /	Differential Cost / Installation
Potential Situation	Improvement			
Two Refrigerators in Home A	Recycle 2nd Refrigerator w/ Coolant	0.09	791	$ 15
Two Refrigerators in Home B	Recycle 2nd Refrigerator w/o Coolant	0.09	791	$ 10
Phantom Electric Loads	Install Power Strips with Auto Shutoff	0.00	450	$ 40
Exterior Lighting Replacement	Install Solar Powered Lights	0.00	350	$ 116

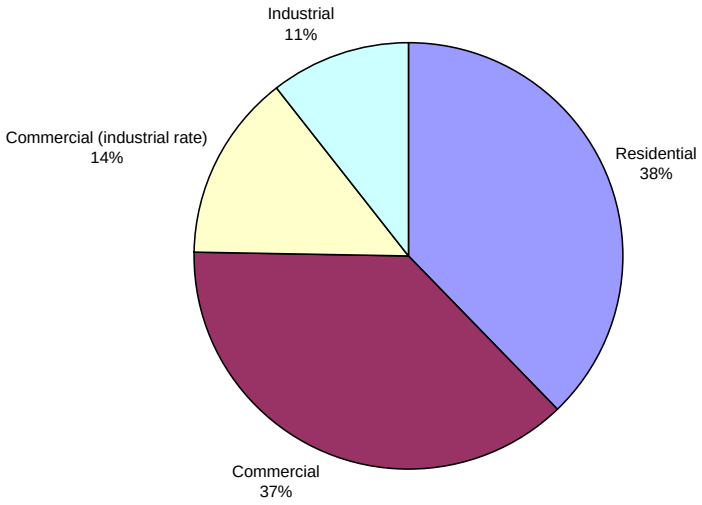
The first two refrigerator options' energy savings and demand savings data provided in Table 4-15 are based on information provided in the Saturation Study. The energy and demand savings for retiring these second refrigerators is considerable for a relatively low cost. As an example, if a CWL residential customer retired their second refrigerator they would save approximately $71.23 per year assuming an average electric rate of $0.09 per kWh and 791 kWh in annual energy savings for a cost of only $15.00. The cost to retire refrigerators is based on the Columbia Solid Waste Divisions' current land fill rates for appliances with coolant and without coolant. It should be noted that these annual energy savings do not account for the fact that second refrigerators left in garages, which is generally the case, consume a much higher amount of energy during the summer than do second refrigerators left in the basement due to the higher cooling load requirement.

The other Appliance options presented in Table 4-15 also provide a reasonable amount of energy savings for a relatively low cost but do not significantly contribute to reducing CWL peak demand requirements. Both the power strips with automatic shutoff and solar powered outdoor lighting reduce the amount of energy consumption in nighttime or off-peak hours, but they do not significantly reduce the daytime or peaking energy consumption since these resources are already in use or off. These options' energy savings, demand savings and installation cost were determined through Energy Star research and other various sources.

4.3 COMMERCIAL ASSESSMENT

This section provides an analysis of Demand Side Management (DSM) opportunities for the existing commercial set of CWL customer base. This includes Small General Service (SGS) and Large General Service (LGS). It also includes large commercial accounts that are classified under industrial rates due to their size but do not have traditional industrial operations. The following chart shows the breakdown of energy use during FY2006 for residential, commercial, commercial (with industrial rates) and industrial accounts. Note that the commercial and commercial (with industrial rates) accounts for 51 percent of the total use.

Figure 4-2: Distribution of CWL Customers Electrical Use by Rate Class



CWL was a participant in a statewide saturation survey for residential customers. These data have proven quite valuable in the residential DSM analysis. No such survey has been conducted for the commercial customer base. The analysis team decided to use information from the DOE Energy Information Agency (EIA) along with the ENERGY STAR building ranking program of the Environmental Protection Agency in order to benchmark typical buildings in the CWL customer base. Based on these benchmarks, target levels of DSM potential by building type were developed along with the amount of electric use reduction required to meet these goals. Parallel to this effort various DSM measures were analyzed to determine demand and energy savings along with implementation costs.

The intent of this analysis was to give a reasonable estimate of the potential for commercial DSM programs with the existing building stock. Further analysis reviewed opportunities for improved building design and construction which can minimize future demand requirements.

The ENERGY STAR program for commercial buildings was first introduced in 1999 with a benchmarking tool for building managers and program for recognizing energy efficient facilities. The energy performance of a facility is compared to data of similar buildings and scored on a 1-100 scale with 50 being the average and 100 the most efficient. Those facilities that achieve a score of 75 or higher are eligible for the ENERGY STAR, indicating that they are among the top 25 percent of facilities in the country for energy performance. On average a commercial buildings that has earned the ENERGY STAR recognition will use 35 percent less energy than typical similar buildings and generate one-third less carbon dioxide. Increasing concern about the financial and environmental risks associated with climate change is driving more organizations to strive for the ENERGY STAR for their buildings, as it is seen as a symbol of an organization that is working to reduce global warming and its impacts.

The process for evaluating the Columbia commercial buildings includes the following steps:

1. Identify the types of building stock from land use database and interviews with CWL staff
2. Obtain sample electric utility use data from CWL for each category
3. Determine level of opportunity based on the ENERGY STAR rating for the "average" building in each category
4. Determine DSM options savings and cost normalized to area for each category
5. Calculate DSM savings and costs – extrapolate to entire commercial inventory

4.3.1 Types of Building Stock

The first step in this procedure was to identify the existing building stock in the CWL service territory. After discussions with CWL personnel it was determined that a fairly extensive set of building data were available from the assessor's office. This information includes the buildings type, age, size and primary heating and cooling systems. The Burns & McDonnell team took this data and grouped the buildings by type and determined the number of buildings, total area, average building size and average building age.

The following table summarizes information for major building categories from the land use database, ENERGY STAR building categories and data from the EIA for the Midwest region. Note an ENERGY STAR ranking category does not exist for restaurants. There is however an EIA category for Food Service.

Table 4-16: Commercial Customers by Land Use Category

COLUMBIA, MO - LAND USE DATABASE					ENERGY STAR	EIA DATABASE		
Land Use Data Category	Area (sqft)	# of Bldgs	Avg Area (sqft)	Avg Year Built	Energy Star Category	Electric EUI (kWh/sqft)	Gas EUI (cf/sqft)	EIA Category
Bank/Financial	374,995	62	6,048	1986	Bank/Fin.	17.9	42.3	Office
Motel Low-Rise	1,142,092	51	22,394	1986	Hotels/Motels	13.0	65.0	Lodging
Hotel/Motel	587,861	8	73,483	1993	Hotels/Motels	13.0	65.0	Lodging
Office 1-4 Story	2,406,714	180	13,371	1987	Office	17.9	42.3	Office
Office Condominium	310,087	164	1,891	1996	Office	17.9	42.3	Office
Office High-Rise	46,748	2	23,374	1936	Office	17.9	42.3	Office
Restaurant	510,828	88	5,805	1972	n/a	29.9	133.2	Food Service
Fast Food Franchise	91,006	25	3,640	1991	n/a	29.9	133.2	Food Service
Fast Food Restaurant	93,545	34	2,751	1992	n/a	29.9	133.2	Food Service
Retail Store	4,442,222	288	15,424	1981	Retail Stores	14.2	54.1	Retail (other than mall)
Discount Store/Mkt	2,196,529	62	35,428	1991	Retail Stores	14.2	54.1	Retail (other than mall)
Warehouse	2,940,899	354	8,308	1982	Warehouse	9.6	31.9	Warehouse
Medical Office	844,309	92	9,177	1989	Medical Office	19.2	51.5	Medical Care-outpatient
Hospital	1,250,820	2	625,410	1990	Hospital	26.4	127.2	Medical Care-inpatient
Grocery Stores	320,859	5	64,172		Supermarket			
TOTALS	***17,238,655***	***1,417***						

4.3.2 Sample Utility Bill Histories for Building Categories

CWL personnel identified a subset of buildings for each category and pulled one year of electric bill usage for each. With this data the Burns & McDonnell team used the size and use of each subset to develop a "typical" building for each of the categories. This information provided the basis for input into the ENERGY STAR benchmarking analysis. Additional inputs such as number of workers were derived from EIA average values or Burns & McDonnell's experience with similar facilities. The following table provides the results of the building subset evaluation along with the required inputs to the ENERGY STAR Benchmarking program. No natural gas usage data to match the CWL electric usage data were available. Therefore, the natural gas Energy Use Intensity (EUI) from the EIA table was used by Burns & McDonnell as estimates for use with the ENERGY STAR program. The natural gas EUIs were derated to 65 percent of the values as provided in the EIA tables. This is due to the fact that the primary use of natural gas is for heating. The Midwest region category in the EIA table includes the far north states such as the Dakota's, Minnesota, Nebraska and Iowa which will have a higher natural gas building use per square foot than a comparable building in Columbia, MO due to increased heating degree days.

Table 4-17: Columbia Commercial Building Sample Set Data

			65%	percent reduction in EIA gas EUI				
	BUILDING SUMMARY (from sample set)					ENERGY STAR INPUTS		
Land Use Data Category	Total area (ft2)	Total Electric Use (kWh)	Electric EUI (kWh/ft2)	Average Annual Electric (kWh)	Average Annual Gas (mcf)	Avg Size (ft2)	Monthly Electric (kWh)	Monthly Gas-EIA (MCF)
Bank/Financial	21,893	585,617	26.75	81,792	84	3,058	6,816	7
Motel Low-Rise	434,203	5,155,100	11.87	468,645	1,668	39,473	39,054	139
Hotel/Motel	235,695	3,791,760	16.09	1,263,920	3,319	78,565	105,327	277
Office 1-4 Story	132,153	2,200,813	16.65	183,401	303	11,013	15,283	25
Restaurant	62,841	3,562,471	56.69	323,861	495			
Retail Store	150,805	2,048,592	13.58	170,716	442	12,567	14,226	37
Discount Store/Mkt	138,586	2,835,225	20.46	310,920	534	15,198	25,910	45
Discount Store (lg)	700,150	20,496,860	29.27	3,416,143	4,103	116,692	284,679	342
Warehouse	88,907	391,917	4.41	35,629	168			
Medical Office	110,305	1,859,240	16.86	154,937	308	9,192	12,911	26
Hospital	1,250,820	42,783,378	34.20	21,391,689	51,709	625,410	1,782,641	4,309
Grocery Stores	320,859	17,829,816	55.57	3,565,963	4,614	64,172	297,164	384

4.3.3 ENERGY STAR Benchmarking and DSM Potential

ENERGY STAR has a web based "Portfolio Manager" which allows the user to list buildings, their characteristics and monthly utility bills. The user can benchmark their building based on a years worth of utility bills, set an ENERGY STAR target and keep track of progress over multiple years. The following is an example of the analysis approach for the Bank/Financial class of customers. The ENERGY STAR inputs along with the location of Columbia, MO were entered. In addition to this data an ENERGY STAR target of 69 was set which matches with the minimum Leadership in Energy & Environmental Design (LEED)-EB requirement.

In addition to the benchmarking the Portfolio Manager uses emissions data for the regional power grid and production plant. This analysis uses the SERC Midwest region and Columbia plant. The following is the Statement of *Energy Performance – Facility Summary Report* produced by Portfolio Manager for the typical Columbia Retail facility. Note the building originally ranked a 53 which is slightly above the industry standard. The "Current" ranking is an example after retrofits have occurred. Now the facility ranks 60 which is still below the target of 69, but well ahead of the industry average. The report lists the Baseline and Current EUI for the building in kBtu/sqft. It also lists the EUI required for the target of 69 as well as the EUI to reach a 75 which meet the criterion for ENERGY STAR recognition.

Figure 4-3: Example ENERGY STAR Facility Summary Report

NOT FOR USE WHEN APPLYING FOR THE ENERGY STAR

ENERGY STAR

Statement of Energy Performance
FACILITY SUMMARY REPORT
Retail

For 12-month Period Ending: December 31, 2001
Date Generated: February 18, 2008

This document was generated using EPA's Portfolio Manager system. All information shown is based on data provided by the Portfolio Manager account holder. Depending on the use of the SEP Facility Summary, building owners or managers may want to have a professional engineer (PE) verify that the underlying data is accurate. Blank space has been left intentionally on the SEP Facility Summary for a PE stamp.

101 Rodeo Dr.
Columbia, MO 65205

Year Built: 1981
Gross Floor Area: (ft²) 12,567

Facility Space Use Summary

Retail

Space Name	Gross Floor Area (ft²)	Operating Hours/Week	Open and Closed Refrigeration/Freezer Cases	Walk-In Refrigeration/Freezer Units	Workers on Main Shift	Number of PCs	Number of Cash Registers	% Air-Conditioned	% Heated
Retail Space	12,567	59	0	0	10	2	5	100	100

Energy Performance Comparison

Results	Current (12/31/2001)	Baseline (12/31/2000)	Delta	Target	Industry Average	ENERGY STAR
Energy Performance Rating	**60**	**53**	**7**	**69**	**50**	**75**
Energy Intensity (kBtu/ft²)						
Site	76	82	-6	68	87	61
Source	173	192	-19	153	198	139
Energy Cost						
$/year	0	0	0	0	0	0
$/ft²/year	0.00	0.00	0.00	0.00	0.00	0.00
CO_2 Emissions (tons/year)	164	183	-19	146	188	132

More than 50% of your building is defined as Retail. Please note that your rating accounts for all of the spaces listed. If you cannot see a rating, you will be compared to the national average of Retail.

EPA
United States
Environmental Protection
Agency

The baseline ENERGY STAR rating was used as an indication of the overall efficiency of the building category as well as a metric for determining the percentage likely available for retrofits. The retrofit potential for a building category with an ENERGY STAR rating of 50 (e.g., the industry average) was assumed to be 35 percent and 50 percent of the total building stock for HVAC and Lighting retrofits, respectively. The potential increases for ENERGY STAR ratings lower than 50 and decreases for ratings higher than 50 as shown in the following table. These estimates are based on experience developing retrofit projects and the cost per kW reduction available. Lighting is by far the most cost effective of the

measures. Due to the high cost to benefit for Appliance replacement a fixed value of 20 percent was used for all categories.

Table 4-18: ENERGY STAR Rating and Estimated DSM Potential

Energy Star	HVAC Potential	Appliance Potential	Lighting Potential
0	55%	20%	90%
10	51%	20%	82%
20	47%	20%	74%
30	43%	20%	66%
40	39%	20%	58%
50	35%	20%	50%
60	31%	20%	42%
70	27%	20%	34%
80	23%	20%	26%
90	19%	20%	18%
100	15%	20%	10%

4.3.4 Determine DSM Savings and Costs

The next step in the analysis was to determine the estimated end-use inventory based on the building stock. The end uses in commercial buildings for electric consumption include the major categories of

- Heating, ventilation and air conditioning (HVAC)
- Appliances (computers, copiers, etc)
- Lighting

The following paragraphs describe the methodology used by Burns & McDonnell to estimate this inventory and the results of the analysis.

4.3.4.1 HVAC

The most common HVAC system used in commercial buildings is the packaged Air Handling Unit (AHU). A packaged AHU incorporates the cooling, heating and fan systems into a single unit. Often these are placed on the roof and referred to as Roof Top Units (RTU). The HVAC savings were determined using eQUEST models. A number of different RTU unit sizes were used and applied to several building types. In addition an 80 ton chiller was modeled to incorporate chilled water systems that are sometimes used in larger buildings. The primary assumption used in sizing the equipment was that on average 1 ton of cooling is required per 500 square feet of building space. A ton is equal to

12,000 Btu/hr of cooling. The intent was to normalize the results to 1,000 square feet of buildings space. Once the savings or costs per 1,000 square feet were determined the results could be extrapolated to include the complete set of buildings in each category. Sample eQUEST results can be found in Appendix D. The results from the eQUEST models are summarized by unit size in the following table.

Table 4-19: Average eQUEST Model Results per Unit Size

Unit (ton)	kW saved per unit	kW saved per ton	kW saved per 1,000 ft2	kWh saved per 1,000 ft2	Cost per kW saved	Cost per 1,000 ft2
5	2.34	0.47	0.94	1,040	$ 2,347	$ 2,200
10	3.52	0.35	0.70	781	$ 3,128	$ 2,200
20	7.43	0.37	0.74	919	$ 2,961	$ 2,200
80	58.30	0.73	1.46	2,545	$ 2,888	$ 4,210

There is a wide variety of building types represented in the Columbia commercial customer set. This is true even within a given facility type such as “Retail”. By far the most common units found in commercial buildings are the smaller RTUs. As an example a strip mall may have one RTU installed per store front. On the other hand a larger building may have a series of these units installed with each used to provide a zone of control. Larger buildings with more complex zoning might user larger packaged units with some level of zone control or central AHUs served by a chilled water system. Based on experience in conducting audits on many commercial buildings, an overall distribution of cooling capacity was set at 50 percent, 30 percent, 10 percent, and 10 percent for the 5 ton, 10 ton, 20 ton and 80 ton units, respectively. The eQUEST results were “bundled” to obtain a representative measure of the savings and cost per 1,000 square feet of building as summarized in the following table.

Table 4-20: Bundled eQUEST HVAC Model Results

Unit Size (ton)	Percent of Total Retrofits	Number of Units	kW saved per 1,000 ft2	kWh saved per 1,000 ft2	Cost per kW saved	Cost per 1,000 ft2
5	50%	3,512	0.47	520	$ 1,174	$ 1,100
10	30%	1,054	0.21	234	$ 938	$ 660
20	10%	176	0.07	92	$ 296	$ 220
80	10%	44	0.15	255	$ 289	$ 421
	100%	4,786	0.90	1,101	$ 2,697	$ 2,401

4.3.4.2 Appliances

Burns & McDonnell chose common appliances that can be found in commercial class buildings. The next step was to determine the average quantity of appliances one might find based on the building type, and then normalize to a "per 1,000 square feet" basis. The following table lists the appliances as well as the estimated quantity per 1,000 square feet.

Table 4-21: Estimated Appliance Quantities per 1,000 Square Feet

Land Use Data Category	Computer	Monitor	Printer	Copier	Fax Machine	Scanner	Refrig.
Bank/Financial	2.00	2.00	0.50	0.50	0.10	0.10	0.10
Motel Low-Rise	0.10	0.10	0.03	0.03	0.01	0.01	0.01
Hotel/Motel	0.10	0.10	0.03	0.03	0.01	0.01	0.01
Office 1-4 Story	2.00	2.00	0.50	0.50	0.10	0.10	0.10
Office Condominium	2.00	2.00	0.50	0.50	0.10	0.10	0.10
Office High-Rise	2.00	2.00	0.50	0.50	0.10	0.10	0.10
Restaurant	0.10	0.10	0.03	0.03	0.01	0.01	0.01
Fast Food Franchise	0.10	0.10	0.03	0.03	0.01	0.01	0.01
Fast Food Restaurant	0.10	0.10	0.03	0.03	0.01	0.01	0.01
Retail Store	0.40	0.40	0.10	0.10	0.02	0.02	0.02
Discount Store/Mkt	0.40	0.40	0.10	0.10	0.02	0.02	0.02
Discount Store (lg)	0.40	0.40	0.10	0.10	0.02	0.02	0.02
Warehouse	0.10	0.10	0.03	0.03	0.01	0.01	0.10
Medical Office	2.50	2.50	0.50	0.50	0.10	0.10	0.10
Hospital	1.00	1.00	0.20	0.20	0.04	0.04	0.04
Grocery Stores	0.40	0.40	0.10	0.10	0.02	0.02	0.02

Estimates for the savings due to appliances were made using ENERGY STAR calculators available from the Environmental Protection Agency (EPA). The results from the ENERGY STAR calculators for typical appliances found in a commercial setting are shown below. Detailed results of the ENERGY STAR Calculators are included in Appendix D.

Table 4-22: ENERGY STAR Calculator Savings & Cost Estimates

Appliance	Demand Savings (kW)	Energy Savings (kWh)	Cost per Unit
Computer	0.006	103	$ 735
Monitor	0.001	99	$ 280
Printer	0.049	559	$ 1,011
Copier	0.100	2,084	$ 4,797
Fax Machine	0.030	165	$ 81
Scanner	0.019	71	$ 150
Refrigerator	0.010	1,967	$ 1,179

Using these results and the assumed density of appliances by building category an estimate of the savings per 1,000 square feet of building area can be developed. Those results are shown in the following table.

Table 4-23: Appliance DSM Savings and Cost Potential by Building Category

	per 1,000 sq ft of retrofit		
Land Use Data Category	kW Saved	kWh Saved	Retrofit Cost
Bank/Financial	0.944	19,458	$ 50,750
Motel Low-Rise	0.047	973	$ 2,538
Hotel/Motel	0.047	973	$ 2,538
Office 1-4 Story	0.944	19,458	$ 50,750
Office Condominium	0.944	19,458	$ 50,750
Office High-Rise	0.944	19,458	$ 50,750
Restaurant	0.047	973	$ 2,538
Fast Food Franchise	0.047	973	$ 2,538
Fast Food Restaurant	0.047	973	$ 2,538
Retail Store	0.189	3,892	$ 10,150
Discount Store/Mkt	0.189	3,892	$ 10,150
Discount Store (lg)	0.189	3,892	$ 10,150
Warehouse	0.057	2,842	$ 3,658
Medical Office	0.979	20,468	$ 55,825
Hospital	0.392	8,187	$ 22,330
Grocery Stores	0.189	3,892	$ 10,150

4.3.4.3 Lighting

Based on Burns & McDonnell's experience surveying millions of square feet of commercial office buildings, the most common lighting retrofits that produce reductions in the utility system peak load include T12 to T8 fluorescent retrofits. The T8 fluorescent light system is approximately 40 percent more energy efficient than conventional T12 fluorescent lamps and standard magnetic core and coil ballasts.

The T8 lamps fit in the existing standard T12 bi-pin sockets without luminaire modification. The electronic ballasts developed specifically for the T8 lamps will replace the old core and coil ballasts. The electronic ballasts operate at high frequencies, which reduces the power requirements to produce the same amount of light as the existing T12 lighting system. Electronic ballasts also reduce the tendency of fluorescent lamps to flicker or ballasts to hum.

Finally, T8 lamps use rare earth phosphor minerals, which provide superior color rendition. In addition advances in the field of light reflection have resulted in the introduction of specular reflectors to the lighting market. The term "specular" simply means "mirror-like" and indeed a specular reflector looks very much like a mirror. A specular reflector installed in a troffer can improve the fixture's performance

significantly, such that in many cases half the lamps and ballasts can be removed without a significant reduction in light levels.

Another retrofit involves the replacement of incandescent lamps, wherever feasible, with screw-in compact fluorescent lamps and ballasts. Compact fluorescent lamps are a much more efficient light source with a typical efficacy of 50 to 70 lumens per watt, and have an average rated lamp life of 10,000 to 12,000 hours as compared to typical incandescent lamps. The higher efficiency, lower wattage compact fluorescent lamp can provide light levels of the same intensity as a higher wattage incandescent lamp without a significant reduction in lighting quality.

The lighting savings and cost analysis involved developing a "typical" set of fixtures and retrofits for a 1,000 square feet area of building space. Such a space might have 12 fixtures using 4, 34W T12 lamps and electronic ballasts or 12 fixtures using 3 T12 lamps. Respective retrofits include a 3 lamp T8 fixture with low power electronic ballast or a 2 lamp T8 fixture with reflector and standard power electronic ballasts. The results from these two scenarios are shown in the *Savings* values listed below. Due to the diversity of buildings in the Columbia commercial stock and based on Burns & McDonnell's experience, an average value assuming 50 percent of the first and 50 percent of the second retrofit will be used. The result is that the T8 retrofits should on average provide reductions of 0.792 kW and 2,265 kWh per 1,000 square feet of area retrofitted. The estimated cost is $678. In addition the analysis assumes that on average there will be one, 100W incandescent light per 1,000 square feet. This lamp can be retrofitted with a 23W compact fluorescent. The savings and cost for this retrofit are listed below and then added to the T8 retrofit results to give a total savings of 0.869 kW and 2,485 kWh per 1,000 sq ft at a cost of $696.

Table 4-24: Lighting DSM Savings and Cost per 1,000 Square Feet

Fixture Description	Fixture Wattage (kW)	Total Wattage (kW)	Total Energy (kWh)	Cost to Retrofit
4 lamp, T12 with magnetic ballast (34 W lamp)	0.144	1.728	4,942	
3 lamp, T8 with low power ballast	0.073	0.876	2,505	$ 504
Savings		0.852	2,437	$ (504)
3 lamp, T12 with magnetic ballast (34 W lamp)	0.115	1.380	3,947	
2 lamp, T8 with reflector and standard power ballast	0.054	0.648	1,853	$ 852
Savings		0.732	2,094	$ (852)
Assume 50-50 Split of Retrofit Options		**0.792**	**2,265**	**$ (678)**

Fixture Description	Fixture Wattage (kW)	Total Wattage (kW)	Total Energy (kWh)	Cost to Retrofit
1 Incan lamps per 1,000 sq ft	0.100	0.100	286	
1 CFL per 1,000 sq ft	0.023	0.023	66	$ 18
Savings		**0.077**	**220**	**$ (18)**
TOTAL SAVINGS		***0.869***	***2,485***	***$ (696)***

The majority of lighting in hotel and motel rooms is either incandescent or Compact Fluorescent (CFL). Survey results from 10 hotel/motels in Columbia revealed that about 66 percent of the rooms are fitted with CFLs. The following is the estimated savings per hotel/motel room that is a candidate for retrofit.

Table 4-25: Hotel/Motel Room Lighting Savings and Costs

Fixture Description	Lamps per Room	Lamp Wattage	Total Wattage	Total Energy (kWh)	Cost to Retrofit
Incandscent	3.0	0.060	0.180	515	
compact fluorescent	3.0	0.014	0.042	120	$ 14
Savings			**0.138**	**395**	**$ (14)**

4.3.5 Impact of Commercial DSM Options

The overall savings as determined by Burns & McDonnell based on its experience in the commercial retrofit market, the analysis herein and the specific CWL building portfolio are listed below by building type. The results were then estimated over the entire set of buildings within each facility type based on the area normalized savings and costs for HVAC, appliance and lighting options. These building categories included in the sample set accounted for over 17 million square feet and are shown in the following table in the blue shaded areas. Other smaller categories accounting for 1.7 million square feet

were identified from the Land Use Data as shown in the green shaded area. These facility types were assigned a type which was most similar to the original set (e.g., Auto Pars – Service assigned to Discount Store – small). These savings and costs were estimated on an area weighted basis. The sum of these two groups is the "Total Commercial non-Public" set. The final group of buildings is shaded in yellow and includes Public Authority, Intradepartmental and Residential Tax and identified as the "Commercial – Public" set. The number of buildings and total area were not known for these. The energy use of each of these groups was compared to the Total Commercial non-Public group (e.g., Public Authority is equal to 13.7 percent of the Total Commercial non-Public use). The estimated savings for these groups were determined by taking this percentage times the Total Commercial non-Public savings. The estimated "Total Commercial" savings and costs include all three building sets.

Table 4-26: Summary of eQUEST/ENERGY STAR Evaluation

	No. of Bldgs	Total Area	kW Reduction	kWh Reduction	Project Cost
Bank/Financial	7	145,933	302	798,515	$ 851,040
Motel Low-Rise	1	22,223	337	753,381	$ 1,130,657
Hotel/Motel	1	11,439	196	415,233	$ 581,975
Office 1-4 Story	45	936,597	2,167	5,648,749	$ 5,787,477
Office Condominium	6	120,673	279	727,799	$ 745,673
Office High-Rise	1	18,192	42	109,721	$ 112,416
Restaurant	0	9,940	332	782,133	$ 505,713
Fast Food Franchise	0	1,771	59	139,340	$ 90,095
Fast Food Restaurant	0	1,820	61	143,227	$ 92,608
Retail Store	17	345,747	3,147	7,216,757	$ 5,940,357
Discount Store/Mkt	48	797,900	590	1,343,336	$ 1,074,758
Discount Store - lg	14	1,400,629	1,351	3,055,954	$ 2,500,423
Discount Store (lg)	6	119,672	385	1,056,256	$ 767,570
Warehouse	3	167,134	752	1,978,295	$ 2,103,337
Medical Office	17	345,626	930	2,230,280	$ 2,033,749
Grocery Store	0	0	214	490,220	$ 409,781
Total eQUEST & Energy Star	*166*	*4,445,297*	*11,145*	*26,889,196*	*$ 24,727,631*
Auto Parts - Service (Disc. Sm.)	72	417,477	308	702,860	$ 562,335
Auto Showroom (Disc. Lg.)	22	329,314	318	718,512	$ 587,896
Convenience Store (Disc. Sm.)	33	113,185	84	190,557	$ 152,458
Tavern - Bar (Restaurant)	21	165,374	108	253,205	$ 163,718
Social - Fraternal Hall (Restaurant)	68	683,184	445	1,046,028	$ 676,344
Total Other Commercial Types	*216*	*1,708,534*	*1,262*	*2,911,162*	*$ 2,142,751*
TOTAL Commercial (non-Public)	**382**	**6,153,831**	**12,407**	**29,800,359**	**$ 26,870,381**
Public Authority @ 13.7% of Comm.			1,703	4,091,210	$ 3,688,961
Intradepartmental @ 1.8% of Comm.			217	522,300	$ 470,947
Residential Tax @ 1.3% of Comm.			165	397,272	$ 358,212
Total Commercial (Public)			**2,086**	**5,010,781**	**$ 4,518,120**
TOTAL COMMERCIAL			***14,493***	***34,811,140***	***$ 31,388,502***

The savings by DSM program are summarized in the following table.

Table 4-27: Savings and Cost by DSM Program

DSM Program	kW Reduction	kWh Reduction	Project Cost
HVAC	5,919	7,654,314	$ 16,509,122
APPLIANCE	142	3,044,889	$ 7,760,387
LIGHTING	8,432	24,111,937	$ 7,118,992
TOTAL for all Programs	***14,493***	***34,811,140***	***$ 31,388,502***

4.3.5.1 HVAC Demand and Energy

The overall savings and costs attributed to the HVAC retrofits are summarized in the following table.

Table 4-28: Commercial HVAC DSM Savings and Costs

	kW Reduction	kWh Reduction	Project Cost
Bank/Financial	119	149,376	$ 333,127
Motel Low-Rise	246	474,616	$ 685,526
Hotel/Motel	127	206,323	$ 352,856
Office 1-4 Story	841	1,051,974	$ 2,346,030
Office Condominium	108	135,539	$ 302,268
Office High-Rise	16	20,434	$ 45,569
Restaurant	110	137,489	$ 306,618
Fast Food Franchise	20	24,494	$ 54,625
Fast Food Restaurant	20	25,178	$ 56,149
Retail Store	1,293	1,616,484	$ 3,604,957
Discount Store/Mkt	240	300,657	$ 670,501
Discount Store - lg	567	708,721	$ 1,580,535
Warehouse	127	158,309	$ 353,048
Medical Office	292	365,411	$ 814,912
Hospital	377	471,321	$ 1,051,105
Grocery Store	89	111,231	$ 248,058
Total eQUEST & Energy Star	*4,591*	*5,957,556*	*$ 12,805,886*
Auto Parts - Service (Disc. Sm.)	126	157,310	350,819
Auto Showroom (Disc. Lg.)	133	166,634	371,613
Convenience Store (Disc. Sm.)	34	42,649	95,113
Tavern - Bar (Restaurant)	36	44,510	99,264
Social - Fraternal Hall (Restaurant)	147	183,879	410,073
Total Other Commercial Types	*476*	*594,982*	*$ 1,326,882*
TOTAL Commercial (non-Public)	**5,067**	**6,552,538**	**$ 14,132,768**
Public Authority @ 13.7% of Comm.	696	899,580	$ 1,940,249
Intradepartmental @ 1.8% of Comm.	89	114,844	$ 247,700
Residential Tax @ 1.3% of Comm.	68	87,353	$ 188,406
Total Commercial (Public)	**852**	**1,101,776**	**$ 2,376,354**
TOTAL COMMERCIAL	***5,919***	***7,654,314***	***$ 16,509,122***

4.3.5.2 Appliance Energy

Using these area normalized savings and estimate for the Columbia commercial building stock can be calculated. The results assume that 20percent of the total commercial inventory will have these retrofits.

Table 4-29: Commercial Appliance Savings and Costs

	kW Reduction	kWh Reduction	Project Cost
Bank/Financial	7	145,933	$ 380,620
Motel Low-Rise	1	22,223	$ 57,961
Hotel/Motel	1	11,439	$ 29,834
Office 1-4 Story	45	936,597	$ 2,442,815
Office Condominium	6	120,673	$ 314,738
Office High-Rise	1	18,192	$ 47,449
Restaurant	0	9,940	$ 25,925
Fast Food Franchise	0	1,771	$ 4,619
Fast Food Restaurant	0	1,820	$ 4,747
Retail Store	17	345,747	$ 901,771
Discount Store/Mkt	2	51,288	$ 133,769
Discount Store (lg)	6	119,672	$ 312,127
Warehouse	3	167,134	$ 215,130
Medical Office	17	345,626	$ 942,671
Hospital	10	204,814	$ 558,616
Grocery Stores	1	24,973	$ 65,134
Total eQUEST & Energy Star	*117*	*2,527,843*	*$ 6,437,926*
Auto Parts - Service (Disc. Sm.)	1	26,835	69,990
Auto Showroom (Disc. Lg.)	1	28,137	73,387
Convenience Store (Disc. Sm.)	0	7,275	18,976
Tavern - Bar (Restaurant)	0	3,218	8,393
Social - Fraternal Hall (Restaurant)	1	13,293	34,672
Total Other Commercial Types	*4*	*78,759*	*$ 205,417*
TOTAL Commercial (non-Public)	**121**	**2,606,602**	**$ 6,643,343**
Public Authority @ 13.7% of Comm.	17	357,853	$ 912,046
Intradepartmental @ 1.8% of Comm.	2	45,685	$ 116,435
Residential Tax @ 1.3% of Comm.	2	34,749	$ 88,563
Total Commercial (Public)	**20**	**438,287**	**$ 1,117,045**
TOTAL COMMERCIAL	***142***	***3,044,889***	***$ 7,760,387***

4.3.5.3 Lighting Demand and Energy

The overall savings and costs attributed to the commercial lighting retrofits are summarized in the following table.

Table 4-30: Commercial Lighting Savings and Costs

	kW Reduction	kWh Reduction	Project Cost
Bank/Financial	176	503,206	$ 137,293
Motel Low-Rise	90	256,542	$ 387,169
Hotel/Motel	69	197,472	$ 199,285
Office 1-4 Story	1,280	3,660,179	$ 998,632
Office Condominium	165	471,587	$ 128,666
Office High-Rise	25	71,095	$ 19,397
Restaurant	222	634,704	$ 173,171
Fast Food Franchise	40	113,075	$ 30,851
Fast Food Restaurant	41	116,230	$ 31,712
Retail Store	1,837	5,254,527	$ 1,433,629
Discount Store/Mkt	347	991,391	$ 270,488
Discount Store - lg	779	2,227,560	$ 607,761
Warehouse	256	730,813	$ 199,393
Medical Office	443	1,267,257	$ 345,755
Hospital	543	1,554,144	$ 424,028
Grocery Store	124	354,017	$ 96,589
Total eQUEST & Energy Star	*6,436*	*18,403,797*	*$ 5,483,820*
Auto Parts - Service (Disc. Sm.)	181	518,715	141,525
Auto Showroom (Disc. Lg.)	183	523,741	142,896
Convenience Store (Disc. Sm.)	49	140,632	38,370
Tavern - Bar (Restaurant)	72	205,477	56,062
Social - Fraternal Hall (Restaurant)	297	848,856	231,599
Total Other Commercial Types	*782*	*2,237,422*	*$ 610,452*
TOTAL Commercial (non-Public)	**7,218**	**20,641,219**	**$ 6,094,271**
Public Authority @ 13.7% of Comm.	991	2,833,776	$ 836,666
Intradepartmental @ 1.8% of Comm.	127	361,771	$ 106,812
Residential Tax @ 1.3% of Comm.	96	275,170	$ 81,243
Total Commercial (Public)	**1,214**	**3,470,718**	**$ 1,024,721**
TOTAL COMMERCIAL	***8,432***	***24,111,937***	***$ 7,118,992***

4.4 REDUCTIONS REQUIRED TO ACHIEVE ENERGY STAR TARGETS

As mentioned earlier two typical ENERGY STAR rating targets are 69 and 75. The rating of 69 is important for certifying a building as LEED-EB. The prescriptive minimum requirement for energy efficiency under LEED-EB is to achieve a rating of 69. A building can also be recognized as ENERGY STAR with a rating of 75 or higher. The set of sample buildings loaded onto the ENERGY STAR Portfolio Manager were reviewed to see what level of electric use reduction would be required to reach ENERGY STAR 69 and ENERGY STAR 75. One must remember that the rating is based on the total energy use intensity which includes both electric and natural gas use. In reality measures would no doubt be taken to reduce natural gas use as well which would help achieve these target. This analysis will assume all savings are electric which would be the worst case scenario. First it was determined what percentage of energy reduction is required for each Portfolio building to reach the targets. These buildings were then matched to the appropriate land use category. The percent reductions were used to

calculate the total energy reduction required for each land use category as summarized in the following table.

Table 4-31: Electric Reductions Required to Meet ENERGY STAR Targets

ENERGY STAR Portfolio Building	Reduction to Reach ENERGY STAR 69	Reduction to Reach ENERGY STAR 75	Land Use Data Category	Total Category Energy (kWh)	Reduction to Reach ENERGY STAR 69 (kWh)	Reduction to Reach ENERGY STAR 75 (kWh)
Bank	30%	38%	Bank/Financial	10,030,761	3,033,302	3,791,628
Motel	28%	34%	Motel Low-Rise	13,559,553	3,850,913	4,676,109
Hotel	11%	17%	Hotel/Motel	9,457,255	1,075,763	1,572,269
Office	42%	49%	Office 1-4 Story	40,080,266	16,698,441	19,734,521
Office	42%	49%	Office Condominium	5,164,041	2,151,469	2,542,645
Office	42%	49%	Office High-Rise	778,519	324,350	383,323
Retail	28%	39%	Retail Store	60,344,819	17,103,446	23,517,238
Discount Store Mkt - sm	31%	41%	Disc. Store/Mkt-sm	16,323,626	5,086,442	6,692,687
Medical Center	32%	38%	Medical Office	14,231,205	4,553,986	5,407,858
Hospital	16%	20%	Hospital	42,783,378	6,638,554	8,734,940
Supermarket	16%	24%	Grocery Store	17,829,816	2,867,034	4,300,552
				323,971,766	***101,557,820***	***124,202,270***
					31%	***38%***

Note that for this subset of commercial buildings reductions of 31 percent and 38 percent would be required to reach the goals. Also note the total energy reduction is over 100,000,000 kWh in both cases. The savings from the DSM opportunities reviewed in this study resulted in savings of over 21,700,000 kWh for this subset. It is quite clear that aggressive measures in terms DSM programs and building standards are required if the future building stock is expected to reach these targets.

Items that should be considered for major renovations of existing buildings or future constructions are standards and codes that require the use of high efficiency equipment and sound, energy efficient construction methods. Incorporation of daylight control can reduce lighting system demand and occupancy sensors can be used in both lighting and HVAC systems to cycle items off or change setpoints thus reducing demand. Other more capital intensive solutions are possible such as thermal storage. These solutions are very site specific and must meet a number of criteria to justify their installation.

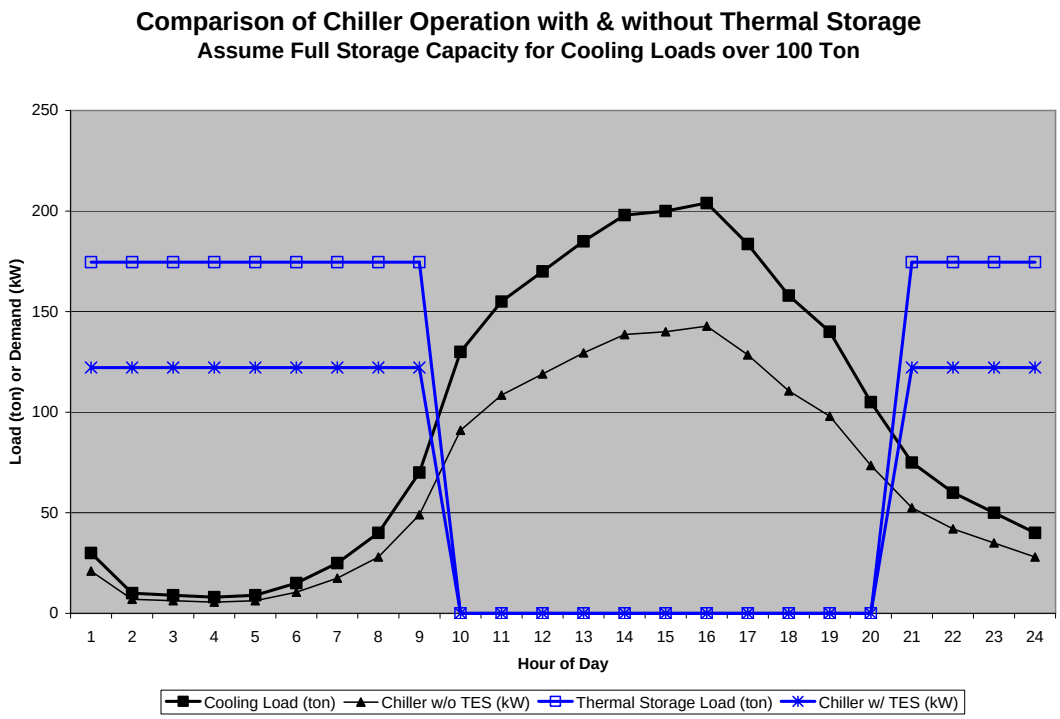
4.4.1 Thermal Energy Storage

The typical CWL commercial customer will find their peak demand occurring during a late summer afternoon on a peak cooling day. This will normally be coincident with the utility's peak. The concept with thermal storage is to cool and store a cold medium (usually chilled water) during off-peak hours and then use that medium for cooling during the peak periods. An immediate constraint can be the size of the storage tank and space limitations at the site. The cost of such systems can often overwhelm the cost

savings. The energy cost benefit to the customer occurs if they are paying a demand charge. By running the chiller at night they avoid adding that load to their peak and thus save money. The benefit to the utility is that a peaking load has been shifted.

Thermal Energy Storage (TES) is an option for buildings that use chilled water, have a low cooling load during the off-peak period and have space for the thermal storage tank. Another consideration is whether the existing chiller can be used or another is needed. The chiller should be capable of producing 37 F chilled water in order to optimize the cooled storage capacity to storage volume. The following graph shows the load in tons and the chiller demand in kW with, and without TES for a sample office building of about 100,000 square feet.

Figure 4-4: Chiller Profiles With & Without Thermal Energy Storage



This example assumes the TES will provide full load shedding during the peak period so that there is no chiller operation. It is assumed the chiller operates with an average efficiency of 0.7 kW/ton. Note that without TES the chiller peaks in the afternoon at the 16th hour at 204 tons and 143 kW. The 11 hour period starting at 1000 requires 1,829 ton-hrs of cooling which must be stored by the TES if full load shifting is to occur. This would require the chiller under the TES option to run on average at 175 ton (122 kW) during the remaining 13 hours.

The Washington State University Energy Program has published representative cost and size ranges for TES. These costs as well as the estimates for the example system are given in the following table.

Table 4-32: Cost and Size Estimates for Thermal Energy Storage Systems

Item	Range	Avg Cost - Size	Example TES Size	Cost - Size
Chiller Cost	200 - 300 $/ton	$ 250	240	$ 60,000
Storage Tank Cost	30-150 $/ton-hr	$ 90	1,829	$ 164,610
Storage Volume	6-20 cu ft/ton-hr	13	1,892	24,596

Note the total system cost is $224,610 and that the tank size will be over 180,000 gallons (e.g., 7.48 gal per cubic foot). Besides the cost and space requirements the reliability of the system must be considered by the customer. Peak demand and associated charges are determined for a single 30 minute period during the month. If the TES didn't provide the required cooling capacity for a single peak afternoon all demand energy charge savings would be lost. To counter this sometimes systems are oversized which will add more cost.

4.5 INDUSTRIAL ASSESSMENT

The set of manufacturing type industrial rate customers in the CWL service territory is small and accounts for only 12 of the 32 industrial rate accounts. The other industrial rate accounts include large retail such as malls and public authority buildings such as schools. The pool of manufacturing customers includes 2 food processing, 7 light manufacturing, 1 chemical product, 1 piping product and a rock quarry. The total estimated electric consumption for this group of customers is 182,387,680 kWh per year.

4.5.1 End Use Evaluation

In order to estimate the distribution of electric use within these plants EIA data were reviewed to determine the average percent by end use and representative load factors. The following table lists the EIA end-use categories and average percent end use. With this information the end-use electric consumptions were calculated for the CWL customers.

Table 4-33: Estimated Energy End-Use for CWL Manufacturing Customers

End Use	EIA End-Use %	Estimated Use by CWL Mfg Customers
Boiler	0.6%	1,141,725
Process Heating	11.6%	21,181,580
Process Cooling & Refrigeration	6.1%	11,169,752
Machine Drive	51.4%	93,778,920
Electro-Chemical Processes	9.8%	17,880,462
Other Process	0.4%	693,073
Facility HVAC	8.9%	16,271,835
Facility Lighting	7.0%	12,706,200
Other Facility Support	1.6%	2,940,024
Onsite Transportation	0.2%	282,971
Other Nonprocess Use	0.1%	142,716
End Use Not Reported	2.3%	4,198,012
TOTALS	***100.0%***	***182,387,680***

4.5.2 Estimated DSM Opportunities

Based on experience in industrial facilities the most promising opportunities for industrial DSM occur with motors, facility HVAC and facility lighting. These end uses account for approximately 67 percent of the total electric consumptions. Savings from 10 percent to 18 percent for each category are possible with aggressive measures. For this analysis and average reduction of 12 percent for each category is used to determine energy savings. The demand savings is based on an estimated load factor of 70 percent. Costs are estimated at $2,789 per kW reduction for motors and facility HVAC and $879 per kW reduction for lighting.

Table 4-34: Estimated Industrial DSM Savings and Costs

End Use	Estimated Use by CWL Mfg Customers	% Reduction via DSM	Energy Reduction (kWh)	Demand Reduction (kW)	Project Cost
Machine Drive	93,778,920	12%	11,253,470	1,835	$ 5,118,384
Facility HVAC	16,271,835	12%	1,952,620	318	$ 888,105
Facility Lighting	12,706,200	12%	1,524,744	249	$ 209,864
TOTALS	***182,387,680***		***14,730,835***	***2,402***	***$ 6,216,352***

4.6 STRATEGIST PROGRAM EVALUATION

The evaluation of DSM programs is performed through benefit/cost analysis. An initial screening of programs is made to determine those that fit the DSM objectives. The costs of the programs are then considered and compared to the benefits derived from the implementation using a benefit/cost analysis. Those programs with a benefit/cost ratio greater than one are then compared to supply side options to determine the most economic mix of demand and supply side alternatives.

There are numerous tests that can be used to screen DSM programs. The tests take different ratepayer and utility perspectives on the benefits and costs of the programs. The tests used in this report and considered necessary by the Missouri statutes on IRP processes include:

- Utility Cost Test(UC): This test assumes that the utility's objective is to minimize revenue requirements. The cost components of this test include the utility's program administration (or overhead) costs, incentive costs, and any direct expenditure by the utility to purchase DSM equipment. The benefits consist of the utility's avoided cost.
- Total Resource Cost Test (TRC): The Total Resource Test evaluates the cost of the of DSM programs on both the participants and utility. The cost components include the utility's program administration (or overhead) costs and the cost of buying the actual conservation measures. Incentive costs are not included. The benefits consist of the avoided utility demand and energy costs. In the case where the cost used in the UC test is the total program and replacement cost, the TRC is equal to the UC test.

As required under the Missouri Department of Economic Development section 4 CSR 240-22.050 Demand Side Resource Analysis, Burns & McDonnell calculated and evaluated both the Utility Cost Test and Total Resource Cost Test. In developing the programs for evaluation, it is worthwhile to understand the condition of the supply side pressures in order to determine the costs being confronted by the utility. These costs become the avoided costs in the benefit/cost analysis. For instance, if peaking energy is needed, programs that conserve overall energy or move on-peak energy to lower cost periods of the day are beneficial. If base load energy is needed, then overall conservation programs are of benefit.

The implementation of DSM requires selecting programs that make sense, considering the end-user base and the types of energy consuming appliances and structures they utilize. Inventory of the appliances and structures is important to understand the relative age, efficiency, quantity, and other necessary data to predict the energy and/or capacity reduction expected from the program. An understanding of the customer base is beneficial to understand the expected participation levels in programs offered. As agreed

to between CWL and Burns & McDonnell, the Saturation Study was assumed to provide this understanding and was used as the basis for the CWL DSM evaluation with adjustments made as noted herein.

4.6.1 Program Options

The implementation of DSM requires selecting programs that make sense, considering the end-user base and the types of energy consuming appliances and structures they utilize. Inventory of the appliances and structures is important to understand the relative age, efficiency, quantity, and other necessary data to predict the energy and/or capacity reduction expected from the program. An understanding of the customer base is beneficial to understand the expected participation levels in programs offered. The program options that were considered in the evaluation are presented in Table 4-35 and Table 4-36. The programs included HVAC, Thermal Envelope, Lighting, Motor and Appliance options.

Burns & McDonnell has included the existing direct load control program currently managed by CWL in the integrated analysis. Based on the existing cost assumptions of the program, it had a benefit / cost ratio of significantly less than one. However, due to the significant peak impact of the program, special consideration of the program was made.

Table 4-35: Residential DSM Options Evaluated

DSM Option Description		Total kW Reduction / Installation	Total kWh Reduction / Installation	Differential Cost / Installation
Potential Situation	Improvement			
HVAC				
AC Refrigerant under charged	Add refrigerant	0.11	448.00	$ 250.00
AC Refrigerant over charged	Remove refrigerant	0.10	100.00	$ 100.00
Low Evaporator Airflow A	Increase duct sizes or add new ducts	0.75	757.00	$ 950.00
Low Evaporator Airflow B	Increase blower speed	0.56	630.00	$ 100.00
High Duct Leakage (25%)	Reduce duct leakage to 5%	0.42	533.00	$ 600.00
Oversized AC Units A (New)	Size AC units to 100% of Manual J	0.30	246.00	$ 314.00
Oversized AC Units B (Replace)	Size AC units to 100% of Manual J	0.78	738.00	$ 210.00
One Inch insul. On ducts in attic	Add two more inches of insulation	0.16	185.00	$ 600.00
Gas Heat and 13 SEER AC	Install AC SEER = 16	0.36	258.00	$ 840.00
Home has 13 SEER Heat Pump	Install Heat Pump SEER = 16	0.55	620.00	$ 750.00
Home has electric strip heat	Install Heat Pump SEER = 16	1.13	3509.00	$ 4,800.00
No programmable thermostat	Install programmable thermostat	0.06	494.00	$ 200.00
3 Ton 10 SEER AC	Replace With 3 Ton 16 SEER AC	0.95	670.30	$ 3,800.00
No Variable Speed Fan	Install Variable Speed Fan Unit	0.00	84.00	$ 700.00
THERMAL ENVELOPE				
Attic Insulation = R-11	Add another R-19 attic insulation	0.34	503.00	$ 809.00
Exposed Walls not insulated	Add R-11 wall insulation	0.57	2517.00	$ 3,500.00
Floor over basement not insulate	Add R-19 wall insulation	-0.13	-225.00	$ 393.00
House infiltration = 0.8 ACH	Reduce infiltration to 0.35 ACH	0.41	1041.00	$ 500.00
Single Pane Window B	Install Low E double pane window 2904	0.48	1102.00	$ 350.00
NO E&W Window Shading A	Add solar screens to E&W sides	0.66	160.00	$ 258.00
NO E&W Window Shading B	Plant deciduous trees on E&W sides	0.13	327.00	$ 900.00
APPLIANCES				
No Compact Florescent Lamps	Use 3 more CFLs throughout the house	0.03	249.30	$ 45.00
Refrigerator needs to be replaced	Purchase Energy Star Refrigerator	0.01	61.00	$ 200.00
Refrigerator early retirement	Purchase Energy Star Refrigerator	0.08	646.00	$ 50.00
Dishwasher to be replaced	Purchase Energy Star dishwasher	0.06	74.00	$ 150.00
Clothes washer to be replaced	Purchase Energy Star clothes washer	0.11	150.00	$ 400.00
No low flow shower heads	Install low flow shower heads	0.00	125.00	$ 20.00
Hot water pipes not insulated	Insulate hot water pipes	0.00	61.00	$ 95.00
Electric water heater not wrapped	Wrap electric water heater	0.00	194.00	$ 60.00
Gas water heater not wrapped	Wrap gas water heater	0.00	0.00	$ 60.00
Two Refrigerators in Home A	Recycle 2nd Refrigerator w/ Coolant	0.09	791.40	$ 15.00
Two Refrigerators in Home B	Recycle 2nd Refrigerator w/o Coolant	0.09	791.40	$ 10.00
Phantom Electric Loads	Install Power Strips with Auto Shutoff	0.00	450.00	$ 40.00
Exterior Lighting Replacement	Install Solar Powered Lights	0.00	350.00	$ 116.00

Table 4-36: Commercial and Industrial DSM Options Evaluated

DSM Option Description		**Total kW**	**Total kWh**	**Differential**
Potential Situation	**Improvement**	**Reduction**	**Reduction**	**Cost**
COMMERCIAL				
Inefficient HVAC	Install New HVAC	5,919	7,654,314	$ 16,509,122
Inefficient Appliance	Install New Appliance	142	3,044,889	$ 7,760,387
Inefficient Lighting	Install New Lighting	8,432	24,111,937	$ 7,118,992
INDUSTRIAL				
Inefficient Machine Drive	Install New Machine Drive	1,835	11,253,470	$ 5,118,384
Inefficient HVAC	Install New HVAC	318	1,952,620	$ 888,105
Inefficient Lighting	Install New Lighting	249	1,524,744	$ 209,864

4.6.2 Program Screening Analysis

Section 3 of this report describes the use of Strategist to identify the "optimal" supply side future for CWL to pursue given the forecast of demand and energy and the assumptions for the supply side options. Strategist was also used to compare the benefits and costs of the various DSM options against the optimal supply side future. Strategist can analyze the benefits and costs of the DSM programs from a variety of viewpoints. For instance the utility may take one view of the benefits and costs of a program versus what may be seen by the ratepayer.

The state of Missouri has promulgated regulations for IRPs for utilities regulated by the Missouri Public Service Commission. (See Missouri 4 CR 240-22.050) In these regulations, the state has identified the utility cost and the total resource cost benefit/cost ratio tests as the measurements to be used for evaluating DSM options. The Strategist model was populated with the assumptions for the DSM programs identified and the Utility Test and Total Resource Cost Test ratios were used to screen DSM options against the optimal supply side future.

Program Costs: The screening of the programs required the costs for implementing the programs to be developed. The residential costs were taken from the Saturation Study and are provided in Table 4-35. Program costs in Table 4-36 were developed based on Burns & McDonnell experience and DOE information.

Program Benefits: The program benefits were calculated with the use of Strategist by estimating the energy and demand reduction cost savings for each type of program.

Program Results: The analysis was performed without any program administrative costs included, since CWL already has administration of DSM programs included in its current budget. This resulted in 23 of 34 residential DSM programs and 4 of 6 commercial and industrial DSM programs evaluated with benefit/cost ratios greater than 1.0. The results of this analysis are summarized in Table 4-37 and Table 4-38.

An example of the benefit / cost module output from Strategist is provided in Appendix C. This example shows the total program benefits for a program if it were implemented in CWL and the total cost to implement the program. In addition to the benefit / cost results, an example from the Load Forecast Module in Strategist is also provided in Appendix C. This shows the level of energy savings, peak

demand savings, non-coincidental peak demand savings and costs for each program over the 2007 to 2027 analysis period. Detailed output reports for each program are provided in Appendix H.

The benefit for each program is based on the net present value of the energy and demand cost savings from 2007 through 2027 discounted at a rate of 5.5 percent. The analysis is based on an in-service date of 2009.

In addition to the benefit / cost ratios, Table 4-37 and Table 4-38 also present what the differential cost would need to be for a program to have a Utility Test benefit / cost ratio greater than 1 if it did not have one in the scenario where CWL was responsible for all of the program costs. For example, if CWL was to replace a 3 Ton 10 SEER unit with a 3 Ton 16 SEER unit, it is estimated that CWL would have a NPV benefit of $1,254 per installation. This amount would be the most CWL would be willing to spend for replacing a 10 SEER unit.

Table 4-37: Residential Benefit / Cost Analysis Results

DSM Option Description		Utility Test Benefit / Cost	Differential Cost / Installation	Differential Cost to Achieve Utility Test B/C > 1
Potential Situation	**Improvement**			
HVAC				
AC Refrigerant under charged	Add refrigerant	2.68	$ 250.00	$ 250.00
AC Refrigerant over charged	Remove refrigerant	1.82	$ 100.00	$ 100.00
Low Evaporator Airflow A	Increase duct sizes or add new ducts	1.44	$ 950.00	$ 950.00
Low Evaporator Airflow B	Increase blower speed	11.35	$ 100.00	$ 100.00
High Duct Leakage (25%)	Reduce duct leakage to 5%	1.56	$ 600.00	$ 600.00
Oversized AC Units A (New)	Size AC units to 100% of Manual J	1.44	$ 314.00	$ 314.00
Oversized AC Units B (Replace)	Size AC units to 100% of Manual J	6.43	$ 210.00	$ 210.00
One Inch insul. On ducts in attic	Add two more inches of insulation	0.55	$ 600.00	$ 330.00
Gas Heat and 13 SEER AC	Install AC SEER = 16	0.57	$ 840.00	$ 478.80
Home has 13 SEER Heat Pump	Install Heat Pump SEER = 16	1.40	$ 750.00	$ 750.00
Home has electric strip heat	Install Heat Pump SEER = 16	1.19	$ 4,800.00	$ 4,800.00
No programmable thermostat	Install programmable thermostat	3.02	$ 200.00	$ 200.00
3 Ton 10 SEER AC	Replace With 3 Ton 16 SEER AC	0.33	$ 3,800.00	$ 1,254.00
No Variable Speed Fan	Install Variable Speed Fan Unit	0.14	$ 700.00	$ 98.00
THERMAL ENVELOPE				
Attic Insulation = R-11	Add another R-19 attic insulation	1.07	$ 809.00	$ 809.00
Exposed Walls not insulated	Add R-11 wall insulation	1.06	$ 3,500.00	$ 3,500.00
Floor over basement not insulate	Add R-19 wall insulation	0.00	$ 393.00	$ -
House infiltration = 0.8 ACH	Reduce infiltration to 0.35 ACH	2.93	$ 500.00	$ 500.00
Single Pane Window B	Install Low E double pane window 2904	4.57	$ 350.00	$ 350.00
NO E&W Window Shading A	Add solar screens to E&W sides	1.17	$ 258.00	$ 258.00
NO E&W Window Shading B	Plant deciduous trees on E&W sides	0.51	$ 900.00	$ 459.00
APPLIANCES				
No Compact Florescent Lamps	Use 3 more CFLs throughout the house	6.62	$ 45.00	$ 45.00
Refrigerator needs to be replaced	Purchase Energy Star Refrigerator	0.41	$ 200.00	$ 82.00
Refrigerator early retirement	Purchase Energy Star Refrigerator	15.95	$ 50.00	$ 50.00
Dishwasher to be replaced	Purchase Energy Star dishwasher	0.81	$ 150.00	$ 121.50
Clothes washer to be replaced	Purchase Energy Star clothes washer	0.62	$ 400.00	$ 248.00
No low flow shower heads	Install low flow shower heads	4.93	$ 20.00	$ 20.00
Hot water pipes not insulated	Insulate hot water pipes	0.51	$ 95.00	$ 48.16
Electric water heater not wrapped	Wrap electric water heater	2.55	$ 60.00	$ 60.00
Gas water heater not wrapped	Wrap gas water heater	0.00	$ 60.00	$ -
Two Refrigerators in Home A	Recycle 2nd Refrigerator w/ Coolant	61.69	$ 15.00	$ 15.00
Two Refrigerators in Home B	Recycle 2nd Refrigerator w/o Coolant	92.54	$ 10.00	$ 10.00
Phantom Electric Loads	Install Power Strips with Auto Shutoff	8.88	$ 40.00	$ 40.00
Exterior Lighting Replacement	Install Solar Powered Lights	2.38	$ 116.00	$ 116.00

Table 4-38: Commercial and Industrial Benefit / Cost Analysis Results

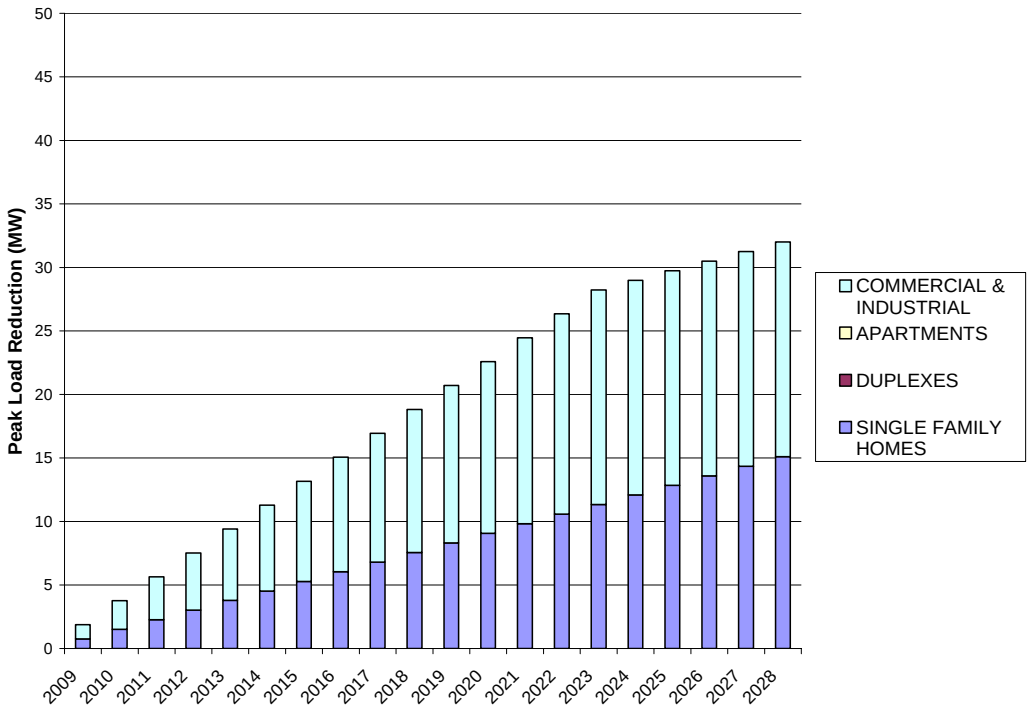
DSM Option Description		**Utility Test**	**Differential**	**Differential Cost to Achieve**
Potential Situation	**Improvement**	**Benefit/Cost**	**Cost**	**Utility Test B/C > 1**
COMMERCIAL				
Inefficient HVAC	Install New HVAC	0.73	$ 16,509,122	$ 12,051,659
Inefficient Appliance	Install New Appliance	0.44	$ 7,760,387	$ 3,414,570
Inefficient Lighting	Install New Lighting	4.65	$ 7,118,992	$ 7,118,992
INDUSTRIAL				
Inefficient Machine Drive	Install New Machine Drive	2.97	$ 5,118,384	$ 5,118,384
Inefficient HVAC	Install New HVAC	2.98	$ 888,105	$ 888,105
Inefficient Lighting	Install New Lighting	9.86	$ 209,864	$ 209,864

4.7 DSM LOAD IMPACT

The DSM programs evaluated above served as the basis for determining the level of DSM economically achievable in Columbia. The scenario depicted below assumes that all of the DSM options developed would be implemented in Columbia and that CWL would only pay for a portion of the program costs. This scenario also assumes that each residential single family home DSM option would have a market penetration rate equivalent to those provided in the Saturation Study. The residential rental apartments and rental duplexes would have market penetration rates equal to zero due to the fact they have no incentive to invest in energy efficient upgrades. This scenario also assumes that all of the Commercial/Industrial programs achieve 100 percent penetration over a 15 year period.

As an example, the "add refrigerant" option has a maximum theoretical peak load reduction of 606 kW. If CWL were only to fund a portion of the program's cost, then the market penetration rate, as determined in the Saturation Study, would be approximately 3.02 percent per year. This means that it would take approximately 30 years for all existing CWL single family home customers to properly charge the refrigerant in their air conditioning systems. This methodology was carried out for each of the DSM options for the single family homes, duplexes, apartments, commercial and industrial customers to arrive at a total DSM Impact. A summary of the DSM impact for each of the customer categories is presented in Figure 4-5. The details leading up to these results are provided in Appendix D.

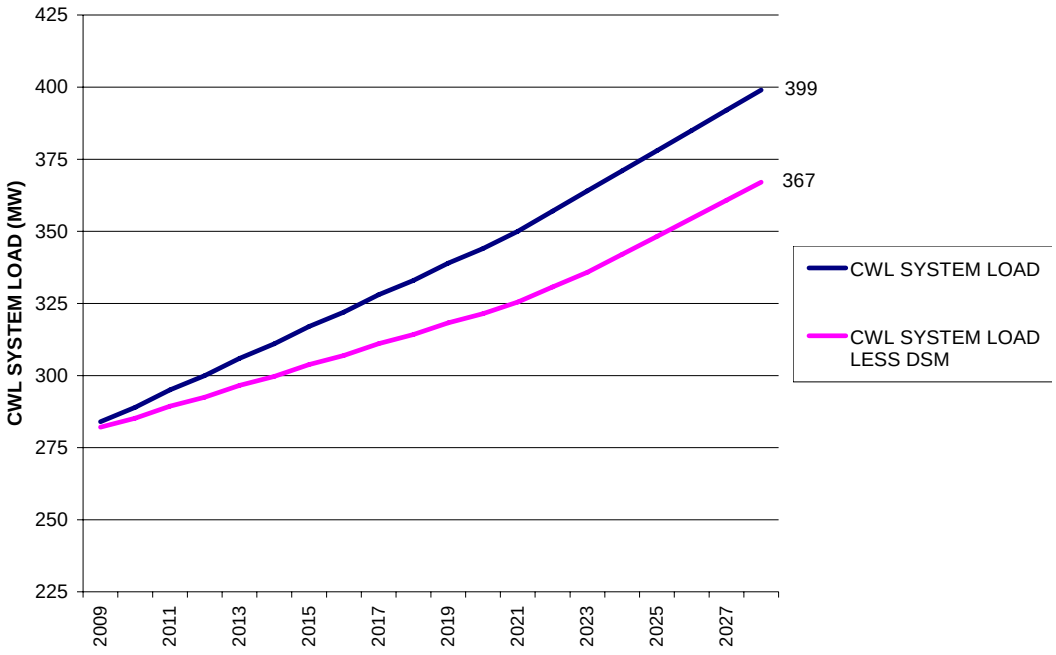
Figure 4-5: Total Estimated DSM Impact



4.7.1 CWL System DSM Impact

DSM's impact on the CWL system load forecast is presented below in Figure 4-6. This scenario is like the current industry approach which would involve CWL paying for a portion of the DSM program costs for all DSM options listed in Table 4-15. As a result, the DSM impacts take longer to penetrate the CWL system.

Figure 4-6: CWL System DSM Impact



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SECTION 5.0

INTEGRATION ANALYSIS

5.0 INTEGRATION ANALYSIS

5.1 PROCESS DESCRIPTION OF STRATEGIST ANALYSIS

5.1.1 Base Case

The base case integration analysis used the supply and demand side options as developed in Sections 3 and 4, respectively. The first step in the integration analysis was to perform an optimization run selecting from only supply side resources. This was done in order to establish a benchmark net present value of production costs that can then be compared to an optimization run that selects from both supply and demand side options. The analysis in the base case was performed with no costs for carbon regulations included. The supply and demand side options were provided to Strategist for determination of how much of each option to take and when the option should be installed. Assumptions for the analysis are included in Appendix A.

The demand side management portfolios that were developed and included in the integrated analyses are presented in Table 5-1. The options were grouped into portfolios of 10 based on their individual benefit / cost ratios. The 10 programs resulting with the greatest portfolio benefit / cost ratio were selected and grouped into Portfolio A which has a Utility Test benefit cost ratio of 16.63. The next 10 best programs were then selected and grouped into Portfolio B which has a benefit cost ratio of 7.68. This same process was repeated for Portfolio C which had a benefit cost ratio of 3.62. The remaining options were also grouped and loaded into various portfolios; however they did not have a portfolio Utility Test benefit cost ratio greater than 1.0. Each of the remaining six DSM programs were evaluated in the integrated analysis on an individual basis.

Table 5-1: Integrated Analysis DSM Portfolio Definition

	Potential Situation	Improvement
Portfolio A		
1.0	Low Evaporator Airflow B	Increase blower speed
2.0	Refrigerator early retirement	Purchase Energy Star Refrigerator
3.0	Oversized AC Units B (Replace)	Size AC units to 100% of Manual J
4.0	Inefficient Industrial Lighting	Install New Industrial Lighting
5.0	Phantom Electric Loads	Install Power Strips with Auto Shutoff
6.0	Inefficient Commercial Lighting	Install New Commercial Lighting
7.0	Single Pane Window B	Install Low E double pane window 2904
8.0	No low flow shower heads	Install low flow shower heads
9.0	NO E&W Window Shading A	Add solar screens to E&W sides
10.0	House infiltration = 0.8 ACH	Reduce infiltration to 0.35 ACH
Portfolio B		
1.0	AC Refrigerant over charged	Remove refrigerant
2.0	No Compact Florescent Lamps	Use 3 more CFLs throughout the house
3.0	AC Refrigerant under charged	Add refrigerant
4.0	Electric water heater not wrapped	Wrap electric water heater
5.0	Inefficient Industrial HVAC	Install New Industrial HVAC
6.0	Inefficient Industrial Machine Drive	Install New Industrial Machine Drive
7.0	No programmable thermostat	Install New programmable thermostat
8.0	Oversized AC Units A (New)	Size AC units to 100% of Manual J
9.0	Low Evaporator Airflow A	Increase duct sizes or add new ducts
10.0	Home has 13 SEER Heat Pump	Install Heat Pump SEER = 16
Portfolio C		
1.0	High Duct Leakage (25%)	Reduce duct leakage to 5%
2.0	Exterior Lighting Replacement	Install Solar Powered Lights
3.0	Attic Insulation = R-11	Add another R-19 attic insulation
4.0	Dishwasher to be replaced	Purchase Energy Star dishwasher
5.0	Inefficient Commercial HVAC	Install New Commercial HVAC
6.0	Home has electric strip heat	Install Heat Pump SEER = 16
7.0	Gas Heat and 13 SEER AC	Install AC SEER = 16
8.0	Exposed Walls not insulated	Add R-11 wall insulation
9.0	Clothes washer to be replaced	Purchase Energy Star clothes washer
10.0	One Inch insul. On ducts in attic	Add two more inches of insulation

5.1.2 CO_2 Cap and Trade Case

The CO_2 cap and trade case for integration was established the same as for the base case. The difference between the two cases was to include an escalating $30 per ton charge for carbon emissions, starting in 2015. The approach to modeling the carbon regulations was to use the future as proposed in the America's Climate Security Act of 2007, commonly referred to as the Lieberman-Warner Bill (Bill). The Bill is assumed to become law with regulation of carbon emissions taking effect in 2015. In 2015, a utility would have credits for 40 percent of its carbon emissions provided free under the Bill. The remaining 60 percent would be procured from the "market" at $30 per ton. The amount of free credits declines to zero in 2031 at a consistent annual rate. The estimated carbon cost increases at the rate of

inflation (3 percent). The assumptions for free credits available to CWL as well as the cost to buy additional carbon allowances throughout the study period can be found in Appendix A.

The same portfolios (Portfolio A, B, and C) of DSM programs that was used in the base case integrated analysis was also used in the CO_2 cap and trade case.

5.2 BOUNDARY CONDITIONS

5.2.1 Supply Options

The general boundary conditions for the supply side options modeled in Strategist for use in the final integration analysis include the following:

1. An unlimited amount of market capacity may be purchased in any year in order to meet a reserve margin requirement of 14 percent over the entire study period. Market capacity was purchased at a rate of $5/kW-yr (2008$) escalated at 3 percent per year.
2. It was assumed that CWL would pursue one CHP project (5 MW) that would be commercially available starting in 2011.
3. Besides market capacity and the CHP project, supply options available for resource selection in the final integration analysis was limited to wind, Wartsila engines, remote participation in a SCPC facility, or repowering the local power plant with a boiler capable of burning biomass fuels.
4. The wind supply option was available for selection in 50 MW increments starting in 2010 with no more than four projects (200 MW) available for selection over the study period.
5. The Wartsila engines supply option was available for selection in 16.8 MW (two engine) increments starting in 2011 with no more than nine projects (150 MW or 18 engines) available for selection over the study period.
6. The remote SCPC supply option was available for selection in 25 MW increments starting in 2015 with no more than four projects (100 MW) available for selection over the study period.
7. The Biomass repower supply option was available for selection as a single 73.5 MW project starting in 2015 with no more than one project available for selection over the study period.

The project costs, operating characteristics, and general study assumptions for all supply options used in this Study can be found in Appendix A.

5.2.2 Demand Side Management Options

For the integration analysis, Burns & McDonnell utilized the options developed and presented in Section 4 of this report. This included multiple residential, commercial, and industrial DSM options. The per unit cost, energy savings, and demand savings of each option were loaded into Strategist and were evaluated along with the supply side options described previously. These options, upon being selected in the resource optimization analysis, would then theoretically be implemented and included in the optimal resource plan.

The general boundary conditions for the DSM options modeled in Strategist for use in the final integration analysis include the following:

1. FY 2009 is the first possible year of program implementation
2. DSM programs would be implemented over a 10 year period
3. DSM programs are assumed to have penetration rates based on the Saturation Study
4. DSM programs' energy and demand savings will remain constant after the 10 year period
5. DSM programs' per unit utility cost or "incentive payment" escalates 3 percent annually
6. The utility's costs included for each option are the costs that CWL would pay for an improvement. This utility cost is what is included as the cost in the Utility Test screening analysis and is the basis for selecting the best portfolio of DSM programs. The benefits included in the Utility Test screening are the power supply production cost savings to CWL.
7. CWL's existing residential/commercial load management program was included starting in 2008 to determine the peak benefits of the program. The assumptions used to develop the characteristics of this direct load control (DLC) program can be found in Appendix E.

The characteristics and definition of all DSM programs evaluated in this Study can be found in Appendix E.

5.3 BASE CASE RESULTS

5.3.1 Supply Side Only Analysis

As described previously, the integration process requires a production cost benchmark to compare integrated resource portfolios against. After incorporating all of the updated assumptions and supply option boundaries, an optimal supply only resource portfolio over the study period was created and is shown compared to the optimal integrated resource portfolio in Table 5-2. Detailed production cost results for each of the integrated analysis runs can be found in Appendix G.

5.3.2 Integrated Analysis

After establishing the supply only benchmark, the supply and DSM options were evaluated together to create an integrated resource selection portfolio. The demand side management options selected in the integration consisted of various residential, commercial and industrial options. Options were selected and then included in portfolios based on their respective benefit / cost ratios. The portfolios were developed in order to group several DSM programs with a net benefit / cost ratio of greater than one together. It was assumed that DSM programs in a portfolio with a benefit / cost ratio of greater than one would likely be selected either individually or within the defined portfolio. In this manner, 30 of the 37 individual DSM programs were grouped into three different portfolios of 10 programs each. The portfolio building process was optimized through Strategist with the portfolios ranked based on the portfolio benefit / cost ratio. This approach was necessary due to the fact that Strategist combines thousands of various supply side and demand side combinations in order to determine which combination has the lowest overall net present value production cost, and there were too many DSM programs to evaluate each one individually.

Table 5-2: Base Case Supply Only and Integrated Portfolio Comparison

Case:	Supply Only Resource (MW)	Integrated Resource (MW)
2008		Load Management[1]
2009	Market(1)	DSM Portfolio A[1]
		DSM Portfolio B[1]
		DSM Portfolio C[1]
2010		
2011	Wartsila(17)	Wartsila(17)
	CHP(5)	CHP(5)
	Market(36)	Market(16)
2012	Market(42)	Market(19)
2013		
2014		
2015	SCPC(25)	SCPC(25)
	Wartsila(17)	
2016	Market(5)	
2017	Market(11)	
2018	Wartsila(17)	
2019	Market(6)	Market(4)
2020	Market(11)	Market(9)
2021	Market(17)	Wartsila(17)
2022	Market(20)	Market(1)
2023	Market(28)	Market(9)
2024	Market(35)	Market(16)
2025	Market(43)	Market(24)
2026	Market(50)	Market(31)
2027	Market(58)	Market(39)
20-Year NPV @ 5.5%:	$1,229,845	$1,187,254
20-Year CO2 Emission[2] Total (Tons):	22,587,409	22,012,456

[1]DSM program has varying peak characteristics over time.
[2]Total CO_2 emissions include theoretical market emissions.

Figure 5-1 shows the impact of the selected DSM programs on the base peak demand forecast. The impacts are shown as a band to reflect the uncertainty associated with demand reduction accruing from existing programs that may already be present in the CWL forecast. Figure 5-2 shows the BLR for the lowest cost resource portfolio.

Figure 5-1: Base Demand Forecast Impact From Selected DSM Programs

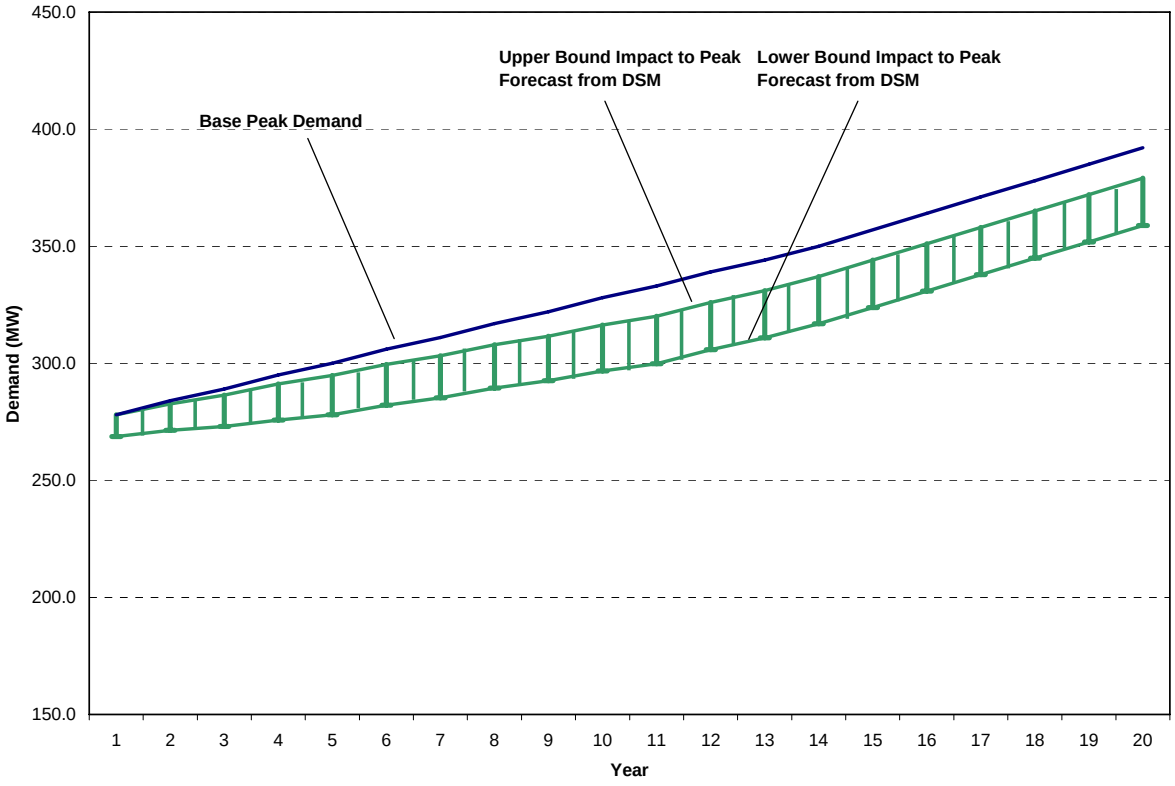
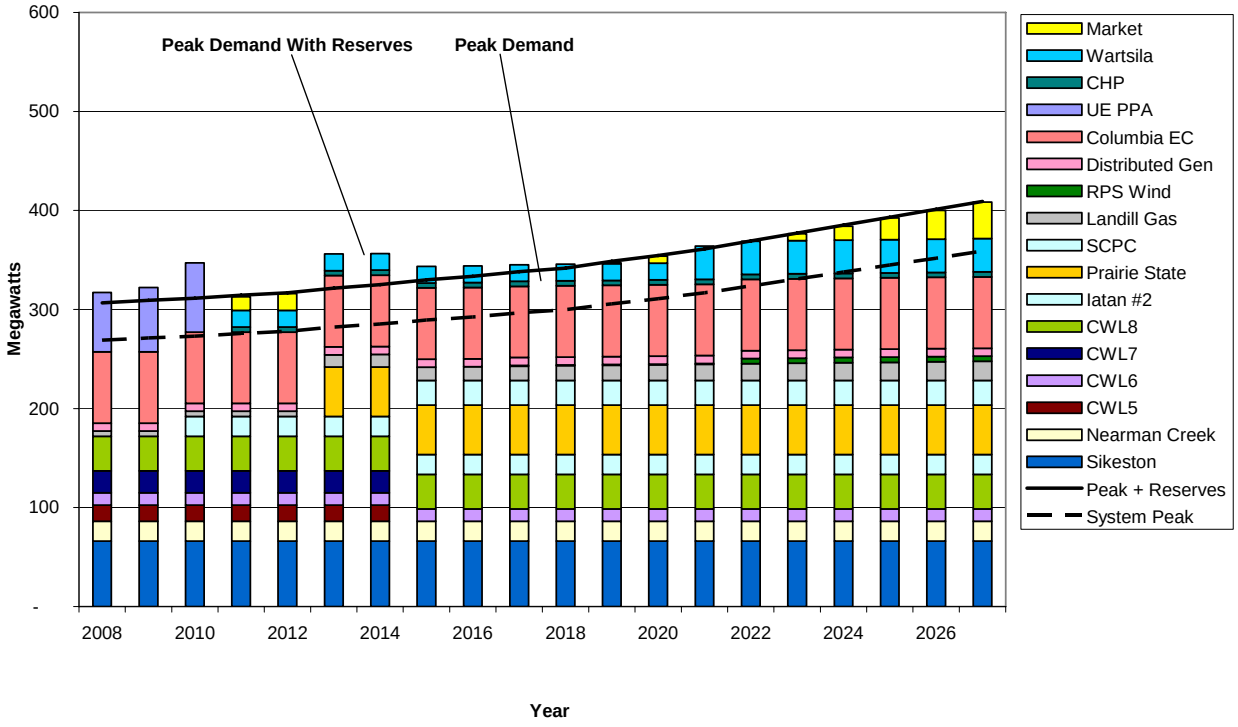


Figure 5-2: Base Case BLR Based on Integrated Portfolio, 2008-2027[1]



[1]BLR based on lower bound for DSM impacts.

5.4 CO_2 CAP AND TRADE CASE RESULTS

5.4.1 Supply Side Only Analysis

As described previously, the integration process requires a production cost benchmark to compare integrated resource portfolios against. All of the updated assumptions and supply option boundaries, as well as the carbon cost parameters as determined through interpretation of the Bill were incorporated in the supply only optimization for the cap and trade sensitivity case. The resulting optimal supply only resource portfolio over the study period is shown compared to the optimal integrated resource portfolio in Table 5-3.

5.4.2 Integrated Analysis

As was done in the Base Case analysis, after establishing the supply only benchmark, supply and DSM options were evaluated together to create an integrated resource selection portfolio. Under the CO_2 Cap and Trade Case, the optimal resource selection portfolio contained the same mixture of DSM programs, Portfolios A, B, and C as well as the Load Management program, with none of the other individual DSM programs selected. In addition to the DSM programs, supply resources selected included market capacity,

Wartsila engines, and 200 MW of wind spread out over several years of the study period. A comparison of the optimal resource portfolios for the supply only and integrated cases under the CO_2 Cap and Trade Scenario is shown in Table 5-3.

Table 5-3: CO_2 Cap and Trade Case Supply Only and Integrated Portfolio Comparison

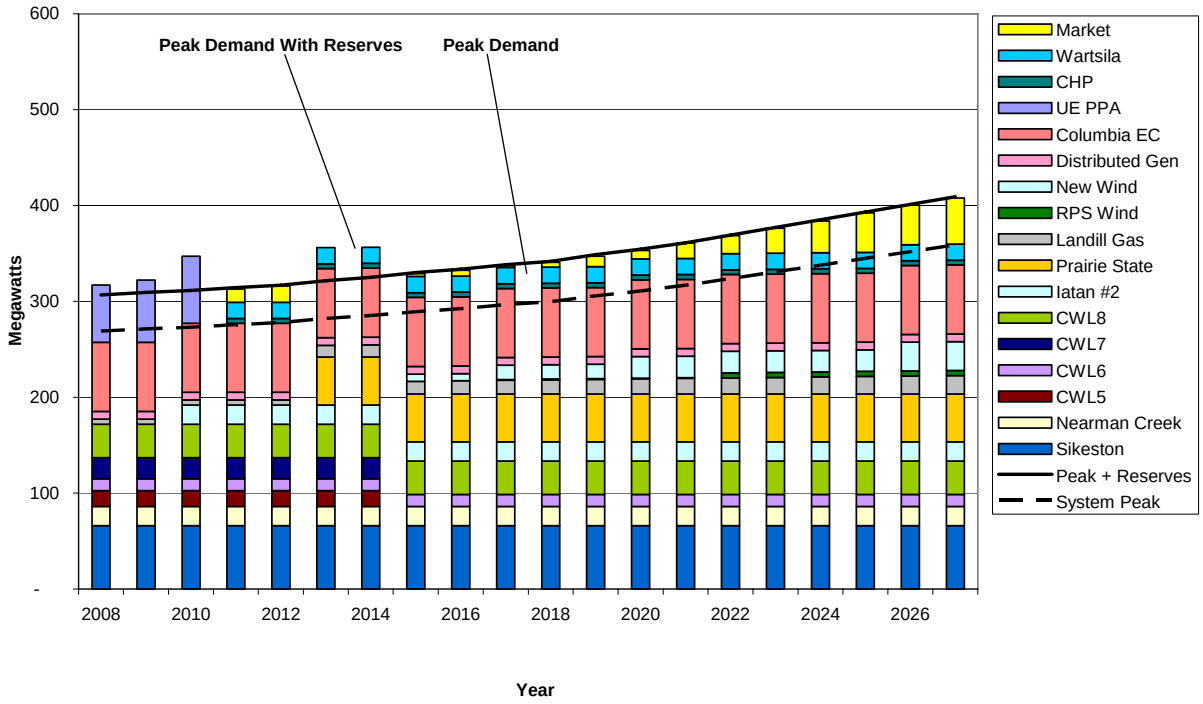
Case:	Supply Only Resource (MW)	Integrated Resource (MW)
2008		Load Management[1]
2009	Market(1)	DSM Portfolio A[1]
		DSM Portfolio B[1]
		DSM Portfolio C[1]
2010		
2011	Wartsila(17)	Wartsila(17)
	CHP(5)	CHP(5)
	Market(36)	Market(16)
2012	Market(42)	Market(19)
2013		
2014		
2015	Wartsila(17)	WIND(50)
	WIND(50)	Market(5)
	Market(18)	
2016	Market(23)	Market(8)
2017	WIND(50)	WIND(50)
	Market(21)	Market(4)
2018	Market(26)	Market(7)
2019	Market(32)	Market(14)
2020	WIND(50)	WIND(50)
	Market(30)	Market(11)
2021	Market(37)	Market(18)
2022	Market(40)	Market(21)
2023	Market(47)	Market(28)
2024	Market(54)	Market(35)
2025	Market(62)	Market(43)
2026	WIND(50)	WIND(50)
	Market(62)	Market(43)
2027	Market(70)	Market(51)
20-Year NPV @ 5.5%:	$1,419,511	$1,369,104
20-Year CO2 Emission[2] Total (Tons):	17,361,060	16,658,524

[1]DSM program has varying peak characteristics over time.
[2]Total CO_2 emissions include theoretical market emissions.

Because the same DSM programs are selected in the integrated CO_2 Cap and Trade Case as in the integrated Base Case, the impact of the selected DSM programs on the base peak demand forecast is the

same as that shown in Figure 5-1. Figure 5-3 shows the BLR for the lowest cost resource portfolio in the CO_2 Cap and Trade Case.

Figure 5-3: CO_2 Case BLR Based on Integrated Portfolio, 2008-2027[1]



[1]BLR based on lower bound for DSM impacts.

5.5 CONCLUSIONS

Burns & McDonnell has reviewed the information provided by CWL on its existing system and expected changes. Based on the analysis of the current and expected load requirements of CWL, its available resources and potential impacts on the amount of capacity available to CWL, and the issues affecting the utility industry, Burns & McDonnell has developed the following conclusions.

5.5.1 Supply Side Conclusions

1. Considering the existing load forecast provided by CWL, significant capacity deficits will occur in 2012 and grow to approximately 145MW in 2027 assuming the Units 5 and 7 at the local power plant are retired and expected new resources are available as anticipated herein.
2. CWL has 70MW of base load resources coming on line between 2010 and 2013 from the Iatan Unit II and Prairie State. These are coal based resources. When these units come on line, CWL will be in an approximate energy balance between its peak, intermediate and base load resources.

With the current mix of resources, the load forecast, and the assumptions used in the Base future analysis, base load energy is not needed until approximately 2015.

3. The current capital and fuel costs for all types of traditional fossil and nuclear generating resources are increasing. In addition, legislation regulating carbon emissions is anticipated to occur during the next few years which will further impact the cost of electricity produced by units fired on fossil fuels. CWL has approximately five years to observe how these issues unfold before needing to make a final decision on its next base load resource.
4. There are advances being made in renewable energy resources that are reducing the rate of escalation of their average energy costs. Advances in research in solar, wind, small hydro and biomass generation options are occurring with the continuing increases in average energy costs from traditional resources. These advances will increase the locations that are found to be economically viable for renewable options.
5. CWL's participation in the MISO market reduces the concern of being able to participate in remote projects (either renewable or traditional) and have the transmission capacity available to deliver the energy for the benefit of CWL customers.
6. Only supply side resources of reciprocating engines, wind and market capacity and energy are selected in the future with a projected cost of $30 per ton of carbon credit cost and a carbon regulation program beginning in 2015.
7. CWL has been approached by parties interested in developing biomass fuels. CWL has an opportunity to repower units at its local power plant using an approximately 73MW boiler that could be designed to use a substantial quantity of biomass fuel. It may be possible for CWL to develop a joint project with other utilities in the state and reserve a portion of the biomass capacity for its use. Participation by others could be through equity participation or through long term power purchase agreements.
8. Although nuclear energy is potentially reappearing as a resource option, there are no specific options for consideration by CWL. Should a real option present itself, it is not likely that the commercial date will be before 2020. CWL would have time during its next update of the integrated resource plan for consideration should such a nuclear option present itself.
9. The delivery capability of the transmission system used by CWL in the immediate area could be improved. This would increase the firm import capability across Associated and Ameren's systems.

5.5.2 Demand Side Conclusions

1. The projections of supply side resource costs results in the selection of numerous demand side options prior to the selection of supply side resources.
2. Pursuit of current and additional DSM programs can reduce the amount of demand and energy forecast to be required by the customers of CWL. Programs reviewed in this study have projected demand reductions from the existing forecast of approximately 5 to 10 percent over the next ten years.
3. Without more stringent building code standards, it will be difficult for CWL to see significant changes in the future average demand and energy required for residential and commercial buildings. Continuation of current standards will also continue the approach whereby CWL is constantly trying to entice owners of buildings that were constructed to lower standards to increase their efficiency. Retrofit costs are almost always more costly than incorporating efficiency into the initial construction.
4. Current appliance efficiency standards are expected to, over time, provide a natural increase in the efficiency of existing appliances installed on the CWL system. These benefits have not been directly incorporated into the reductions of demand and energy projections.
5. Demand reductions through load control have been found beneficial to CWL. The primary device for load control on the CWL system is the central air conditioner. The mandated efficiency improvements to higher SEER units will gradually increase the number of dual compressor units to be controlled on the system. Burns & McDonnell is not aware of studies that have reviewed the impacts, if any, of the average kW per point reductions seen from controlling dual compressor units versus the older single compressor units. Therefore, the assumptions for ongoing benefits of direct load control may not apply for these type units.
6. Time of use pricing allows customers to make better economic decisions regarding demand side management investments, renewable energy deployment, energy storage devices, and energy consumption throughout the day than average rate pricing. As a member of MISO, CWL has a ready access to the price of energy at its city gate as it varies throughout the day.

5.6 RECOMMENDATIONS

Based on the above conclusions, the analysis of CWL's system and Burns & McDonnell knowledge of the electric utility industry, the following recommendations are offered to CWL for consideration. Burns & McDonnell recommends that CWL should:

1. Pursue the future outlined in the regulated carbon future with DSM. The cost for this future is not significantly different than a future without carbon legislation in the first several years. Should carbon regulation not be legislated, then CWL could move to the lower evaluated cost power supply futures without carbon regulation.
2. Work with the City to improve building code standards for commercial and residential structures that have a minimum energy consumption goal of an Energy Star rating. Programs to encourage higher Energy Star ratings should be developed. The information provided in Appendix F can be used to establish the Energy Star levels, rebate levels, modeling analysis and submittal process to CWL.
3. Implement the demand side management programs as outlined in Appendix E. Add staff as necessary at CWL to aggressively pursue these programs and work through the existing building stock over the next ten years. Increase the data gathering for end use inventories, ages of appliances, use per consumer, and other information needed to refine the evaluation of DSM programs through energy audits on the majority of existing residential and commercial facilities. Increase the verification process for the programs to make sure they are on track to meet the projected demand and energy reductions.
4. Develop a pilot for measuring the effects of controlling dual compressor air conditioners. Compare the results with the expected results as measured in the past by CWL and as assumed in this analysis. If necessary, adjust the load control program in accordance with the results.
5. Continue its aggressive pursuit of demand side involvement by the deployment of time of use metering and pricing structure to customers. The MISO pricing for CWL can be used to provide day ahead hourly price signals. This will allow the most valid economic basis for decisions to be made regarding renewable and demand side investments by consumers and CWL. Industrial and commercial customers should be the first to be moved to time of use pricing followed by residential. This metering can also be used in the further deployment of a Smart Grid.
6. Continue to balance the costs of market capacity and energy versus the cost of installing and operating the reciprocating engines reviewed in this study. Prepare in early 2010 to install two engine sets of approximately 8MW each for a commercial operating date of 2012 should the economics reviewed herein remain as studied. Site selection, permitting, design and construction can be done within a 12 to 18 month period. Engine delivery is the largest unknown due to the demand for this type of resource. Current deliveries are at two years from the date of commitment.
7. Determine if there is sufficient interest from other utilities in the state to develop the biomass repowering project at CWL's local power plant. Should the renewable referendum being

considered by Missouri become law, this type of option could hold significant benefit for other Missouri utilities.

8. Acquire additional wind energy (or equivalent priced other renewable energy) in the quantities and on the time line as shown in the regulated carbon future with DSM.
9. Pursue the transmission projects with AECI necessary to improve the firm import capability.
10. Update the integrated resource plan in 2012 to 2013 This should be sufficient time to determine the success of the demand side programs, have better clarity about the legislation regarding carbon and more knowledge about the advances in renewable energy technologies.

* * * * *

APPENDIX A

STUDY ASSUMPTIONS

Assumptions for Production Cost Modeling

General Assumptions

- 20-year Net Present Value of incremental production expenses to serve native load: January 2008 to December 2027 time frame, NPV in 2008 dollars
- Required reserve margin: 14 percent

Financial Assumptions

- Interest Rate: 5.5 percent
- Discount Rate: 5.5 percent
- General Inflation/O&M Escalation Rate: 3.0 percent

Existing DSM Programs & CWL Estimates of Results

Educational:	Savings:
Peak Warning……..	1-2 MW When Imp.
Energy Challenge……	250 kWh Per Student / yr
"Energy Guy"…..……	50,000 kWh per year
Calendar Contest…..……..	10,000 kWh per year
Promotional Displays / Trade Shows and Saturday Science	

Industrial Programs:	Savings:
Energy Audits……..	800,000 kWh/yr
Infrared Scans	
Ultrasonic Leak Detection	
Energy Conservation Loans……	*
Load Shedding……..	8 MW at Peak
Interruptible Program……	2 MW at Peak
Lighting Incentive……..	200.3 kW
PV Rebates……	*

* No customer usage yet

Commercial:	Savings:
Energy Audits……..	150,000 kWh/yr
AC Rebates……..	*
Solar Hot Water Rebate……	*
Load Management……..	1.75 MW at Peak
Super Saver Loan……	*
Lighting Incentive……	157.54 kW
Building Operator Certification Program..	5,676,000 kWh/yr
PV Rebates……..	*

Residential Programs:	Savings:
Energy Audits……	377,600 kWh Total
AC Rebates……	56,103 kWh/yr
Solar Domestic Hot Water Rebate…….	3,600 kWh/yr
Load Management……	5.25 MW at Peak
Super Saver Loan……	121,800 kWh/yr
Change a Light……..	3,585,943 kWh/yr
Tree Power……..	320 kW at Peak
Home Performance Energy Star (In Dev).	*
PV Rebates……	*

Demand and Energy Assumptions

CWL provided a Low, Normal, and High forecast for Demand and Energy. The Normal forecast was used in this Study and is shown below.

	Demand (MW)	Energy (GWh)
2008	278	1,221
2009	284	1,244
2010	289	1,266
2011	295	1,292
2012	300	1,318
2013	306	1,340

2014	311	1,362
2015	317	1,388
2016	322	1,414
2017	328	1,437
2018	333	1,459
2019	339	1,485
2020	344	1,511
2021	350	1,533
2022	357	1,563
2023	364	1,594
2024	371	1,629
2025	378	1,656
2026	385	1,686
2027	392	1,717
2028	399	1,752

Market Forecast Assumptions

- ✓ One year historical hourly market prices covering the period from January 2007 – December 2007 from MISO CWLD.CWLD Node
- ✓ Seasonal market prices entered in 2007$ as follows:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
OffPeak	$26.52	$46.30	$32.46	$34.52	$28.59	$28.89	$30.06	$34.12	$25.58	$28.72	$26.53	$34.79
OnPeak	$47.86	$67.00	$55.51	$61.98	$67.80	$62.28	$56.03	$74.22	$49.54	$55.23	$55.78	$52.53

- ✓ Annual escalation follows EIA gas forecast annual escalation:

Year	Escalation	Year	Escalation
2008	11.37%	2018	3.54%
2009	4.92%	2019	3.22%
2010	1.01%	2020	3.61%
2011	5.20%	2021	1.69%
2012	5.82%	2022	1.47%
2013	5.13%	2023	0.70%
2014	3.60%	2024	1.16%
2015	6.55%	2025	1.07%
2016	4.15%	2026	1.02%
2017	1.75%	2027	1.08%

- ✓ For updated market forecast used in the final integration, 2008 prices were escalated 25% from the seasonal 2007$ shown and then follow the same yearly escalation as shown in the previous table

Emission Allowance Cost Assumptions

- ✓ Assumed cost per ton (or ounce for Hg) for criteria pollutants during study period

Year	Hg ($/Ounce)	Annual NOx ($/Ton)	SO2 ($/Ton)
2007			$547
2008			$701
2009		$1,842	$900
2010	$609	$1,901	$1,156
2011	$636	$1,965	$1,486
2012	$663	$2,110	$1,675
2013	$745	$2,374	$1,885
2014	$811	$2,584	$2,051
2015	$883	$2,813	$2,232
2016	$930	$2,962	$2,351
2017	$1,012	$3,223	$2,558
2018	$1,101	$3,508	$2,784
2019	$1,198	$3,817	$3,029
2020	$1,304	$4,153	$3,296
2021	$1,420	$3,790	$3,581
2022	$1,546	$3,459	$3,891
2023	$1,684	$3,157	$4,228
2024	$1,833	$2,881	$4,595
2025	$1,996	$2,629	$4,992

- ✓ Annual NOx allowance price includes seasonal Ozone NOx
- ✓ Allowances for CO_2 in the cap and trade sensitivity were based on 2008 emissions of 605,449 tons of CO_2
- ✓ The following are the allowances distributed by year, and allowance cost by year (starting in 2015) assumed for carbon emissions in the cap and trade sensitivity

Study Year	% Free	Free Allowances	Allowance Cost ($/Ton)
2015	40%	242,179	$30.00
2016	40%	242,179	$30.90
2017	40%	242,179	$31.83
2018	38%	229,433	$32.78
2019	36%	216,687	$33.77
2020	34%	203,941	$34.78
2021	29%	178,448	$35.82
2022	27%	165,702	$36.90
2023	25%	152,955	$38.00
2024	23%	140,209	$39.14
2025	21%	127,463	$40.32
2026	17%	101,970	$41.53
2027	13%	76,478	$42.77

CWL Existing Resources

Combustion Turbines (Total Capacity of 84.5 MW):

Columbia Power Plant Unit 6 (Model Name: CWL Unit 6):

- ✓ 12.5 MW peaking unit number 6
- ✓ Associated fuel forecast – Natural Gas
- ✓ Heat rate 17,809 Btu/kWh
- ✓ Fixed O&M $121.27/kW-year, 2008$, escalated at inflation
- ✓ Variable O&M $43.67/MWh, 2008$, escalated at inflation

Modeled Emission Rates
NO_X: 0.2451 lbs/MMBtu
SO_2: 0.00053 lbs/MMBtu
CO_2: 119 lbs/MMBtu
Hg: N/A

Columbia Energy Center (Model Name: Columbia Energy Center):

- ✓ 72 MW of peaking capacity at the Columbia Energy Center
- ✓ Associated fuel forecast – Natural Gas
- ✓ Heat rate 12,793 Btu/kWh
- ✓ Fixed O&M $73.01/kW-year, 2008$, escalated at inflation
- ✓ Variable O&M $1.74/MWh, 2008$, escalated at inflation

Modeled Emission Rates
NO_X: 0.039 lbs/MMBtu
SO_2: N/A
CO_2: 118.75 lbs/MMBtu
Hg: N/A

Diesels (Total Capacity of 8 MW):

Diesels - Oil (Model Name: Distributed Generation):

- ✓ 8 MW of fuel oil diesel engine capacity
- ✓ Associated fuel forecast – Distillate Oil
- ✓ Heat rate 8,961 Btu/kWh
- ✓ Fixed O&M Included in VOM
- ✓ Variable O&M $192.95/MWh, 2008$, escalated at inflation

Modeled Emission Rates
NO_X: N/A
SO_2: N/A
CO_2: N/A
Hg: N/A

Baseload and Intermediate Facilities (Total Capacity of 229.5 MW):

Columbia Power Plant Unit 5 (Model Name: CWL Unit 5):

- ✓ 16.5 MW coal-fired unit number 5
- ✓ Associated fuel forecast – Bituminous Coal
- ✓ Heat rate 15,941 Btu/kWh
- ✓ Forced outage rate 100%
- ✓ Fixed O&M $0.00/kW-year, 2008$, escalated at inflation
- ✓ Variable O&M $0.00/MWh, 2008$, escalated at inflation

Modeled Emission Rates
NO_X: N/A
SO_2: N/A
CO_2: N/A
Hg: N/A

Columbia Power Plant Unit 7 (Model Name: CWL Unit 7):

- ✓ 22.0 MW coal-fired unit number 7
- ✓ Associated fuel forecast – Bituminous Coal
- ✓ Heat rate 15,523 Btu/kWh
- ✓ Fixed O&M $68.90/kW-year, 2008$, escalated at inflation
- ✓ Variable O&M $26.52/MWh, 2008$, escalated at inflation

Modeled Emission Rates
NO_X: 0.529 lbs/MMBtu
SO_2: 1.428 lbs/MMBtu
CO_2: 205 lbs/MMBtu
Hg: 8.488 lbs/TBtu

Columbia Power Plant Unit 8 (Model Name: CWL Unit 8):

- ✓ 35 MW gas-fired unit number 8
- ✓ Associated fuel forecast – Natural Gas
- ✓ Heat rate 13,900 Btu/kWh
- ✓ Fixed O&M $10.80/kW-year, 2008$, escalated at inflation
- ✓ Variable O&M $0.94/MWh, 2008$, escalated at inflation

Modeled Emission Rates
NO_X: 0.529 lbs/MMBtu
SO_2: 1.925 lbs/MMBtu
CO_2: 205 lbs/MMBtu
Hg: 8.488 lbs/TBtu

Nearman Creek (Model Name: Nearman Creek):

- ✓ 20.0 MW of capacity at coal-fired unit Nearman Creek facility
- ✓ Associated fuel forecast – N/A (Fuel cost included in VOM)
- ✓ Heat rate 11,084 Btu/kWh
- ✓ Fixed O&M $160.92/kW-year, 2008$, escalated at 4% annually

- ✓ Variable O&M $17.93/MWh, 2008$, escalated at 4% annually

Modeled Emission Rates
NO_X: 0.43 lbs/MMBtu
SO_2: 0.77 lbs/MMBtu
CO_2: 205 lbs/MMBtu
Hg: 3.33 lbs/TBtu

<u>Sikeston (Model Name: Sikeston):</u>
- ✓ 66.0 MW of capacity at coal-fired unit Sikeston facility
- ✓ Associated fuel forecast – N/A (Fuel cost included in VOM)
- ✓ Heat rate 10,120 Btu/kWh
- ✓ Fixed O&M $165.65/kW-year, 2008$, escalated at 5% annually
- ✓ Variable O&M $17.06/MWh, 2008$, escalated at inflation

Modeled Emission Rates
NO_X: 0.22 lbs/MMBtu
SO_2: 0.6 lbs/MMBtu
CO_2: 212 lbs/MMBtu
Hg: 4.282 lbs/TBtu

<u>Iatan 2 (Model Name: Iatan 2):</u>
- ✓ 20.0 MW of capacity at coal-fired unit 2 Iatan facility
- ✓ 2010 COD
- ✓ Associated fuel forecast – N/A (Fuel cost included in VOM)
- ✓ Heat rate 9,200 Btu/kWh
- ✓ Fixed O&M $28.00/kW-year, 2008$, escalated at inflation
  Note: Fixed O&M does NOT include debt service payments
- ✓ Variable O&M $15.00/MWh, 2008$, escalated at inflation

Modeled Emission Rates (These are permit limits, unit not in service)
NO_X: 0.08 lbs/MMBtu
SO_2: 0.09 lbs/MMBtu
CO_2: 289 lbs/MMBtu
Hg: 0.045 lbs/TBtu

<u>Prairie State (Model Name: Prairie State):</u>
- ✓ 50.0 MW of capacity at coal-fired unit Prairie State facility
- ✓ Unit 1-2011 COD
- ✓ Unit 2-2012 COD
- ✓ Associated fuel forecast – Prairie State Fuel
- ✓ Heat rate 9,400 Btu/kWh
- ✓ Fixed O&M $46.19/kW-year, 2008$, escalated at inflation
  Note: Fixed O&M does NOT include debt service payments
- ✓ Variable O&M $5.18/MWh, 2008$, escalated at inflation

Modeled Emission Rates (These are permit limits, unit not in service
NO_X: 0.07 lbs/MMBtu

SO_2: 0.182 lbs/MMBtu
CO_2: 355 lbs/MMBtu
Hg: 2.013 lbs/TBtu

Power Purchase Agreements (Total Capacity varies over Study period):

Union Electric Power Purchase Agreement (Model Name: AmerenUE PPA):

- ✓ 60.0 MW of contract capacity, increased by 5.0 MW increments every June 1 of each year – capped at 70 MW
- ✓ Available for 2008-2011
- ✓ Associated fuel forecast – N/A
- ✓ Heat rate N/A
- ✓ Fixed O&M $10.20/kW-year, 2008$, escalated based on contract terms
- ✓ Variable O&M $49.35/MWh, 2008$, escalated based on contract terms

Modeled Emission Rates
NO_X: N/A
SO_2: N/A
CO_2: N/A
Hg: N/A

Blue Grass Ridge Wind Farm (Model Name: Blue Grass Ridge):

- ✓ 6.3 MW of aggregate wind power
- ✓ Associated fuel forecast – N/A
- ✓ Heat rate N/A
- ✓ Fixed O&M $0.00/kW-year, 2008$, no escalation
- ✓ Variable O&M $68.55/MWh, 2008$, no escalation

Modeled Emission Rates
NO_X: N/A
SO_2: N/A
CO_2: N/A
Hg: N/A

Ameresco and Columbia Landfill Gas (Model Name: Landfill Gas):

- ✓ 5.2 MW of contract capacity
- ✓ Energy provided at ~91% capacity factor annually
- ✓ Associated fuel forecast – N/A
- ✓ Heat rate N/A
- ✓ Fixed O&M $0.00/kW-year, 2008$, no escalation
- ✓ Variable O&M $58.00/MWh, 2008$, no escalation

Modeled Emission Rates
NO_X: N/A
SO_2: N/A
CO_2: N/A
Hg: N/A

Future Landfill Gas (Model Name: RPS Landfill Gas):

- ✓ 7.0 MW of contract capacity, increasing 0.5 MW each year through end of study
- ✓ Available starting in 2013
- ✓ Energy provided at ~91% capacity factor annually
- ✓ Associated fuel forecast – N/A
- ✓ Heat rate N/A
- ✓ Fixed O&M $0.00/kW-year, 2008$, no escalation
- ✓ Variable O&M $60.00/MWh, 2008$, no escalation

Modeled Emission Rates
NO_X: N/A
SO_2: N/A
CO_2: N/A
Hg: N/A

RPS Requirements Wind Generator

- ✓ Nameplate wind capacity to meet RPS requirements based on a typical wind profile with 33% capacity factor
- ✓ Accredited Capacity 15% of nameplate

Wind Generator Nameplate Capacity by case (Model Name: RPS Wind):

Year	Nameplate Capacity	Year	Nameplate Capacity
2008	0	2018	5
2009	0	2019	5
2010	0	2020	5
2011	0	2021	5
2012	0	2022	35
2013	0	2023	35
2014	0	2024	35
2015	0	2025	35
2016	0	2026	35
2017	5	2027	35

CWL Supply Alternatives

Local CFB (Model Name: CFB):

- ✓ 108.5 MW CFB facility at Columbia Power Plant
- ✓ Commercial operation 2015
- ✓ Interim Analysis Capital Cost $3,710/kW, 2015$, escalated at inflation

- ✓ Final Integrated Analysis Capital Cost $4,110/kW, 2015$, escalated at inflation
- ✓ Associated fuel forecast – Bituminous Coal
- ✓ Heat rate 9,646 Btu/kWh
- ✓ Fixed O&M $31.52/kW-year, 2008$, escalated at inflation
- ✓ Variable O&M $3.53/MWh, 2008$, escalated at inflation

Modeled Emission Rates
NO_X: 0.10 lbs/MMBtu
SO_2: 0.04 lbs/MMBtu
CO_2: 214 lbs/MMBtu
Hg: 0.72 lbs/TBtu

<u>Local Biomass (Model Name: Biomass):</u>
- ✓ 73.5 MW CFB repowers Units 5, 7, and 8 at Columbia Power Plant
- ✓ Commercial operation 2015
- ✓ Interim Analysis Capital Cost $2,940/kW, 2015$, escalated at inflation
- ✓ Final Integrated Analysis Capital Cost $2,940/kW, 2015$, escalated at inflation
- ✓ Associated fuel forecast – Bituminous Coal, Biomass TDF (Burn 50/50)
- ✓ Heat rate 11,085 Btu/kWh
- ✓ Fixed O&M $31.52/kW-year, 2008$, escalated at inflation
- ✓ Variable O&M $3.53/MWh, 2008$, escalated at inflation

Modeled Emission Rates
NO_X: 0.11 lbs/MMBtu
SO_2: 0.05 lbs/MMBtu
CO_2: 118 lbs/MMBtu
Hg: 1.89 lbs/TBtu

<u>Local Combined Cycle Facility (Model Name: 7EA CCGT):</u>
- ✓ 125.0 MW combined cycle facility at a greenfield location
- ✓ Commercial operation 2012
- ✓ Interim Analysis Capital Cost $1,740/kW, 2012$, escalated at inflation
- ✓ Final Integrated Analysis Capital Cost $1,740/kW, 2012$, escalated at inflation
- ✓ Associated fuel forecast – Natural Gas
- ✓ Heat rate 7,965 Btu/kWh
- ✓ Fixed O&M $20.60/kW-year, 2008$, escalated at inflation
- ✓ Variable O&M $4.89/MWh, 2008$, escalated at inflation

Modeled Emission Rates
NO_X: 0.007 lbs/MMBtu
SO_2: 0.0051 lbs/MMBtu
CO_2: 118 lbs/MMBtu
Hg: N/A

<u>Local IGCC (Model Name: IGCC):</u>
- ✓ 148 MW IGCC facility at a greenfield location
- ✓ Commercial operation 2015

- ✓ Interim Analysis Capital Cost $2,830/kW, 2015$, escalated at inflation
- ✓ Final Integrated Analysis Capital Cost $3,220/kW, 2015$, escalated at inflation
- ✓ Associated fuel forecast – Bituminous Coal
- ✓ Heat rate 9,300 Btu/kWh
- ✓ Fixed O&M $33.18/kW-year, 2008$, escalated at inflation
- ✓ Variable O&M $5.18/MWh, 2008$, escalated at inflation

Modeled Emission Rates
NO_X: 0.03 lbs/MMBtu
SO_2: 0.016 lbs/MMBtu
CO_2: 205 lbs/MMBtu
Hg: 0.65 lbs/TBtu

<u>Local Simple Cycle Facility (Model Name: FT8):</u>
- ✓ 54.8 MW FT8 simple cycle facility at a greenfield location
- ✓ Commercial operation 2011
- ✓ Interim Analysis Capital Cost $850/kW, 2011$, escalated at inflation
- ✓ Final Integrated Analysis Capital Cost $1,057/kW, 2011$, escalated at inflation
- ✓ Associated fuel forecast – Natural Gas
- ✓ Heat rate 10,346 Btu/kWh
- ✓ Fixed O&M $12.50/kW-year, 2008$, escalated at inflation
- ✓ Variable O&M $1.53/MWh, 2008$, escalated at inflation

Modeled Emission Rates
NO_X: 0.10 lbs/MMBtu
SO_2: 0.0051 lbs/MMBtu
CO_2: 133 lbs/MMBtu
Hg: N/A

<u>Local Simple Cycle Facility (Model Name: Wartsila):</u>
- ✓ 8.4 MW Wartsila engine at a greenfield location
- ✓ Commercial operation 2011
- ✓ Interim Analysis Capital Cost $950/kW, 2011$, escalated at inflation
- ✓ Final Integrated Analysis Capital Cost $1,155/kW, 2011$, escalated at inflation
- ✓ Associated fuel forecast – Natural Gas
- ✓ Heat rate 8,642 Btu/kWh
- ✓ Fixed O&M $8.08/kW-year, 2008$, escalated at inflation
- ✓ Variable O&M $8.18/MWh, 2008$, escalated at inflation

Modeled Emission Rates
NO_X: 0.02 lbs/MMBtu
SO_2: 0.0051 lbs/MMBtu
CO_2: 125 lbs/MMBtu
Hg: N/A

<u>Remote Unit Participation (Model Name: SCPC):</u>
- ✓ 25 MW of coal-fired SCPC capacity at a remote greenfield location

- ✓ Commercial operation 2015
- ✓ Interim Analysis Capital Cost $3,340/kW, 2015$, escalated at inflation
- ✓ Final Integrated Analysis Capital Cost $3,650/kW, 2015$, escalated at inflation
- ✓ Associated fuel forecast – PRB Coal
- ✓ Heat rate 8,980 Btu/kWh
- ✓ Fixed O&M $36.05/kW-year, 2008$, escalated at inflation
- ✓ Variable O&M $7.91/MWh, 2008$, escalated at inflation
- ✓ Transmission Cost $6.00/MWh, 2008$ plus 8 percent losses

Modeled Emission Rates
NO_X: 0.04 lbs/MMBtu
SO_2: 0.03 lbs/MMBtu
CO_2: 216 lbs/MMBtu
Hg: 0.72 lbs/TBtu

<u>Combined Heat and Power (Model Name: CHP):</u>
- ✓ 5 MW of gas-fired CHP at a local site
- ✓ Commercial operation 2011
- ✓ Interim Analysis Capital Cost $1,880/kW, 2011$, escalated at inflation
- ✓ Final Integrated Analysis Capital Cost $1,880/kW, 2011$, escalated at inflation
- ✓ Associated fuel forecast – Natural Gas
- ✓ Heat rate 5,500 Btu/kWh
- ✓ Fixed O&M $0.00/kW-year, 2008$, escalated at inflation
- ✓ Variable O&M $15.45/MWh, 2008$, escalated at inflation

Modeled Emission Rates
NO_X: N/A
SO_2: N/A
CO_2: N/A
Hg: N/A

<u>Market Capacity (Model Name: Mkt Purchase):</u>
- ✓ Variable capacity only unit for reserve requirement needs
- ✓ Commercial operation 2008-2027, 1 year contracts
- ✓ Associated fuel forecast – N/A
- ✓ Heat rate N/A
- ✓ Fixed O&M $60.00/kW-year, 2008$, escalated at inflation
- ✓ Variable O&M $0.00/MWh, 2008$, escalated at inflation

Modeled Emission Rates
NO_X: N/A
SO_2: N/A
CO_2: N/A
Hg: N/A

<u>New Wind (Model Name: Wind):</u>
- ✓ 50 MW increments of new wind generation at a remote location

- ✓ Commercial operation 2010
- ✓ Associated fuel forecast – N/A
- ✓ Fixed O&M $0.00/kW-year, 2008$, escalated at inflation
- ✓ Variable O&M $68.55/MWh, 2008$, escalated at inflation

Modeled Emission Rates
NO_X: N/A
SO_2: N/A
CO_2: N/A
Hg: N/A

<u>Solar Power (Model Name: Solar):</u>
- ✓ 10 MW of solar photovoltaic power at a local site
- ✓ Commercial operation 2009
- ✓ Capital Cost $4,000/kW, 2009$, escalated at inflation
- ✓ Associated fuel forecast – N/A
- ✓ Fixed O&M $0.00/kW-year, 2008$, escalated at inflation
- ✓ Variable O&M $0.00/MWh, 2008$, escalated at inflation

Modeled Emission Rates
NO_X: N/A
SO_2: N/A
CO_2: N/A
Hg: N/A

<u>Pumped Storage Hydro (Model Name: Pumped Storage):</u>
- ✓ 60 MW of pumped storage
- ✓ Commercial operation 2015
- ✓ Capital Cost $4,740/kW, 2015$, escalated at inflation
- ✓ Associated fuel forecast – N/A
- ✓ Fixed O&M $6.18/kW-year, 2008$, escalated at inflation
- ✓ Variable O&M at cost of spot market to pump water from lower reservoir to upper reservoir

Modeled Emission Rates
NO_X: N/A
SO_2: N/A
CO_2: N/A
Hg: N/A

Escalations & Fuel Forecasts

- ✓ PRB Coal price of $1.79/MMBtu, 2008$, escalated at 2.0% annually in Interim Analysis, 2.8% annually in Final Integrated Analysis
- ✓ Bituminous Coal price of $3.57/MMBtu, 2008$, escalated at 2.0% annually in Interim Analysis, 2.8% annually in Final Integrated Analysis
- ✓ Biomass TDF fuel price of $2.27/MMBtu, 2008$, escalated at 3.0% annually

- ✓ Interim Analysis Natural gas forecast based on EIA Natural Gas Forecast, shown below

	January	February	March	April	May	June	July	August	September	October	November	December
2008	$7.59	$7.48	$7.18	$6.95	$6.84	$6.72	$6.65	$6.83	$7.03	$7.28	$7.66	$7.98
2009	$7.96	$7.85	$7.54	$7.30	$7.18	$7.05	$6.98	$7.17	$7.37	$7.63	$8.04	$8.37
2010	$8.04	$7.93	$7.61	$7.37	$7.25	$7.12	$7.05	$7.24	$7.45	$7.71	$8.12	$8.46
2011	$8.46	$8.34	$8.01	$7.75	$7.63	$7.50	$7.41	$7.62	$7.84	$8.11	$8.55	$8.90
2012	$8.96	$8.82	$8.48	$8.20	$8.07	$7.93	$7.84	$8.06	$8.29	$8.59	$9.04	$9.41
2013	$9.41	$9.28	$8.91	$8.62	$8.49	$8.34	$8.25	$8.48	$8.72	$9.03	$9.51	$9.90
2014	$9.75	$9.61	$9.23	$8.94	$8.79	$8.64	$8.54	$8.78	$9.03	$9.35	$9.85	$10.25
2015	$10.39	$10.24	$9.84	$9.52	$9.37	$9.20	$9.10	$9.36	$9.62	$9.96	$10.49	$10.92
2016	$10.82	$10.67	$10.24	$9.92	$9.76	$9.59	$9.48	$9.74	$10.02	$10.38	$10.93	$11.38
2017	$11.01	$10.85	$10.42	$10.09	$9.93	$9.75	$9.65	$9.92	$10.20	$10.56	$11.12	$11.58
2018	$11.40	$11.24	$10.79	$10.45	$10.28	$10.10	$9.99	$10.27	$10.56	$10.93	$11.51	$11.99
2019	$11.77	$11.60	$11.14	$10.78	$10.61	$10.42	$10.31	$10.60	$10.90	$11.28	$11.89	$12.37
2020	$12.20	$12.02	$11.54	$11.17	$10.99	$10.80	$10.68	$10.98	$11.29	$11.69	$12.31	$12.82
2021	$12.40	$12.22	$11.74	$11.36	$11.18	$10.98	$10.86	$11.16	$11.48	$11.89	$12.52	$13.04
2022	$12.58	$12.40	$11.91	$11.53	$11.34	$11.14	$11.02	$11.33	$11.65	$12.06	$12.71	$13.23
2023	$12.67	$12.49	$11.99	$11.61	$11.42	$11.22	$11.10	$11.41	$11.73	$12.15	$12.79	$13.32
2024	$12.82	$12.63	$12.13	$11.74	$11.56	$11.35	$11.23	$11.54	$11.87	$12.29	$12.94	$13.47
2025	$12.96	$12.77	$12.26	$11.87	$11.68	$11.47	$11.35	$11.66	$11.99	$12.42	$13.08	$13.62
2026	$13.09	$12.90	$12.39	$11.99	$11.80	$11.59	$11.46	$11.78	$12.12	$12.55	$13.22	$13.76
2027	$13.23	$13.04	$12.52	$12.12	$11.93	$11.72	$11.59	$11.91	$12.25	$12.68	$13.36	$13.90

- ✓ Final Integrated Analysis Natural gas forecast based on EIA Natural Gas Forecast plus short-term price increases, shown below

	January	February	March	April	May	June	July	August	September	October	November	December
2008	$10.31	$10.95	$12.18	$11.60	$11.03	$10.46	$10.10	$10.03	$10.15	$10.45	$10.64	$10.96
2009	$10.53	$11.18	$12.43	$11.84	$11.25	$10.68	$10.31	$10.23	$10.36	$10.67	$10.86	$11.19
2010	$10.74	$11.40	$12.68	$12.08	$11.48	$10.89	$10.52	$10.44	$10.57	$10.88	$11.08	$11.41
2011	$10.96	$11.63	$12.93	$12.32	$11.71	$11.12	$10.73	$10.65	$10.78	$11.10	$11.30	$11.65
2012	$11.35	$12.05	$13.40	$12.76	$12.13	$11.51	$11.11	$11.03	$11.17	$11.50	$11.70	$12.06
2013	$11.24	$11.93	$13.27	$12.64	$12.01	$11.40	$11.01	$10.92	$11.06	$11.39	$11.59	$11.95
2014	$11.56	$12.28	$13.65	$13.01	$12.36	$11.73	$11.32	$11.24	$11.38	$11.72	$11.93	$12.29
2015	$12.19	$12.94	$14.39	$13.71	$13.03	$12.37	$11.94	$11.85	$12.00	$12.35	$12.57	$12.96
2016	$12.75	$13.54	$15.06	$14.34	$13.63	$12.94	$12.49	$12.40	$12.55	$12.92	$13.15	$13.56
2017	$12.97	$13.77	$15.32	$14.59	$13.87	$13.16	$12.71	$12.61	$12.77	$13.15	$13.38	$13.79
2018	$12.93	$13.73	$15.27	$14.55	$13.83	$13.12	$12.67	$12.57	$12.73	$13.11	$13.34	$13.75
2019	$12.87	$13.66	$15.19	$14.47	$13.76	$13.05	$12.60	$12.51	$12.66	$13.04	$13.27	$13.68
2020	$12.75	$13.54	$15.06	$14.35	$13.64	$12.94	$12.49	$12.40	$12.55	$12.92	$13.16	$13.56
2021	$12.79	$13.58	$15.10	$14.39	$13.67	$12.98	$12.53	$12.43	$12.59	$12.96	$13.19	$13.60
2022	$12.95	$13.75	$15.29	$14.57	$13.85	$13.14	$12.69	$12.59	$12.75	$13.13	$13.36	$13.77
2023	$12.99	$13.80	$15.34	$14.62	$13.89	$13.18	$12.73	$12.63	$12.79	$13.17	$13.40	$13.81
2024	$13.12	$13.93	$15.49	$14.75	$14.02	$13.31	$12.85	$12.75	$12.91	$13.29	$13.53	$13.94
2025	$13.23	$14.04	$15.61	$14.88	$14.14	$13.42	$12.95	$12.86	$13.02	$13.40	$13.64	$14.06
2026	$13.52	$14.35	$15.96	$15.21	$14.45	$13.71	$13.24	$13.14	$13.30	$13.70	$13.94	$14.37
2027	$13.82	$14.67	$16.31	$15.54	$14.77	$14.02	$13.53	$13.43	$13.60	$14.00	$14.25	$14.69

APPENDIX B

SELECTED STRATEGIST AND PROMOD SUPPLY SIDE INTERIM ANALYSIS

Columbia Water Light Department
Integrated Resource Planning
Project 46806

Plan Rank:	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Plan Year	RESOURCE(Capacity)							
2008								
2009	MKT(10)	MKT(10)	MKT(10)	MKT(10)	MKT(10)	MKT(10)	MKT(10)	MKT(10)
2010								
2011	MKT(30) WART(2)	MKT(30) WART(2)	MKT(30) WART(2)	MKT(30) WART(2)	MKT(30) WART(2)	MKT(30) WART(2)	MKT(30) WART(2)	MKT(30) WART(2)
2012	MKT(40)	MKT(40)	MKT(40)	MKT(40)	MKT(40)	MKT(40)	MKT(40)	MKT(40)
2013								
2014								
2015	SCPC(1) MKT(10)	SCPC(1) MKT(10)	SCPC(1) MKT(10)	SCPC(1) MKT(10)	SCPC(1) MKT(10)	SCPC(1) MKT(10)	SCPC(1) MKT(10)	SCPC(1) MKT(10)
2016	SCPC(1)	MKT(20)	MKT(20)	SCPC(1)	MKT(20)	SCPC(1)	MKT(20)	SCPC(1)
2017		SCPC(1)	MKT(20)		SCPC(1)		MKT(20)	
2018			SCPC(1)				SCPC(1)	
2019	MKT(10)	MKT(10)	MKT(10)	MKT(10)	MKT(10)	MKT(10)	MKT(10)	MKT(10)
2020	MKT(20)	MKT(20)	MKT(20)	MKT(20)	MKT(20)	MKT(20)	MKT(20)	MKT(20)
2021	MKT(20)	MKT(20)	MKT(20)	MKT(20)	MKT(20)	MKT(20)	MKT(20)	MKT(20)
2022	MKT(30)	MKT(30)	MKT(30)	MKT(30)	MKT(30)	MKT(30)	MKT(30)	MKT(30)
2023	MKT(30)	MKT(30)	MKT(30)	MKT(30)	MKT(30)	MKT(30)	MKT(30)	MKT(30)
2024	MKT(40)	MKT(40)	MKT(40)	MKT(20) WART(1)	MKT(20) WART(1)	MKT(40)	MKT(20) WART(1)	MKT(40)
2025	MKT(50)	MKT(50)	MKT(50)	MKT(30)	MKT(30)	MKT(30) WART(1)	MKT(30)	MKT(50)
2026	MKT(60)	MKT(60)	MKT(60)	MKT(40)	MKT(40)	MKT(40)	MKT(40)	MKT(40) WART(1)
2027	MKT(60)	MKT(60)	MKT(60)	MKT(50)	MKT(50)	MKT(50)	MKT(50)	MKT(50)
NPV UTILITY COST (@ 5.5%)								
PLANNING PERIOD ($000)	$1,225,378	$1,225,429	$1,225,449	$1,225,627	$1,225,677	$1,225,680	$1,225,698	$1,225,717
Resource Totals								
Gas (MW)	34	34	34	50	50	50	50	50
Coal (MW)	50	50	50	50	50	50	50	50
Max Market (MW)	60	60	60	50	50	50	50	50

Columbia Water Light Department
Integrated Resource Planning
Project 46806

UnitDescription	Data Item	UOM	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027
	PeakLoad	(MW)	278.0	284.0	289.0	295.0	300.0	306.0	311.0	317.0	322.0	328.0	333.0	339.0	344.0	350.0	357.0	364.0	371.0	378.0	385.0	392.0
	EnergyDemand	(MWH)	1,220,972	1,243,916	1,265,826	1,292,103	1,317,598	1,340,292	1,362,182	1,388,459	1,414,223	1,436,644	1,458,541	1,484,834	1,510,854	1,532,981	1,563,684	1,594,325	1,629,433	1,655,639	1,686,294	1,716,972
	MarketPurchase	(MWH)	179,033	111,497	69,782	293,187	430,750	167,414	175,045	115,618	56,352	76,165	74,525	84,130	91,276	109,377	84,943	102,747	124,804	152,559	151,834	161,505
	CostOfMarketPurchases	($)	$8,698,550	$5,547,648	$3,656,279	$13,410,545	$21,756,373	$8,720,479	$9,096,461	$6,739,845	$3,238,262	$4,491,417	$4,258,341	$5,271,390	$6,428,998	$7,814,576	$5,679,661	$7,289,555	$8,899,331	$11,348,316	$11,047,794	$11,828,276
Columbia Energy Center	MaxCap	(MW)	72.0	72.0	72.0	72.0	72.0	72.0	72.0	72.0	72.0	72.0	72.0	72.0	72.0	72.0	72.0	72.0	72.0	72.0	72.0	72.0
CWL Unit 5	MaxCap	(MW)	16.5	16.5	16.5	16.5	16.5	16.5	16.5	16.5												
CWL Unit 6	MaxCap	(MW)	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5
CWL Unit 7	MaxCap	(MW)	22.0	22.0	22.0	22.0	22.0	22.0	22.0	22.0												
CWL Unit 8	MaxCap	(MW)	35.0	35.0	35.0	35.0	35.0	35.0	35.0	35.0	35.0	35.0	35.0	35.0	35.0	35.0	35.0	35.0	35.0	35.0	35.0	35.0
Distributed Generation	MaxCap	(MW)	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0
Iatan 2	MaxCap	(MW)			20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0
Nearman Creek	MaxCap	(MW)	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0
Prairie State Energy Campus	MaxCap	(MW)						50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0
SCPC1	MaxCap	(MW)								25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0
SCPC2	MaxCap	(MW)									25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0
Sikeston	MaxCap	(MW)	66.0	66.0	66.0	66.0	66.0	66.0	66.0	66.0	66.0	66.0	66.0	66.0	66.0	66.0	66.0	66.0	66.0	66.0	66.0	66.0
Wartsila1	MaxCap	(MW)				8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4
Wartsila2	MaxCap	(MW)				8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4
Wartsila3	MaxCap	(MW)				8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4
Wartsila4	MaxCap	(MW)				8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4
Wartsila (Total)	MaxCap	(MW)				33.6	33.6	33.6	33.6	33.6	33.6	33.6	33.6	33.6	33.6	33.6	33.6	33.6	33.6	33.6	33.6	33.6
	SUBTOTAL CAPACITY	**(MW)**	252.0	252.0	272.0	305.6	305.6	355.6	355.6	380.6	367.1	367.1	367.1	367.1	367.1	367.1	367.1	367.1	367.1	367.1	367.1	367.1
Columbia Energy Center	UnitGeneration	(MWH)	23,392	12,412	12,686	21,729	22,095	12,496	15,878	9,676	4,845	6,577	6,646	5,847	10,156	9,970	9,140	11,421	12,498	15,791	16,547	21,916
CWL Unit 6	UnitGeneration	(MWH)			72	72	114		50	106					48	56			108	91	56	25
CWL Unit 7	UnitGeneration	(MWH)	4,154	2,206	632	1,714	2,685	997	563													
CWL Unit 8	UnitGeneration	(MWH)	71,771	36,876	25,001	34,862	45,956	27,267	23,518	19,331	14,704	12,299	11,728	13,892	13,097	15,038	10,628	10,110	10,780	4,744	5,234	4,419
Iatan 2	UnitGeneration	(MWH)			137,978	142,103	145,535	144,654	144,876	144,040	139,884	139,605	140,837	140,625	142,093	133,124	136,506	137,325	139,537	139,996	152,935	141,137
Nearman Creek	UnitGeneration	(MWH)	117,070	71,451	53,937	82,590	112,325	81,964	83,929	65,724	54,127	51,600	55,424	60,657	56,901	64,930	53,095	50,306	54,158	57,903	55,808	57,339
Prairie State Energy Campus	UnitGeneration	(MWH)						364,113	364,063	364,259	364,688	363,516	363,921	363,835	365,461	349,755	360,850	377,897	363,706	341,878	362,348	383,480
SCPC1	UnitGeneration	(MWH)								170,717	166,038	168,059	169,565	168,768	175,715	171,971	166,959	159,575	168,034	178,518	168,021	168,314
SCPC2	UnitGeneration	(MWH)									163,441	161,943	164,499	166,025	166,426	169,107	160,850	162,628	164,543	164,119	158,125	171,921
Sikeston	UnitGeneration	(MWH)	457,187	398,146	311,109	356,632	435,025	381,091	388,858	340,256	295,000	284,246	293,580	293,884	297,422	311,654	282,834	280,775	284,693	285,892	298,329	282,749
Wartsila1	UnitGeneration	(MWH)				11,623	15,298	11,441	11,551	8,754	7,106	6,762	7,147	8,723	8,353	8,997	8,309	8,366	8,479	9,403	8,609	9,871
Wartsila2	UnitGeneration	(MWH)				11,353	15,942	11,784	11,821	9,221	7,487	6,907	7,697	8,870	8,492	9,780	8,271	8,481	8,456	9,534	9,270	9,738
Wartsila3	UnitGeneration	(MWH)				11,184	15,473	11,411	11,601	9,285	6,661	7,008	7,166	8,213	8,817	8,976	8,437	7,832	7,880	9,160	9,171	9,831
Wartsila4	UnitGeneration	(MWH)				11,446	16,095	10,116	10,936	7,970	6,101	6,211	6,181	7,790	8,581	8,740	7,789	7,345	7,887	9,101	8,755	9,716
	SUBTOTAL	**(MWH)**	673,575	521,091	541,415	685,309	826,544	1,057,333	1,067,643	1,149,339	1,230,082	1,214,733	1,234,390	1,247,129	1,261,561	1,262,096	1,213,669	1,222,059	1,230,760	1,226,128	1,253,207	1,270,456
Columbia Energy Center	CapacityFactor	(%)	3.70	1.97	2.01	3.45	3.49	1.98	2.52	1.53	0.77	1.04	1.05	0.93	1.61	1.58	1.45	1.81	1.98	2.50	2.62	3.47
CWL Unit 5	CapacityFactor	(%)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00												
CWL Unit 6	CapacityFactor	(%)	0.00	0.00	0.07	0.07	0.10	0.00	0.05	0.10	0.00	0.00	0.00	0.00	0.04	0.05	0.00	0.00	0.10	0.08	0.05	0.02
CWL Unit 7	CapacityFactor	(%)	2.15	1.14	0.33	0.89	1.39	0.52	0.29	0.00												
CWL Unit 8	CapacityFactor	(%)	23.34	12.03	8.15	11.37	14.95	8.89	7.67	6.31	4.78	4.01	3.83	4.53	4.26	4.90	3.47	3.30	3.51	1.55	1.71	1.44
Distributed Generation	CapacityFactor	(%)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Iatan 2	CapacityFactor	(%)		0.00	78.75	81.11	82.84	82.56	82.69	82.21	79.62	79.68	80.39	80.27	80.88	75.98	77.91	78.38	79.43	79.91	87.29	80.56
Nearman Creek	CapacityFactor	(%)	66.64	40.78	30.79	47.14	63.94	46.78	47.90	37.51	30.81	29.45	31.63	34.62	32.39	37.06	30.31	28.71	30.83	33.05	31.85	32.73
Prairie State Energy Campus	CapacityFactor	(%)					0.00	83.13	83.12	83.16	83.03	82.99	83.09	83.07	83.21	79.85	82.39	86.28	82.81	78.05	82.73	87.55
SCPC1	CapacityFactor	(%)							0.00	77.95	75.61	76.74	77.43	77.06	80.02	78.53	76.24	72.87	76.52	81.51	76.72	76.86
SCPC2	CapacityFactor	(%)								0.00	74.43	73.95	75.11	75.81	75.79	77.22	73.45	74.26	74.93	74.94	72.20	78.50
Sikeston	CapacityFactor	(%)	78.86	68.86	53.81	61.68	75.04	65.91	67.26	58.85	50.88	49.16	50.78	50.83	51.30	53.90	48.92	48.56	49.11	49.45	51.60	48.91
Wartsila1	CapacityFactor	(%)			0.00	15.80	20.73	15.55	15.70	11.90	9.63	9.19	9.71	11.85	11.32	12.23	11.29	11.37	11.49	12.78	11.70	13.42
Wartsila2	CapacityFactor	(%)			0.00	15.43	21.61	16.01	16.06	12.53	10.15	9.39	10.46	12.05	11.51	13.29	11.24	11.53	11.46	12.96	12.60	13.23
Wartsila3	CapacityFactor	(%)			0.00	15.20	20.97	15.51	15.77	12.62	9.03	9.52	9.74	11.16	11.95	12.20	11.47	10.64	10.68	12.45	12.46	13.36
Wartsila4	CapacityFactor	(%)			0.00	15.55	21.81	13.75	14.86	10.83	8.27	8.44	8.40	10.59	11.63	11.88	10.59	9.98	10.69	12.37	11.90	13.20
Columbia Energy Center	FixedOMCost	($)	$5,316,917	$5,449,840	$5,586,086	$5,725,737	$5,868,881	$6,015,603	$6,165,993	$6,320,143	$6,478,146	$6,640,100	$6,982,109	$7,156,662	$7,335,579	$7,518,967	$7,706,941	$7,899,614	$8,097,105	$8,299,532	$8,507,021	$8,719,697
CWL Unit 6	FixedOMCost	($)	$1,536,607	$1,582,705	$1,630,186	$1,679,091	$1,729,464	$1,781,348	$1,834,789	$1,889,832	$1,946,527	$2,004,923	$2,065,070	$2,127,022	$2,190,833	$2,256,557	$2,324,254	$2,393,981	$2,465,801	$2,539,775	$2,615,968	$2,694,446
CWL Unit 7	FixedOMCost	($)	$1,536,531	$1,582,627	$1,630,105	$1,679,008	$1,729,378	$1,781,260	$1,834,698	$5,011												
CWL Unit 8	FixedOMCost	($)	$383,170	$394,665	$406,505	$418,700	$431,261	$444,199	$457,524	$471,250	$485,388	$499,949	$514,948	$530,396	$546,308	$562,697	$579,578	$596,966	$614,875	$633,321	$652,320	$671,890
Iatan 2	FixedOMCost	($)			$620,296	$638,905	$658,072	$677,814	$698,149	$719,093	$740,666	$762,886	$785,772	$809,345	$833,626	$858,634	$884,393	$910,925	$938,253	$966,400	$995,392	$1,025,254
Nearman Creek	FixedOMCost	($)	$3,276,986	$3,408,065	$3,544,388	$3,686,163	$3,833,610	$3,986,955	$4,146,433	$4,312,290	$4,484,781	$4,664,173	$4,850,740	$5,044,769	$5,246,559	$5,456,421	$5,674,677	$5,901,664	$6,137,730	$6,383,240	$6,638,569	$6,904,113
Prairie State Energy Campus	FixedOMCost	($)						$2,795,379	$2,879,240	$2,965,617	$3,054,586	$3,146,224	$3,240,610	$3,337,828	$3,437,963	$3,541,101	$3,647,335	$3,756,755	$3,869,458	$3,985,542	$4,105,108	$4,228,261
SCPC1	FixedOMCost	($)								$1,090,857	$1,123,583	$1,157,290	$1,192,009	$1,227,769	$1,264,602	$1,302,540	$1,341,616	$1,381,864	$1,423,320	$1,466,020	$1,510,001	$1,555,300
SCPC2	FixedOMCost	($)									$1,123,583	$1,157,290	$1,192,009	$1,227,769	$1,264,602	$1,302,540	$1,341,616	$1,381,864	$1,423,320	$1,466,020	$1,510,001	$1,555,300
Sikeston	FixedOMCost	($)	$11,535,148	$12,111,905	$12,717,498	$13,353,371	$14,021,037	$14,722,088	$15,458,189	$16,231,097	$17,042,652	$17,894,783	$18,789,521	$19,728,995	$20,715,442	$21,751,214	$22,838,774	$23,980,711	$25,179,747	$26,438,729	$27,760,663	$29,148,699
Wartsila1	FixedOMCost	($)				$72,947	$75,135	$77,389	$79,711	$82,102	$84,565	$87,102	$89,715	$92,407	$95,179	$98,034	$100,976	$104,005	$107,125	$110,339	$113,649	$117,058
Wartsila2	FixedOMCost	($)				$72,947	$75,135	$77,389	$79,711	$82,102	$84,565	$87,102	$89,715	$92,407	$95,179	$98,034	$100,976	$104,005	$107,125	$110,339	$113,649	$117,058
Wartsila3	FixedOMCost	($)				$72,947	$75,135	$77,389	$79,711	$82,102	$84,565	$87,102	$89,715	$92,407	$95,179	$98,034	$100,976	$104,005	$107,125	$110,339	$113,649	$117,058
Wartsila4	FixedOMCost	($)				$72,947	$75,135	$77,389	$79,711	$82,102	$84,565	$87,102	$89,715	$92,407	$95,179	$98,034	$100,976	$104,005	$107,125	$110,339	$113,649	$117,058
	TOTAL FIXED OM COST	**($)**	$23,585,358	$24,529,806	$26,135,064	$27,472,763	$28,572,245	$32,514,203	$33,793,859	$34,333,601	$36,818,173	$38,276,027	$39,971,649	$41,560,183	$43,216,230	$44,942,810	$46,743,086	$48,620,364	$50,578,108	$52,619,934	$54,749,637	$56,971,194
Columbia Energy Center	VarOMCost	($)	$41,225	$22,469	$23,545	$41,385	$43,044	$24,978	$32,541	$20,348	$10,445	$14,528	$15,046	$13,557	$24,151	$24,306	$22,824	$29,259	$32,804	$42,467	$45,628	$61,909

Columbia Water Light Department
Integrated Resource Planning
Project 46806

UnitDescription	Data Item	UOM	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027
CWL Unit 6	VarOMCost	($)			$3,395	$3,503	$5,714		$2,653	$5,806					$3,039	$3,670			$7,677	$6,700	$4,255	$1,948
CWL Unit 7	VarOMCost	($)	$111,214	$61,314	$18,083	$50,558	$81,452	$30,992	$18,110													
CWL Unit 8	VarOMCost	($)	$68,332	$36,238	$25,325	$36,441	$49,309	$30,148	$26,810	$22,743	$17,838	$15,330	$15,081	$18,335	$17,827	$21,103	$15,344	$15,061	$16,513	$7,498	$8,522	$7,404
Iatan 2	VarOMCost	($)			$2,292,907	$2,433,668	$2,567,499	$2,627,953	$2,709,968	$2,778,216	$2,778,244	$2,855,875	$2,964,836	$3,049,762	$3,176,875	$3,062,679	$3,233,342	$3,348,823	$3,506,719	$3,621,029	$4,078,503	$3,880,467
Nearman Creek	VarOMCost	($)	$2,130,979	$1,354,478	$1,064,289	$1,699,421	$2,395,729	$1,818,887	$1,937,436	$1,576,788	$1,353,240	$1,340,232	$1,499,225	$1,703,663	$1,664,063	$1,974,240	$1,679,186	$1,657,526	$1,854,779	$2,061,819	$2,063,424	$2,206,214
Prairie State Energy Campus	VarOMCost	($)						$2,285,140	$2,353,189	$2,425,517	$2,499,429	$2,567,881	$2,646,802	$2,727,019	$2,821,220	$2,778,150	$2,953,842	$3,185,989	$3,157,293	$3,056,925	$3,336,623	$3,638,106
SCPC1	VarOMCost	($)								$1,684,568	$1,688,457	$1,759,205	$1,828,826	$1,875,129	$2,012,264	$2,026,901	$2,026,670	$1,994,813	$2,162,054	$2,367,597	$2,297,225	$2,367,890
SCPC2	VarOMCost	($)									$1,660,242	$1,696,592	$1,775,167	$1,843,565	$1,903,088	$1,992,913	$1,953,459	$2,032,647	$2,119,086	$2,175,439	$2,158,617	$2,419,005
Sikeston	VarOMCost	($)	$7,895,169	$7,091,573	$5,708,535	$6,749,294	$8,466,360	$7,641,271	$8,026,667	$7,229,398	$6,456,417	$6,405,724	$6,815,404	$7,028,950	$7,318,587	$7,906,726	$7,395,853	$7,558,632	$7,899,330	$8,169,950	$8,777,311	$8,565,233
Wartsila1	VarOMCost	($)				$105,577	$142,601	$109,959	$114,374	$89,307	$74,798	$73,251	$79,788	$100,144	$98,733	$109,666	$104,322	$108,347	$112,991	$129,024	$121,760	$143,677
Wartsila2	VarOMCost	($)				$103,081	$148,666	$113,191	$117,036	$94,124	$78,783	$74,828	$85,930	$101,781	$100,368	$119,154	$103,822	$109,811	$112,704	$130,836	$131,105	$141,694
Wartsila3	VarOMCost	($)				$101,547	$144,311	$109,622	$114,810	$94,758	$70,087	$75,898	$80,001	$94,271	$104,309	$109,415	$105,891	$101,444	$105,092	$125,764	$129,689	$143,027
Wartsila4	VarOMCost	($)				$103,949	$150,107	$97,161	$108,256	$81,317	$64,194	$67,266	$68,968	$89,428	$101,486	$106,490	$97,732	$95,124	$105,107	$124,906	$123,814	$141,379
	TOTAL VAR OM COST	**($)**	$10,246,920	$8,566,072	$9,136,079	$11,428,424	$14,194,791	$14,889,301	$15,561,849	$16,102,892	$16,752,176	$16,946,610	$17,875,075	$18,645,603	$19,346,011	$20,235,412	$19,692,289	$20,237,476	$21,192,149	$22,019,955	$23,276,476	$23,717,952
Columbia Energy Center	ReceiptsFuelCost	($)	$2,077,747	$1,146,151	$1,181,118	$2,124,987	$2,294,963	$1,357,091	$1,790,533	$1,165,626	$605,686	$831,876	$872,134	$794,825	$1,434,459	$1,429,277	$1,314,676	$1,668,856	$1,852,281	$2,349,673	$2,499,162	$3,344,021
CWL Unit 6	ReceiptsFuelCost	($)			$9,290	$9,789	$16,407		$7,819	$17,703					$9,380	$11,184			$22,128	$18,951	$11,803	$5,302
CWL Unit 7	ReceiptsFuelCost	($)	$230,223	$124,694	$36,453	$100,807	$161,084	$60,979	$35,117													
CWL Unit 8	ReceiptsFuelCost	($)	$3,561,500	$1,866,506	$1,290,722	$1,835,856	$2,468,448	$1,493,905	$1,314,275	$1,101,899	$854,911	$729,376	$709,450	$857,124	$824,247	$965,347	$695,905	$675,205	$734,330	$329,628	$370,968	$319,459
Prairie State Energy Campus	ReceiptsFuelCost	($)						$3,132,036	$3,219,588	$3,311,830	$3,409,191	$3,491,457	$3,593,548	$3,693,642	$3,814,723	$3,751,629	$3,979,017	$4,283,662	$4,238,345	$4,095,424	$4,462,180	$4,856,767
SCPC1	ReceiptsFuelCost	($)								$3,144,138	$3,118,340	$3,219,430	$3,313,230	$3,363,608	$3,573,020	$3,567,038	$3,532,132	$3,442,571	$3,697,557	$4,007,573	$3,847,650	$3,931,470
SCPC2	ReceiptsFuelCost	($)									$3,070,796	$3,102,262	$3,214,456	$3,309,380	$3,384,165	$3,507,653	$3,403,416	$3,508,422	$3,621,228	$3,684,340	$3,620,074	$4,015,173
Wartsila1	ReceiptsFuelCost	($)				$786,412	$1,099,647	$858,034	$896,602	$720,553	$611,283	$587,502	$645,038	$817,077	$811,822	$886,747	$824,710	$840,085	$860,503	$963,117	$897,866	$1,031,363
Wartsila2	ReceiptsFuelCost	($)				$769,745	$1,145,339	$883,642	$916,434	$761,359	$642,770	$602,695	$693,830	$828,182	$822,943	$964,193	$823,958	$850,491	$861,603	$978,940	$964,044	$1,025,186
Wartsila3	ReceiptsFuelCost	($)				$759,249	$1,111,111	$855,295	$896,482	$769,042	$569,898	$610,416	$643,489	$770,750	$853,246	$882,454	$837,729	$786,106	$800,242	$938,303	$953,719	$1,032,231
Wartsila4	ReceiptsFuelCost	($)				$775,254	$1,153,389	$761,949	$846,498	$661,086	$520,472	$540,107	$555,627	$728,110	$829,211	$852,989	$769,552	$737,485	$803,233	$934,060	$908,346	$1,019,308
	TOTAL REC FUEL COST	**($)**	$5,869,471	$3,137,351	$2,517,583	$7,162,099	$9,450,388	$9,402,930	$9,923,347	$11,653,238	$13,403,346	$13,715,120	$14,240,803	$15,162,699	$16,357,217	$16,818,510	$16,181,096	$16,792,883	$17,491,449	$18,300,010	$18,535,812	$20,580,279
AmerenUE PPA	PurchCap	(MW)	60.0	65.0	70.0	70.0																
Bluegrass Ridge	PurchCap	(MW)	6.3	6.3	6.3	6.3	6.3	6.3	6.3	6.3	6.3	6.3	6.3	6.3	6.3	6.3	6.3	6.3	6.3	6.3	6.3	6.3
Landfill Gas	PurchCap	(MW)	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2
RPS Landfill Gas	PurchCap	(MW)						7.0	7.5	8.0	8.5	9.0	9.5	10.0	10.5	11.0	11.5	12.0	12.5	13.0	13.5	14.0
RPS Wind	PurchCap	(MW)										5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
RPS Wind2	PurchCap	(MW)															30.0	30.0	30.0	30.0	30.0	30.0
Total Wind	FirmCap	(MW)	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	1.7	1.7	1.7	1.7	1.7	6.2	6.2	6.2	6.2	6.2	6.2
	SUBTOT FIRM PUR CAP	**(MW)**	66.1	71.1	76.1	76.1	6.1	13.1	13.6	14.1	14.6	15.9	16.4	16.9	17.4	17.9	22.9	23.4	23.9	24.4	24.9	25.4
	TOTAL FIRM CAPACITY	**(MW)**	318.1	323.1	348.1	381.7	311.7	368.7	369.2	394.7	381.7	383.0	383.5	384.0	384.5	385.0	390.0	390.5	391.0	391.5	392.0	392.5
AmerenUE PPA	PurchEnergyByComp	(MWH)	308,160	551,280	595,080	253,680																
Bluegrass Ridge	PurchEnergyByComp	(MWH)	17,992	17,997	17,970	17,952	18,066	17,965	17,951	17,997	17,997	18,018	17,972	17,965	18,025	17,970	17,952	18,018	18,014	17,951	17,997	17,970
Landfill Gas	PurchEnergyByComp	(MWH)	42,237	42,113	42,113	42,113	42,237	42,113	42,113	42,113	42,237	42,113	42,113	42,113	42,237	42,113	42,113	42,113	42,237	42,113	42,113	42,113
RPS Landfill Gas	PurchEnergyByComp	(MWH)						55,468	59,430	63,392	67,554	71,316	75,278	79,240	83,449	87,164	91,126	95,088	99,344	103,012	106,974	110,936
RPS Wind	PurchEnergyByComp	(MWH)										14,300	14,264	14,258	14,305	14,261	14,247	14,300	14,297	14,247	14,284	14,261
RPS Wind2	PurchEnergyByComp	(MWH)															99,634	100,001	99,977	99,629	99,887	99,732
	SUBTOTAL PurEnByCom	**(MWH)**	368,390	611,390	655,162	313,744	60,303	115,545	119,493	123,502	127,789	145,746	149,626	153,575	158,017	161,507	265,072	269,519	273,869	276,951	281,254	285,012
	TOTAL	**(MWH)**	1,220,997	1,243,978	1,266,359	1,292,241	1,317,598	1,340,292	1,362,182	1,388,459	1,414,223	1,436,644	1,458,541	1,484,834	1,510,854	1,532,981	1,563,684	1,594,325	1,629,434	1,655,639	1,686,294	1,716,973
AmerenUE PPA	PurchCapFactor	(%)	100.00%	100.00%	100.00%	100.00%																
Bluegrass Ridge	PurchCapFactor	(%)	32.51%	32.61%	32.56%	32.53%	32.65%	32.55%	32.53%	32.61%	32.52%	32.65%	32.57%	32.55%	32.57%	32.56%	32.53%	32.65%	32.55%	32.53%	32.61%	32.56%
Landfill Gas	PurchCapFactor	(%)	92.47%	92.45%	92.45%	92.45%	92.47%	92.45%	92.45%	92.45%	92.47%	92.45%	92.45%	92.45%	92.47%	92.45%	92.45%	92.45%	92.47%	92.45%	92.45%	92.45%
RPS Landfill Gas	PurchCapFactor	(%)						90.46%	90.46%	90.46%	90.48%	90.46%	90.46%	90.46%	90.48%	90.46%	90.46%	90.46%	90.48%	90.46%	90.46%	90.46%
RPS Wind	PurchCapFactor	(%)										32.65%	32.57%	32.55%	32.57%	32.56%	32.53%	32.65%	32.55%	32.53%	32.61%	32.56%
RPS Wind2	PurchCapFactor	(%)															37.91%	38.05%	37.94%	37.91%	38.01%	37.95%
AmerenUE PPA	PurchEnergyCost	($)	$15,207,696	$27,339,204	$29,856,894	$12,798,156																
Bluegrass Ridge	PurchEnergyCost	($)	$1,233,376	$1,233,714	$1,231,809	$1,230,597	$1,238,421	$1,231,483	$1,230,541	$1,233,715	$1,233,704	$1,235,125	$1,232,000	$1,231,483	$1,235,608	$1,231,810	$1,230,597	$1,235,125	$1,234,835	$1,230,541	$1,233,715	$1,231,810
Landfill Gas	PurchEnergyCost	($)	$2,449,772	$2,442,533	$2,442,533	$2,442,533	$2,449,772	$2,442,533	$2,442,533	$2,442,533	$2,449,772	$2,442,533	$2,442,533	$2,442,533	$2,449,772	$2,442,533	$2,442,533	$2,442,533	$2,449,772	$2,442,533	$2,442,533	$2,442,533
RPS Landfill Gas	PurchEnergyCost	($)						$3,328,070	$3,565,788	$3,803,509	$4,053,255	$4,278,947	$4,516,664	$4,754,386	$5,006,961	$5,229,821	$5,467,541	$5,705,262	$5,960,671	$6,180,700	$6,418,420	$6,656,140
RPS Wind	PurchEnergyCost	($)										$1,279,009	$1,314,046	$1,352,900	$1,398,155	$1,435,673	$1,477,287	$1,527,204	$1,572,651	$1,614,197	$1,666,911	$1,714,267
RPS Wind2	PurchEnergyCost	($)															$6,739,241	$6,967,064	$7,174,389	$7,363,896	$7,604,396	$7,820,423
	TOTAL PUR EN COST	**($)**	$18,890,843	$31,015,452	$33,531,237	$16,471,287	$3,688,193	$7,002,086	$7,238,862	$7,479,757	$7,736,730	$9,235,615	$9,505,244	$9,781,302	$10,090,496	$10,339,837	$17,357,200	$17,877,188	$18,392,317	$18,831,867	$19,365,976	$19,865,173
AmerenUE PPA	PurchCapCost	($)	$353,014	$757,229	$1,001,968	$512,264																
RPS Wind	PurchCapCost	($)										$136,551	$140,647	$144,867	$149,621	$153,689	$1,108,097	$1,141,340	$1,178,801	$1,210,848	$1,247,173	$1,284,588
RPS Wind2	PurchCapCost	($)															$949,798	$978,292	$1,010,401	$1,037,869	$1,069,005	$1,101,076
	TOTAL PUR CAP COST	**($)**	$353,014	$757,229	$1,001,968	$512,264	$0	$0	$0	$0	$0	$136,551	$140,647	$144,867	$149,621	$153,689	$2,057,895	$2,119,632	$2,189,202	$2,248,717	$2,316,178	$2,385,664
	TOTAL FIXED COSTS	**($)**	$23,938,372	$25,905,036	$27,137,031	$27,985,027	$31,273,466	$32,514,203	$33,793,859	$34,333,601	$36,818,173	$38,412,578	$40,112,296	$42,535,589	$44,221,308	$46,858,740	$50,616,088	$53,544,337	$56,618,606	$58,835,485	$62,173,115	$65,669,479

Columbia Water Light Department
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UnitDescription	Data Item	UOM	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027
Columbia Energy Center	CO2	(LBS)	35,534,718	18,854,001	19,270,815	33,007,675	33,563,965	18,982,456	24,120,363	14,698,262	7,360,022	9,990,324	10,094,996	8,882,275	15,427,013	15,144,753	13,884,834	17,348,551	18,985,664	23,987,168	25,136,478	33,292,529
CWL Unit 6	CO2	(LBS)			152,653	152,890	242,166		105,963	225,171					101,673	119,208			228,188	193,365	119,208	52,981
CWL Unit 7	CO2	(LBS)	13,232,973	7,026,705	2,013,910	5,460,056	8,553,828	3,174,584	1,792,356													
CWL Unit 8	CO2	(LBS)	204,711,341	105,181,191	71,308,496	99,436,791	131,078,685	77,773,362	67,080,162	55,137,820	41,939,973	35,079,942	33,452,543	39,623,276	37,356,341	42,893,343	30,314,888	28,836,452	30,746,612	13,531,014	14,929,376	12,604,338
Iatan 2	CO2	(LBS)			368,075,081	379,079,081	388,233,365	385,882,812	386,474,923	384,245,692	373,159,220	372,414,303	375,700,348	375,135,344	379,051,280	355,125,823	364,148,538	366,331,189	372,232,658	373,458,217	407,972,574	376,501,644
Nearman Creek	CO2	(LBS)	266,404,701	162,593,608	122,740,026	187,942,002	255,608,111	186,517,400	190,988,539	149,562,167	123,172,605	117,421,214	126,122,909	138,031,591	129,483,273	147,754,456	120,822,893	114,476,161	123,242,554	131,765,258	126,996,466	130,479,842
Prairie State Energy Campus	CO2	(LBS)						1,218,367,803	1,218,200,532	1,218,859,064	1,220,292,136	1,216,371,130	1,217,726,362	1,217,440,651	1,222,878,532	1,170,325,900	1,207,451,348	1,264,491,380	1,217,009,219	1,143,966,722	1,212,462,824	1,283,173,224
SCPC1	CO2	(LBS)								331,136,402	322,060,518	325,981,470	328,901,045	327,354,948	340,829,803	333,567,762	323,846,864	309,524,997	325,932,406	346,267,110	325,907,401	326,475,662
SCPC2	CO2	(LBS)									317,023,544	314,117,591	319,075,777	322,036,070	322,812,835	328,012,701	311,996,965	315,445,716	319,159,962	318,337,322	306,711,332	333,471,096
Sikeston	CO2	(LBS)	981,250,700	854,533,788	667,726,778	765,432,272	933,686,464	817,927,776	834,598,186	730,284,996	633,151,749	610,071,232	630,104,634	630,757,503	638,351,686	668,896,451	607,040,962	602,620,973	611,031,114	613,603,234	640,297,017	606,859,244
Wartsila1	CO2	(LBS)				12,555,951	16,525,500	12,358,610	12,477,549	9,456,269	7,676,083	7,304,450	7,720,245	9,422,945	9,023,267	9,718,966	8,975,870	9,036,877	9,159,951	10,157,072	9,299,353	10,663,474
Wartsila2	CO2	(LBS)				12,264,184	17,221,162	12,729,512	12,769,370	9,960,734	8,087,458	7,461,792	8,314,692	9,581,450	9,173,475	10,564,306	8,934,646	9,161,918	9,134,817	10,299,560	10,013,606	10,519,401
Wartsila3	CO2	(LBS)				12,081,879	16,714,527	12,327,122	12,532,130	10,029,698	7,195,822	7,570,538	7,741,269	8,871,587	9,524,963	9,696,533	9,114,294	8,460,340	8,512,501	9,894,780	9,907,095	10,619,910
Wartsila4	CO2	(LBS)				12,364,499	17,386,782	10,928,062	11,814,017	8,609,282	6,590,936	6,709,318	6,676,835	8,415,274	9,269,926	9,440,943	8,413,990	7,934,595	8,519,737	9,831,254	9,457,685	10,495,348
	TOTAL CO2	**(LBS)**	1,501,134,433	1,148,189,293	1,251,287,759	1,519,777,281	1,818,814,554	2,756,969,499	2,772,954,089	2,922,205,558	3,067,710,067	3,030,493,304	3,071,631,654	3,095,552,915	3,123,284,067	3,101,261,145	3,014,946,091	3,053,669,149	3,053,895,383	3,005,292,076	3,099,210,416	3,145,208,695
CWL Unit 7	Hg	(LBS)	0.547	0.291	0.083	0.226	0.354	0.131	0.074													
CWL Unit 8	Hg	(LBS)	8.468	4.351	2.950	4.113	5.422	3.217	2.775	2.281	1.735	1.451	1.384	1.639	1.545	1.774	1.254	1.193	1.272	0.560	0.618	0.521
Iatan 2	Hg	(LBS)			0.057	0.059	0.060	0.060	0.060	0.059	0.058	0.058	0.058	0.058	0.059	0.055	0.056	0.057	0.057	0.058	0.063	0.058
Nearman Creek	Hg	(LBS)	4.325	2.640	1.993	3.051	4.150	3.028	3.101	2.428	2.000	1.906	2.048	2.241	2.102	2.399	1.961	1.858	2.001	2.139	2.062	2.118
Prairie State Energy Campus	Hg	(LBS)						6.891	6.890	6.894	6.902	6.880	6.888	6.886	6.917	6.620	6.830	7.152	6.884	6.470	6.858	7.258
SCPC1	Hg	(LBS)								1.104	1.074	1.087	1.096	1.091	1.136	1.112	1.079	1.032	1.086	1.154	1.086	1.088
SCPC2	Hg	(LBS)									1.057	1.047	1.064	1.073	1.076	1.093	1.040	1.051	1.064	1.061	1.022	1.112
Sikeston	Hg	(LBS)	19.806	17.248	13.477	15.449	18.845	16.509	16.845	14.740	12.779	12.314	12.718	12.731	12.884	13.501	12.252	12.163	12.333	12.385	12.924	12.249
	TOTAL Hg	**(LBS)**	33.146	24.529	18.560	22.898	28.831	29.836	29.745	27.506	25.604	24.742	25.255	25.720	25.719	26.554	24.473	24.506	24.697	23.827	24.633	24.404
Columbia Energy Center	NOx	(LBS)	11,654	6,183	6,320	10,825	11,008	6,226	7,911	4,820	2,414	3,276	3,311	2,913	5,059	4,967	4,554	5,690	6,227	7,867	8,244	10,919
CWL Unit 6	NOx	(LBS)			314	315	499		218	464					209	246			470	398	246	109
CWL Unit 7	NOx	(LBS)	34,114	18,115	5,192	14,076	22,052	8,184	4,621													
CWL Unit 8	NOx	(LBS)	527,741	271,155	183,832	256,346	337,918	200,498	172,931	142,144	108,120	90,435	86,240	102,148	96,304	110,578	78,151	74,340	79,264	34,883	38,488	32,494
Iatan 2	NOx	(LBS)			101,552	104,588	107,114	106,465	106,629	106,014	102,955	102,749	103,656	103,500	104,581	97,980	100,469	101,071	102,699	103,037	112,560	103,877
Nearman Creek	NOx	(LBS)	556,000	339,341	256,165	392,244	533,467	389,271	398,603	312,144	257,068	245,064	263,225	288,079	270,238	308,371	252,164	238,918	257,214	275,001	265,048	272,318
Prairie State Energy Campus	NOx	(LBS)						239,586	239,553	239,683	239,965	239,194	239,460	239,404	240,473	230,139	237,440	248,656	239,319	224,956	238,425	252,330
SCPC1	NOx	(LBS)								61,321	59,641	60,367	60,908	60,621	63,117	61,772	59,972	57,319	60,358	64,123	60,353	60,458
SCPC2	NOx	(LBS)									58,708	58,170	59,088	59,636	59,780	60,743	57,777	58,416	59,104	58,951	56,798	61,754
Sikeston	NOx	(LBS)	1,009,274	878,937	686,795	787,291	960,351	841,285	858,432	751,140	651,232	627,493	648,098	648,770	656,581	687,998	624,376	619,830	628,480	631,126	658,582	624,189
Wartsila1	NOx	(LBS)				2,009	2,644	1,977	1,996	1,513	1,228	1,169	1,235	1,508	1,444	1,555	1,436	1,446	1,466	1,625	1,488	1,706
Wartsila2	NOx	(LBS)				1,962	2,755	2,037	2,043	1,594	1,294	1,194	1,330	1,533	1,468	1,690	1,430	1,466	1,462	1,648	1,602	1,683
Wartsila3	NOx	(LBS)				1,933	2,674	1,972	2,005	1,605	1,151	1,211	1,239	1,419	1,524	1,551	1,458	1,354	1,362	1,583	1,585	1,699
Wartsila4	NOx	(LBS)				1,978	2,782	1,748	1,890	1,377	1,055	1,074	1,068	1,346	1,483	1,511	1,346	1,270	1,363	1,573	1,513	1,679
	TOTAL NOx	**(LBS)**	2,138,783	1,513,731	1,240,170	1,573,568	1,983,263	1,799,251	1,796,832	1,623,819	1,484,831	1,431,396	1,468,858	1,510,878	1,502,261	1,569,100	1,420,572	1,409,774	1,438,786	1,406,772	1,444,932	1,425,216
CWL Unit 6	SO2	(LBS)			1	1	1		0	1					0	1			1	1	1	0
CWL Unit 7	SO2	(LBS)	92,089	48,899	14,015	37,997	59,527	22,092	12,473													
CWL Unit 8	SO2	(LBS)	1,920,417	986,715	668,952	932,826	1,229,662	729,600	629,286	517,253	393,443	329,088	313,822	371,710	350,444	402,387	284,387	270,518	288,437	126,936	140,054	118,243
Iatan 2	SO2	(LBS)			114,246	117,662	120,503	119,773	119,957	119,265	115,824	115,593	116,613	116,437	117,653	110,227	113,027	113,705	115,536	115,917	126,630	116,861
Nearman Creek	SO2	(LBS)	1,002,138	611,630	461,712	706,983	961,524	701,624	718,444	562,610	463,340	441,705	474,438	519,235	487,079	555,809	454,501	430,626	463,603	495,663	477,724	490,827
Prairie State Energy Campus	SO2	(LBS)						622,923	622,837	623,174	623,907	621,902	622,595	622,449	625,229	598,360	617,341	646,505	622,228	584,883	619,904	656,056
SCPC1	SO2	(LBS)								49,057	47,713	48,294	48,726	48,497	50,493	49,418	47,977	45,856	48,286	51,299	48,283	48,367
SCPC2	SO2	(LBS)									46,967	46,536	47,271	47,709	47,824	48,595	46,222	46,733	47,283	47,161	45,439	49,403
Sikeston	SO2	(LBS)	2,791,384	2,430,907	1,899,493	2,177,439	2,656,077	2,326,773	2,374,196	2,077,454	1,801,137	1,735,480	1,792,469	1,794,326	1,815,930	1,902,821	1,726,859	1,714,286	1,738,210	1,745,527	1,821,463	1,726,342
Wartsila1	SO2	(LBS)				512	674	504	509	386	313	298	315	384	368	397	366	369	374	414	379	435
Wartsila2	SO2	(LBS)				500	703	519	521	406	330	304	339	391	374	431	365	374	373	420	409	429
Wartsila3	SO2	(LBS)				493	682	503	511	409	294	309	316	362	389	396	372	345	347	404	404	433
Wartsila4	SO2	(LBS)				504	709	446	482	351	269	274	272	343	378	385	343	324	348	401	386	428
	TOTAL SO2	**(LBS)**	5,806,027	4,078,152	3,158,419	3,974,918	5,030,062	4,524,758	4,479,217	3,950,367	3,493,536	3,339,782	3,417,175	3,521,844	3,496,161	3,669,225	3,291,761	3,269,639	3,325,026	3,169,026	3,281,075	3,207,826
CWL Unit 7	Hg	($)			$812	$2,298	$3,753	$1,565	$962													
CWL Unit 8	Hg	($)			$28,741	$41,855	$57,517	$38,347	$36,005	$32,222	$25,814	$23,496	$24,376	$31,416	$32,240	$40,311	$31,018	$32,139	$37,300	$17,875	$21,475	$19,742
Iatan 2	Hg	($)			$554	$596	$636	$711	$775	$839	$859	$931	$1,022	$1,111	$1,222	$1,246	$1,391	$1,524	$1,686	$1,842	$2,193	$2,205
Nearman Creek	Hg	($)		$443	$19,428	$31,065	$44,034	$36,116	$40,267	$34,331	$29,782	$30,866	$36,081	$42,980	$43,869	$54,543	$48,561	$50,074	$58,710	$68,362	$71,746	$80,225
Prairie State Energy Campus	Hg	($)						$82,192	$89,487	$97,467	$102,883	$111,400	$121,368	$132,068	$144,480	$150,395	$168,935	$192,707	$201,896	$206,640	$238,476	$275,196
SCPC1	Hg	($)								$15,605	$15,974	$17,594	$19,313	$20,916	$23,731	$25,298	$26,732	$27,799	$31,863	$36,893	$37,821	$41,255
SCPC2	Hg	($)									$15,752	$16,954	$18,741	$20,588	$22,477	$24,877	$25,772	$28,331	$31,220	$33,918	$35,552	$42,114
Sikeston	Hg	($)			$131,323	$157,214	$199,913	$196,787	$218,587	$208,247	$190,159	$199,382	$224,041	$244,031	$268,821	$307,098	$303,556	$327,727	$361,938	$395,861	$449,802	$463,883
	TOTAL Hg	**($)**	$0	$443	$180,859	$233,029	$305,854	$355,718	$386,083	$388,711	$381,224	$400,624	$444,943	$493,110	$536,839	$603,769	$605,965	$660,303	$724,613	$761,389	$857,066	$924,620
Columbia Energy Center	NOx	($)		$5,695	$6,007	$10,636	$11,613	$7,390	$10,220	$6,780	$3,575	$5,280	$5,807	$5,560	$10,506	$9,412	$7,876	$8,981	$8,969	$10,341	$9,889	$11,954
CWL Unit 6	NOx	($)			$299	$309	$526		$282	$652					$435	$465			$677	$524	$295	$119
CWL Unit 7	NOx	($)		$16,684	$4,935	$13,830	$23,264	$9,714	$5,970													
CWL Unit 8	NOx	($)		$249,733	$174,732	$251,859	$356,503	$237,991	$223,427	$199,925	$160,126	$145,736	$151,265	$194,949	$199,975	$209,545	$135,162	$117,345	$114,180	$45,853	$46,171	$35,574
Iatan 2	NOx	($)			$96,581	$102,899	$113,052	$126,449	$137,884	$149,212	$152,753	$165,581	$181,864	$197,645	$216,985	$185,671	$173,760	$159,540	$147,938	$135,442	$134,882	$113,559

Columbia Water Light Department
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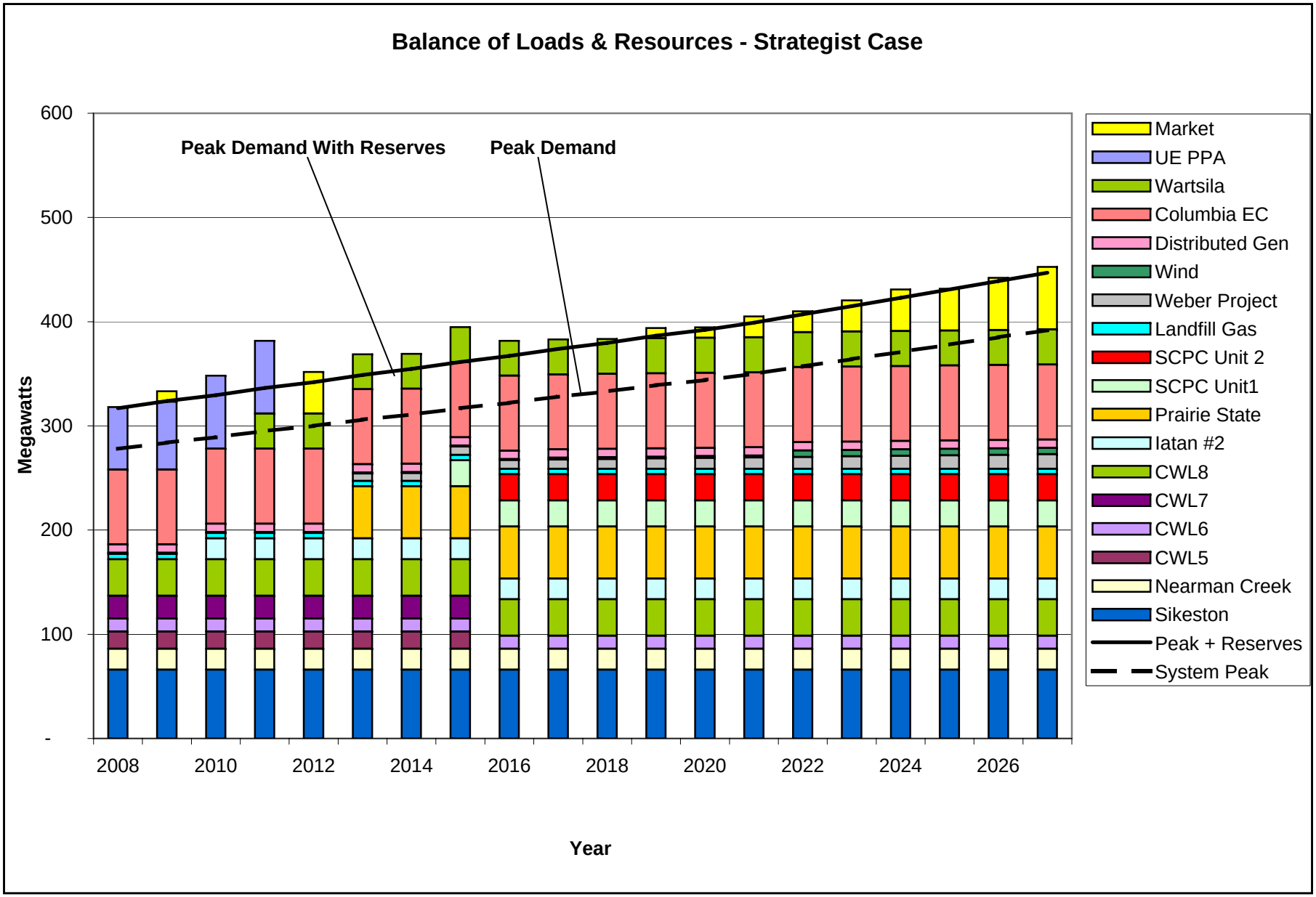
UnitDescription	Data Item	UOM	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027
Nearman Creek	NOx	($)	$4,330	$312,706	$243,604	$385,748	$562,996	$462,354	$515,424	$439,375	$381,075	$394,921	$461,848	$550,144	$561,012	$583,891	$435,751	$377,131	$370,324	$361,246	$317,733	$298,068
Prairie State Energy Campus	NOx	($)						$284,555	$309,773	$337,349	$356,005	$385,459	$420,135	$457,166	$498,768	$436,113	$410,651	$392,505	$344,715	$295,703	$286,020	$275,871
SCPC1	NOx	($)								$86,306	$88,328	$97,281	$106,832	$115,696	$130,915	$116,896	$103,606	$90,479	$86,946	$84,220	$72,319	$66,112
SCPC2	NOx	($)									$87,100	$93,741	$103,669	$113,880	$123,991	$114,947	$99,748	$92,209	$85,088	$77,426	$68,137	$67,568
Sikeston	NOx	($)		$809,503	$652,800	$773,512	$1,013,170	$998,605	$1,109,095	$1,056,480	$964,476	$1,011,207	$1,136,764	$1,238,178	$1,363,393	$1,302,266	$1,078,192	$978,401	$904,748	$828,926	$789,379	$683,235
Wartsila1	NOx	($)				$1,974	$2,790	$2,347	$2,580	$2,128	$1,819	$1,883	$2,167	$2,878	$2,997	$2,947	$2,484	$2,282	$2,111	$2,136	$1,785	$1,868
Wartsila2	NOx	($)				$1,928	$2,907	$2,418	$2,640	$2,242	$1,917	$1,924	$2,334	$2,926	$3,047	$3,203	$2,472	$2,314	$2,105	$2,166	$1,922	$1,843
Wartsila3	NOx	($)				$1,899	$2,822	$2,341	$2,591	$2,257	$1,705	$1,952	$2,173	$2,709	$3,164	$2,940	$2,522	$2,137	$1,962	$2,081	$1,902	$1,860
Wartsila4	NOx	($)				$1,944	$2,935	$2,075	$2,442	$1,937	$1,562	$1,730	$1,874	$2,570	$3,080	$2,862	$2,328	$2,004	$1,963	$2,068	$1,815	$1,838
	TOTAL NOx	**($)**	$4,330	$1,394,320	$1,178,957	$1,546,538	$2,092,579	$2,136,238	$2,322,327	$2,284,644	$2,200,439	$2,306,696	$2,576,731	$2,884,301	$3,118,269	$2,971,160	$2,454,553	$2,225,329	$2,071,725	$1,848,131	$1,732,247	$1,559,470
CWL Unit 6	SO2	($)			$0	$1	$1		$0	$1					$1	$1			$2	$2	$1	$1
CWL Unit 7	SO2	($)	$32,277	$22,005	$8,101	$28,232	$49,854	$20,822	$12,791													
CWL Unit 8	SO2	($)	$673,106	$444,022	$386,654	$693,089	$1,029,841	$687,647	$645,332	$577,254	$462,492	$420,904	$436,840	$562,955	$577,531	$720,473	$553,275	$571,874	$662,684	$316,832	$379,837	$348,444
Iatan 2	SO2	($)			$66,359	$87,629	$100,963	$112,952	$123,123	$133,193	$136,398	$147,844	$162,371	$176,448	$194,048	$197,361	$219,894	$240,372	$265,446	$289,329	$343,804	$344,870
Nearman Creek	SO2	($)	$352,092	$276,581	$267,972	$526,150	$805,547	$661,692	$737,375	$628,368	$545,168	$564,940	$660,634	$786,876	$802,901	$995,975	$884,968	$910,343	$1,065,674	$1,237,999	$1,296,541	$1,446,708
Prairie State Energy Campus	SO2	($)						$587,445	$639,279	$695,950	$734,677	$795,416	$866,904	$943,247	$1,031,547	$1,071,363	$1,201,044	$1,366,709	$1,429,677	$1,459,872	$1,681,230	$1,935,932
SCPC1	SO2	($)								$54,785	$56,086	$61,768	$67,827	$73,449	$83,305	$88,603	$93,442	$96,939	$110,938	$128,148	$131,095	$142,695
SCPC2	SO2	($)									$55,306	$59,520	$65,819	$72,296	$78,904	$87,129	$90,084	$98,793	$108,698	$117,814	$123,234	$145,669
Sikeston	SO2	($)	$978,377	$1,093,908	$1,097,904	$1,617,836	$2,224,459	$2,192,983	$2,434,727	$2,318,430	$2,117,235	$2,219,674	$2,495,109	$2,717,502	$2,992,650	$3,410,856	$3,364,737	$3,623,999	$3,996,044	$4,360,422	$4,944,120	$5,088,210
Wartsila1	SO2	($)				$381	$565	$475	$522	$431	$368	$381	$438	$582	$607	$710	$712	$779	$859	$1,034	$1,029	$1,282
Wartsila2	SO2	($)				$372	$588	$490	$534	$454	$388	$389	$472	$592	$617	$772	$709	$790	$856	$1,049	$1,108	$1,265
Wartsila3	SO2	($)				$366	$571	$474	$524	$457	$345	$395	$440	$548	$641	$708	$723	$730	$798	$1,008	$1,096	$1,277
Wartsila4	SO2	($)				$375	$594	$420	$494	$392	$316	$350	$379	$520	$623	$690	$668	$684	$799	$1,001	$1,047	$1,262
	TOTAL SO2	**($)**	$2,035,852	$1,836,515	$1,826,991	$2,954,430	$4,212,983	$4,265,401	$4,594,703	$4,409,714	$4,108,780	$4,271,580	$4,757,232	$5,335,015	$5,763,374	$6,574,640	$6,410,257	$6,912,013	$7,642,474	$7,914,510	$8,904,141	$9,457,614
	TOTAL GASSES	**($)**	$2,040,183	$3,231,278	$3,186,807	$4,733,997	$6,611,415	$6,757,358	$7,303,113	$7,083,068	$6,690,442	$6,978,900	$7,778,906	$8,712,426	$9,418,482	$10,149,569	$9,470,775	$9,797,644	$10,438,812	$10,524,030	$11,493,454	$11,941,703
	TOTAL VARIABLE COST	**($)**	$39,876,496	$48,360,449	$49,510,401	$46,044,252	$46,250,773	$37,369,224	$39,200,285	$37,405,563	$34,417,610	$37,652,541	$39,417,566	$42,410,721	$45,283,988	$48,539,394	$52,199,924	$55,201,863	$58,922,609	$62,724,168	$65,183,700	$67,353,104
	PeakLoad	(MW)	278.0	284.0	289.0	295.0	300.0	306.0	311.0	317.0	322.0	328.0	333.0	339.0	344.0	350.0	357.0	364.0	371.0	378.0	385.0	392.0
	Reserves	(MW)	38.92	39.76	40.46	41.3	42	42.84	43.54	44.38	45.08	45.92	46.62	47.46	48.16	49	49.98	50.96	51.94	52.92	53.9	54.88
	TotalCapacityResponsibility	(MW)	316.9	323.8	329.5	336.3	342.0	348.8	354.5	361.4	367.1	373.9	379.6	386.5	392.2	399.0	407.0	415.0	422.9	430.9	438.9	446.9
(Wind 15% Firm)	TotalFirmResources	(MW)	318.1	323.1	348.1	381.7	311.7	368.7	369.2	394.7	381.7	383.0	383.5	384.0	384.5	385.0	390.0	390.5	391.0	391.5	392.0	392.5
	ReserveSurplus(Deficit)	(MW)	1.2	(0.6)	18.7	45.4	(30.3)	19.9	14.7	33.4	14.7	9.1	3.9	(2.5)	(7.7)	(14.0)	(17.0)	(24.5)	(31.9)	(39.4)	(46.9)	(54.4)
	ReserveMargin	(%)	14.44%	13.78%	20.47%	29.41%	3.91%	20.50%	18.73%	24.53%	18.55%	16.77%	15.16%	13.27%	11.77%	10.00%	9.24%	7.28%	5.39%	3.57%	1.82%	0.13%
	Market Capacity	(MW)	0.0	10.0	0.0	0.0	40.0	0.0	0.0	0.0	0.0	0.0	0.0	10.0	10.0	20.0	20.0	30.0	40.0	40.0	50.0	60.0
	Capacity Cost	($/kW-yr)	$60.00	$61.80	$63.65	$65.56	$67.53	$69.56	$71.64	$73.79	$76.01	$78.29	$80.63	$83.05	$85.55	$88.11	$90.76	$93.48	$96.28	$99.17	$102.15	$105.21
	Capacity Cost	($)	$0	$618,000	$0	$0	$2,701,221	$0	$0	$0	$0	$0	$0	$830,540	$855,457	$1,762,240	$1,815,108	$2,804,341	$3,851,295	$3,966,834	$5,107,299	$6,312,622
New Capacity Investment	SCPC1 DebtService	($)	$0	$0	$0	$0	$0	$0	$0	$5,752,131	$5,752,131	$5,752,131	$5,752,131	$5,752,131	$5,752,131	$5,752,131	$5,752,131	$5,752,131	$5,752,131	$5,752,131	$5,752,131	$5,752,131
	SCPC2 DebtService	($)	$0	$0	$0	$0	$0	$0	$0	$0	$5,924,694	$5,924,694	$5,924,694	$5,924,694	$5,924,694	$5,924,694	$5,924,694	$5,924,694	$5,924,694	$5,924,694	$5,924,694	$5,924,694
	Wart1 DebtService	($)	$0	$0	$0	$665,251	$665,251	$665,251	$665,251	$665,251	$665,251	$665,251	$665,251	$665,251	$665,251	$665,251	$665,251	$665,251	$665,251	$665,251	$665,251	$665,251
	Wart2 DebtService	($)	$0	$0	$0	$665,251	$665,251	$665,251	$665,251	$665,251	$665,251	$665,251	$665,251	$665,251	$665,251	$665,251	$665,251	$665,251	$665,251	$665,251	$665,251	$665,251
	Wart3 DebtService	($)	$0	$0	$0	$665,251	$665,251	$665,251	$665,251	$665,251	$665,251	$665,251	$665,251	$665,251	$665,251	$665,251	$665,251	$665,251	$665,251	$665,251	$665,251	$665,251
	Wart4 DebtService	($)	$0	$0	$0	$665,251	$665,251	$665,251	$665,251	$665,251	$665,251	$665,251	$665,251	$665,251	$665,251	$665,251	$665,251	$665,251	$665,251	$665,251	$665,251	$665,251
	Total Fixed Costs	($000)	$23,938	$25,905	$27,137	$27,985	$31,273	$32,514	$33,794	$34,334	$36,818	$38,413	$40,112	$42,536	$44,221	$46,859	$50,616	$53,544	$56,619	$58,835	$62,173	$65,669
	Total Variable Costs	($000)	$39,876	$48,360	$49,510	$46,044	$46,251	$37,369	$39,200	$37,406	$34,418	$37,653	$39,418	$42,411	$45,284	$48,539	$52,200	$55,202	$58,923	$62,724	$65,184	$67,353
	Total Fuel Costs	($000)	$5,869	$3,137	$2,518	$7,162	$9,450	$9,403	$9,923	$11,653	$13,403	$13,715	$14,241	$15,163	$16,357	$16,819	$16,181	$16,793	$17,491	$18,300	$18,536	$20,580
	Total Investment Costs	($000)	$0	$0	$0	$2,661	$2,661	$2,661	$2,661	$8,413	$14,338	$14,338	$14,338	$14,338	$14,338	$14,338	$14,338	$14,338	$14,338	$14,338	$14,338	$14,338
	Total Costs	($000)	$69,684	$77,403	$79,165	$83,852	$89,636	$81,947	$85,578	$91,806	$98,977	$104,118	$108,108	$114,447	$120,200	$126,554	$133,335	$139,877	$147,370	$154,197	$160,230	$167,941

20-Year NPV @ 5.5% ($000): $1,232,108


Balance of Loads & Resources - Strategist Case
Peak Demand With Reserves
Peak Demand
Megawatts
600
500
400
300
200
100
-
2008
2010
2012
2014
2016
2018
2020
2022
2024
2026
Year
Market
UE PPA
Wartsila
Columbia EC
Distributed Gen
Wind
Weber Project
Landfill Gas
SCPC Unit 2
SCPC Unit1
Prairie State
Iatan #2
CWL8
CWL7
CWL6
CWL5
Nearman Creek
Sikeston
Peak + Reserves
System Peak

APPENDIX C

SELECTED STRATEGIST DSM OUTPUT FROM INTERIM ANALYSIS

DIFFERENTIAL COST EFFECTIVENESS MODULE

DETAILED BENEFIT AND COST REPORT

OPTION CASE - BASE CASE ($000)

ALTERNATIVE NAME : ADD REF

	PART TEST	UTIL TEST	TRC TEST	SOC TEST	RIM TEST
BENEFITS:					
CUSTOMER BILL SAVINGS	0.				
OTHER CUSTOMER BENEFITS	0.		0.	0.	
PRODUCTION COST SAVINGS		3320.	3320.	3320.	3320.
DEFERRED T&D CAP. COSTS		0.	0.	0.	0.
DEFERRED GEN. CAP. COSTS		0.	0.	0.	0.
RET. FUEL SWITCH SAVINGS	0.				
WHOL. FUEL SWITCH SAV.			0.	0.	
UTILITY REVENUE INCREASE					0.
EXTERNAL BENEFITS				0.	
CUSTOMER IMPACT BENEFITS			0.	0.	
INCENTIVE PAYMENTS	1238.				
VALUE INCREASE PART.	0.		0.	0.	
COSTS:					
DIRECT CUSTOMER COSTS	1238.		1238.	1238.	
PRODUCTION COST INCREASE		0.	0.	0.	0.
T&D CAP. COST INCREASE		0.	0.	0.	0.
GEN. CAP. COST INCREASE		0.	0.	0.	0.
DSM EXPENSES		0.	0.	0.	0.
EVALUATION EXPENSES		0.	0.	0.	0.
CAPITAL CHARGES		0.	0.	0.	0.
INCENTIVE PAYMENTS		1238.			1238.
EXTERNAL COSTS				0.	
CUSTOMER INTERRUPT COSTS	0.				
CUSTOMER IMPACT COSTS			0.	0.	
UTILITY REVENUE DECREASE					0.
CUSTOMER BILL INCREASE	0.				
RET. FUEL SWITCH COSTS	0.				
WHOLE. FUEL SWITCH COSTS			0.	0.	
SHARED SAVINGS COSTS		0.	0.	0.	0.
VALUE DECREASE PART.	0.		0.	0.	
TOTAL BENEFITS	1238.	3320.	3320.	3320.	3320.
TOTAL COSTS	1238.	1238.	1238.	1238.	1238.
NET BENEFITS	0.	2081.	2081.	2081.	2081.
BENEFIT/COST RATIO	1.00	2.68	2.68	2.68	2.68

LOAD FORECAST ADJUSTMENT MODULE
GROUP DETAIL REPORT

CLASS: Columbia

LOAD GROUP: Add Ref

PEAK AND ENERGY RESULTS	2007	2008	2009	2010	2011	2012	2013	2014
ENERGY SALES	0.00	0.00	-2.47	-2.47	-2.47	-2.47	-2.47	-2.47
ENERGY LOSSES	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ENERGY REQUIREMENTS	0.00	0.00	-2.47	-2.47	-2.47	-2.47	-2.47	-2.47
PEAK AT METER (NON COINC.)	0.00	0.00	-0.61	-0.61	-0.61	-0.61	-0.61	-0.61
PEAK LOSSES (NON COINC.)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PEAK DEMAND (NON COINC.)	0.00	0.00	-0.61	-0.61	-0.61	-0.61	-0.61	-0.61
PEAK AT METER (COINC.)	0.00	0.00	-0.61	-0.61	-0.61	-0.61	-0.61	-0.61
PEAK DEMAND (COINC.)	0.00	0.00	-0.61	-0.61	-0.61	-0.61	-0.61	-0.61
LOAD FACTOR	0.000	0.000	0.465	0.465	0.465	0.463	0.465	0.464

EXPENSE AND COST RESULTS

	2007	2008	2009	2010	2011	2012	2013	2014
CAPACITY CREDIT ($000)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CUSTOMER COST ($000)	0.0	0.0	1378.2	0.0	0.0	0.0	0.0	0.0
DSM EXPENSE ($000)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
EVALUATION EXPENSE ($000)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
EXTERNAL COST ($000)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FUEL SWITCH SAVINGS:								
RETAIL ($000)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
WHOLESALE ($000)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
INCENTIVE PAYMENT ($000)	0.0	0.0	1378.2	0.0	0.0	0.0	0.0	0.0
LOST REVENUES ($000)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OTHER CUST BENEFITS ($000)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SHAREHOLDER SAVINGS ($000)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL T&D CREDITS ($000)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PENETRATION FACTOR	0.0	0.0	1.0	1.0	1.0	1.0	1.0	1.0
PARTICIPATION	0.0	0.0	1.0	1.0	1.0	1.0	1.0	1.0
PART. NET FREE RIDERS	0.0	0.0	1.0	1.0	1.0	1.0	1.0	1.0

APPENDIX D

DSM LOAD IMPACT DETAILS

CWL MANAGED DSM - SINGLE FAMILY HOMES

Program Description		Total System						2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
Potential Situation	Improvement	Total Installs	Total Potential kW Savings	Total Potential kWh Savings	Total Differential Cost	B/C >1 (Y)	Market Capture Rate																				
AC Refrigerant under charged	Add refrigerant	5,513	606	2,469,824	$ 1,378,250	Y	20.00%	121	243	364	485	606	606	606	606	606	606	606	606	606	606	606	606	606	606	606	606
AC Refrigerant over charged	Remove refrigerant	4,624	462	462,400	$ 462,400	Y	20.00%	92	185	277	370	462	462	462	462	462	462	462	462	462	462	462	462	462	462	462	462
Low Evaporator Airflow A	Increase duct sizes or add new ducts	10,670	8,003	8,077,190	$ 10,136,500	Y	20.00%	1,601	3,201	4,802	6,402	8,003	8,003	8,003	8,003	8,003	8,003	8,003	8,003	8,003	8,003	8,003	8,003	8,003	8,003	8,003	8,003
Low Evaporator Airflow B	Increase blower speed	2,134	1,195	1,344,420	$ 213,400	Y	20.00%	239	478	717	956	1,195	1,195	1,195	1,195	1,195	1,195	1,195	1,195	1,195	1,195	1,195	1,195	1,195	1,195	1,195	1,195
High Duct Leakage (25%)	Reduce duct leakage to 5%	11,738	4,930	6,256,354	$ 7,042,800	Y	20.00%	986	1,972	2,958	3,944	4,930	4,930	4,930	4,930	4,930	4,930	4,930	4,930	4,930	4,930	4,930	4,930	4,930	4,930	4,930	4,930
Oversized AC Units A (New)	Size AC units to 100% of Manual J	114	34	28,044	$ 35,796	Y	20.00%	7	14	21	27	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34
Oversized AC Units B (Replace)	Size AC units to 100% of Manual J	837	653	617,706	$ 175,770	Y	20.00%	131	261	392	522	653	653	653	653	653	653	653	653	653	653	653	653	653	653	653	653
One Inch insul. On ducts in attic	Add two more inches of insulation	3,557	569	658,045	$ 2,134,200		0.00%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gas Heat and 13 SEER AC	Install AC SEER = 16	959	345	247,422	$ 805,560		0.00%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Home has 13 SEER Heat Pump	Install Heat Pump SEER = 16	75	41	46,500	$ 56,250	Y	20.00%	8	17	25	33	41	41	41	41	41	41	41	41	41	41	41	41	41	41	41	41
Home has electric strip heat	Install Heat Pump SEER = 16	87	98	305,283	$ 417,600	Y	20.00%	20	39	59	79	98	98	98	98	98	98	98	98	98	98	98	98	98	98	98	98
No programmable thermostat	Install programmable thermostat	8,893	534	4,393,142	$ 1,778,600	Y	20.00%	107	213	320	427	534	534	534	534	534	534	534	534	534	534	534	534	534	534	534	534
Attic Insulation = R-11	Add another R-19 attic insulation	1,245	423	626,235	$ 1,007,205	Y	20.00%	85	169	254	339	423	423	423	423	423	423	423	423	423	423	423	423	423	423	423	423
Exposed Walls not insulated	Add R-11 wall insulation	1,068	609	2,688,156	$ 3,738,000	Y	20.00%	122	244	365	487	609	609	609	609	609	609	609	609	609	609	609	609	609	609	609	609
Floor over basement not insulate	Add R-19 wall insulation	1,779	-231	-400,275	$ 699,147		0.00%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
House infiltration = 0.8 ACH	Reduce infiltration to 0.35 ACH	7,114	2,917	7,405,674	$ 3,557,000	Y	20.00%	583	1,167	1,750	2,333	2,917	2,917	2,917	2,917	2,917	2,917	2,917	2,917	2,917	2,917	2,917	2,917	2,917	2,917	2,917	2,917
Single Pane Window B	Install Low E double pane window 2904	1,849	888	2,037,598	$ 647,150	Y	20.00%	178	355	533	710	888	888	888	888	888	888	888	888	888	888	888	888	888	888	888	888
NO E&W Window Shading A	Add solar screens to E&W sides	11,559	7,629	1,849,440	$ 2,982,222	Y	20.00%	1,526	3,052	4,577	6,103	7,629	7,629	7,629	7,629	7,629	7,629	7,629	7,629	7,629	7,629	7,629	7,629	7,629	7,629	7,629	7,629
NO E&W Window Shading B	Plant decidous trees on E&W sides	8,670	1,127	2,835,090	$ 7,803,000		0.00%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
No Compact Florescent Lamps	Use 3 more CFLs throughout the house	10,670	288	2,660,031	$ 480,150	Y	20.00%	58	115	173	230	288	288	288	288	288	288	288	288	288	288	288	288	288	288	288	288
Refrigerator needs to be replaced	Purchase Energy Star Refridgerator	1,388	14	84,668	$ 277,600		0.00%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Refrigerator early retirement	Purchase Energy Star Refridgerator	4,802	384	3,102,092	$ 240,100	Y	20.00%	77	154	230	307	384	384	384	384	384	384	384	384	384	384	384	384	384	384	384	384
Dishwasher to be replaced	Purchase Energy Star dishwasher	3,976	239	294,224	$ 596,400		0.00%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Clothes washer to be replaced	Purchase Energy Star clothes washer	3,365	370	504,750	$ 1,346,000		0.00%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
No low flow shower heads	Install low flow shower heads	1,779	0	222,375	$ 35,580	Y	20.00%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hot water pipes not insulated	Insulate hot water pipes	15,116	0	922,076	$ 1,436,020		0.00%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Electric water heater not wrapped	Wrap electric water heater	8,893	0	1,725,242	$ 533,580	Y	20.00%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gas water heater not wrapped	Wrap gas water heater	12,627	0	0	$ 757,620		0.00%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Program Description		Total System																									
Potential Situation	Improvement	Total Installs	Total Potential kW Savings	Total Potential kWh Savings	Total Differential Cost	B/C >1 (Y)	Market Capture Rate																				
Gas Heat and 3 Ton 10 SEER A	Replace With 3 Ton 16 SEER AC	1,612	1,527	1,080,524	$ 6,125,600		0.00%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Heating System Replacement	Install Variable Speed Fan Unit	5,868	0	492,912	$ 4,107,600		0.00%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Two Refrigerators in Home A	Recycle 2nd Refrigerator w/ Coolant	5,086	457.74	4,025,060	$ 76,290	Y	20.00%	92	183	275	366	458	458	458	458	458	458	458	458	458	458	458	458	458	458	458	458
Two Refrigerators in Home B	Recycle 2nd Refrigerator w/o Coolant	5,086	457.74	4,025,060	$ 50,860	Y	20.00%	92	183	275	366	458	458	458	458	458	458	458	458	458	458	458	458	458	458	458	458
Phantom Electric Loads	Install Power Strips with Auto Shutoff	16,006	0	7,202,700	$ 640,240	Y	20.00%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Exterior Lighting Replacement	Install Solar Powered Lights	8,893	0	3,112,550	$ 1,031,588	Y	20.00%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL SINGLE FAMILY HOME DSM - CWL MANAGED (kW)								6,122	12,244	18,366	24,488	30,610	30,610	30,610	30,610	30,610	30,610	30,610	30,610	30,610	30,610	30,610	30,610	30,610	30,610	30,610	30,610
TOTAL DSM (MW)								6	12	18	24	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31

CUSTOMER MANAGED DSM - SINGLE FAMILY HOMES

Program Description		Total System						2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
Potential Situation	Improvement	Total Installs	Total Potential kW Savings	Total Potential kWh Savings	Total Differential Cost	B/C >1 (Y)	Market Capture Rate																				
AC Refrigerant under charged	Add refrigerant	4,875	536	2,184,000	$ 1,218,750	Y	3.02%	16	32	49	65	81	97	113	130	146	162	178	194	211	227	243	259	275	292	308	324
AC Refrigerant over charged	Remove refrigerant	4,089	409	408,900	$ 408,900	Y	3.73%	15	31	46	61	76	92	107	122	137	153	168	183	198	214	229	244	259	275	290	305
Low Evaporator Airflow A	Increase duct sizes or add new ducts	9,435	7,076	7,142,295	$ 8,963,250	Y	1.06%	75	150	225	300	375	450	525	600	675	750	825	900	975	1,050	1,125	1,200	1,275	1,350	1,425	1,500
Low Evaporator Airflow B	Increase blower speed	1,887	1,057	1,188,810	$ 188,700	Y	10.00%	106	211	317	423	528	634	740	845	951	1,057	1,162	1,268	1,374	1,479	1,585	1,691	1,796	1,902	2,008	2,113
High Duct Leakage (25%)	Reduce duct leakage to 5%	10,379	4,359	5,532,007	$ 6,227,400	Y	1.72%	75	150	225	300	375	450	525	600	675	750	825	900	975	1,050	1,125	1,200	1,275	1,350	1,425	1,500
Oversized AC Units A (New)	Size AC units to 100% of Manual J	101	30	24,846	$ 31,714	Y	1.26%	0	1	1	2	2	2	3	3	3	4	4	5	5	5	6	6	6	7	7	8
Oversized AC Units B (Replace)	Size AC units to 100% of Manual J	740	577	546,120	$ 155,400	Y	2.23%	13	26	39	51	64	77	90	103	116	129	142	154	167	180	193	206	219	232	245	257
One Inch insul. On ducts in attic	Add two more inches of insulation	3,145	503	581,825	$ 1,887,000	Y	1.44%	7	14	22	29	36	43	51	58	65	72	80	87	94	101	109	116	123	130	138	145
Gas Heat and 13 SEER AC	Install AC SEER = 16	848	305	218,784	$ 712,320	Y	0.97%	3	6	9	12	15	18	21	24	27	30	33	36	38	41	44	47	50	53	56	59
Home has 13 SEER Heat Pump	Install Heat Pump SEER = 16	66	36	40,920	$ 49,500	Y	1.20%	0	1	1	2	2	3	3	3	4	4	5	5	6	6	7	7	7	8	8	9
Home has electric strip heat	Install Heat Pump SEER = 16	77	87	270,193	$ 369,600	Y	0.30%	0	1	1	1	1	2	2	2	2	3	3	3	3	4	4	4	4	5	5	5
No programmable thermostat	Install programmable thermostat	7,863	472	3,884,322	$ 1,572,600	Y	9.41%	44	89	133	178	222	266	311	355	400	444	488	533	577	622	666	710	755	799	843	888
Attic Insulation = R-11	Add another R-19 attic insulation	1,101	374	553,803	$ 890,709	Y	2.63%	10	20	30	39	49	59	69	79	89	98	108	118	128	138	148	158	167	177	187	197
Exposed Walls not insulated	Add R-11 wall insulation	944	538	2,376,048	$ 3,304,000	Y	0.68%	4	7	11	15	18	22	26	29	33	37	40	44	48	51	55	59	62	66	70	73
Floor over basement not insulate	Add R-19 wall insulation	1,573	-204	-353,925	$ 618,189	Y	2.11%	-4	-9	-13	-17	-22	-26	-30	-35	-39	-43	-47	-52	-56	-60	-65	-69	-73	-78	-82	-86
House infiltration = 0.8 ACH	Reduce infiltration to 0.35 ACH	6,290	2,579	6,547,890	$ 3,145,000	Y	6.97%	180	359	539	719	899	1,078	1,258	1,438	1,618	1,797	1,977	2,157	2,337	2,516	2,696	2,876	3,056	3,235	3,415	3,595
Single Pane Window B	Install Low E double pane window 2904	1,635	785	1,801,770	$ 572,250	Y	3.85%	30	60	91	121	151	181	212	242	272	302	332	363	393	423	453	483	514	544	574	604
NO E&W Window Shading A	Add solar screens to E&W sides	10,221	6,746	1,635,360	$ 2,637,018	Y	1.48%	100	200	300	399	499	599	699	799	899	998	1,098	1,198	1,298	1,398	1,498	1,597	1,697	1,797	1,897	1,997
NO E&W Window Shading B	Plant decidous trees on E&W sides	7,666	997	2,506,782	$ 6,899,400	Y	0.80%	8	16	24	32	40	48	56	64	72	80	88	96	104	112	120	128	136	144	151	159
No Compact Florescent Lamps	Use 3 more CFLs throughout the house	9,435	255	2,352,146	$ 424,575	Y	3.01%	8	15	23	31	38	46	54	61	69	77	84	92	100	107	115	123	130	138	146	153
Refrigerator needs to be replaced	Purchase Energy Star Refridgerator	1,227	12	74,847	$ 245,400	Y	7.31%	1	2	3	4	4	5	6	7	8	9	10	11	12	13	13	14	15	16	17	18
Refrigerator early retirement	Purchase Energy Star Refridgerator	4,246	340	2,742,916	$ 212,300	Y	8.68%	29	59	88	118	147	177	206	236	265	295	324	354	383	413	442	472	501	531	560	590
Dishwasher to be replaced	Purchase Energy Star dishwasher	3,516	211	260,184	$ 527,400	Y	10.00%	21	42	63	84	105	127	148	169	190	211	232	253	274	295	316	338	359	380	401	422
Clothes washer to be replaced	Purchase Energy Star clothes washer	2,975	327	446,250	$ 1,190,000	Y	4.16%	14	27	41	54	68	82	95	109	123	136	150	163	177	191	204	218	231	245	259	272
No low flow shower heads	Install low flow shower heads	1,573	0	196,625	$ 31,460	Y	10.00%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hot water pipes not insulated	Insulate hot water pipes	13,366	0	815,326	$ 1,269,770	Y	7.29%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Electric water heater not wrapped	Wrap electric water heater	7,863	0	1,525,422	$ 471,780	Y	10.00%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gas water heater not wrapped	Wrap gas water heater	11,165	0	0	$ 669,900	Y	6.66%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Program Description		Total System																									
Potential Situation	Improvement	Total Installs	Total Potential kW Savings	Total Potential kWh Savings	Total Differential Cost	B/C >1 (Y)	Market Capture Rate																				
Gas Heat and 3 Ton 10 SEER A(	Replace With 3 Ton 16 SEER AC	1,425	1,349	955,178	$ 5,415,000	Y	0.00%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Heating System Replacement	Install Variable Speed Fan Unit	5,189	0	435,876	$ 3,632,300	Y	0.00%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Two Refrigerators in Home A	Recycle 2nd Refrigerator w/ Coolant	4,497	404.73	3,558,926	$ 67,455	Y	0.00%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Two Refrigerators in Home B	Recycle 2nd Refrigerator w/o Coolant	4,497	404.73	3,558,926	$ 44,970	Y	0.00%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Phantom Electric Loads	Install Power Strips with Auto Shutoff	14,153	0	6,368,850	$ 566,120	Y	0.00%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Exterior Lighting Replacement	Install Solar Powered Lights	7,863	0	2,752,050	$ 912,108	Y	0.00%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL SINGLE FAMILY HOME DSM - RESIDENTIAL MANAGED (kW)								755	1,511	2,266	3,022	3,777	4,532	5,288	6,043	6,798	7,554	8,309	9,065	9,820	10,575	11,331	12,086	12,841	13,597	14,352	15,108
TOTAL DSM (MW)								1	2	2	3	4	5	5	6	7	8	8	9	10	11	11	12	13	14	14	15

CWL MANAGED DSM - APARTMENTS

DSM Option Description			Apartments - Owned		Apartments - Rented		Total System						2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
Potential Situation	Improvement	Max Raw Program Potential	Number of Customers	Maximum Number of Installs	Number of Customers	Maximum Number of Installs	Total Installs	Total Potential kW Savings	Total Potential kWh Savings	Total Differential Cost	B/C >1 (Y)	Market Capture Rate																				
No Compact Florescent Lamps	Use 3 more CFLs throughout the house	60.00%	0	0	14,231	8,539	8,539	231	57,477	$ 2,586,459	Y	20.00%	46	92	138	184	231	231	231	231	231	231	231	231	231	231	231	231	231	231	231	231
Refrigerator needs to be replace	Purchase Energy Star Refrigerator	7.80%	0	0	14,231	1,110	1,110	11	677	$ 135,420		0.00%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Refrigerator early retirement	Purchase Energy Star Refrigerator	27.00%	0	0	14,231	3,842	3,842	307	198,555	$ 9,927,728	Y	20.00%	61	123	184	246	307	307	307	307	307	307	307	307	307	307	307	307	307	307	307	307
Dishwasher to be replaced	Purchase Energy Star dishwasher	22.36%	0	0	14,231	3,182	3,182	191	14,128	$ 2,119,212		0.00%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Clothes washer to be replaced	Purchase Energy Star clothes washer	18.92%	0	0	14,231	2,693	2,693	296	44,435	$ 17,773,800		0.00%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
No low flow shower heads	Install low flow shower heads	10.00%	0	0	14,231	1,423	1,423	0	0	$ -	Y	20.00%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hot water pipes not insulated	Insulate hot water pipes	85.00%	0	0	14,231	12,096	12,096	0	0	$ -		0.00%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Electric water heater not wrappe	Wrap electric water heater	50.00%	0	0	14,231	7,116	7,116	0	0	$ -	Y	20.00%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
												TOTAL DSM (kW)	108	215	323	430	538	538	538	538	538	538	538	538	538	538	538	538	538	538	538	538
												TOTAL DSM (MW)	0.11	0.22	0.32	0.43	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54

CUSTOMER MANAGED DSM - APARTMENTS

DSM Option Description			Apartments - Owned		Apartments - Rented		Total System						2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
Potential Situation	Improvement	Max Raw Program Potential	Number of Customers	Maximum Number of Installs	Number of Customers	Maximum Number of Installs	Total Installs	Total Potential kW Savings	Total Potential kWh Savings	Total Differential Cost	B/C >1 (Y)	Market Capture Rate																				
No Compact Florescent Lamps	Use 3 more CFLs throughout the house	60.00%	0	0	14,231	0	0	0	0	$ -	Y	3.01%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Refrigerator needs to be replaced	Purchase Energy Star Refrigerator	7.80%	0	0	14,231	0	0	0	0	$ -		0.00%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Refrigerator early retirement	Purchase Energy Star Refrigerator	27.00%	0	0	14,231	0	0	0	0	$ -	Y	8.68%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Dishwasher to be replaced	Purchase Energy Star dishwasher	22.36%	0	0	14,231	0	0	0	0	$ -		0.00%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Clothes washer to be replaced	Purchase Energy Star clothes washer	18.92%	0	0	14,231	0	0	0	0	$ -		0.00%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
No low flow shower heads	Install low flow shower heads	10.00%	0	0	14,231	0	0	0	0	$ -	Y	10.00%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hot water pipes not insulated	Insulate hot water pipes	85.00%	0	0	14,231	0	0	0	0	$ -		0.00%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Electric water heater not wrappe	Wrap electric water heater	50.00%	0	0	14,231	0	0	0	0	$ -	Y	10.00%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
												TOTAL DSM (kW)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
												TOTAL DSM (MW)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

CWL MANAGED DSM - DUPLEXES

DSM Option Description			Duplexes - Owned		Duplexes - Rented		Total System						2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
Potential Situation	Improvement	Max Raw Potential	Number of Customers	Maximum Potential	Number of Customers	Maximum Potential	Total Installs	Total Potential kW Savings	Total Potential kWh Savings	Total Differential Cost	B/C >1 (Y)	Market Capture Rate																				
AC Refrigerant under charged	Add refrigerant	31.00%	0	0	5,156	1,598	1,598	88	357,952	$ 199,750	Y	20.00%	18	35	53	70	88	88	88	88	88	88	88	88	88	88	88	88	88	88	88	88
AC Refrigerant over charged	Remove refrigerant	26.00%	0	0	5,156	1,341	1,341	67	67,050	$ 67,050	Y	20.00%	13	27	40	54	67	67	67	67	67	67	67	67	67	67	67	67	67	67	67	67
Low Evaporator Airflow A	Increase duct sizes or add new ducts	60.00%	0	0	5,156	3,094	3,094	1,160	1,171,079	$ 1,469,650	Y	20.00%	232	464	696	928	1,160	1,160	1,160	1,160	1,160	1,160	1,160	1,160	1,160	1,160	1,160	1,160	1,160	1,160	1,160	1,160
Low Evaporator Airflow B	Increase blower speed	12.00%	0	0	5,156	619	619	173	194,985	$ 30,950	Y	20.00%	35	69	104	139	173	173	173	173	173	173	173	173	173	173	173	173	173	173	173	173
High Duct Leakage (25%)	Reduce duct leakage to 5%	66.00%	0	0	5,156	3,403	3,403	715	906,900	$ 1,020,900	Y	20.00%	143	286	429	572	715	715	715	715	715	715	715	715	715	715	715	715	715	715	715	715
Oversized AC Units A (New)	Size AC units to 100% of Manual J	0.64%	0	0	5,156	33	33	5	4,059	$ 5,181	Y	20.00%	1	2	3	4	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
Oversized AC Units B (Replace)	Size AC units to 100% of Manual J	4.70%	0	0	5,156	243	243	95	89,667	$ 25,515	Y	20.00%	19	38	57	76	95	95	95	95	95	95	95	95	95	95	95	95	95	95	95	95
One Inch insul. On ducts in attic	Add two more inches of insulation	20.00%	0	0	5,156	1,031	1,031	82	95,368	$ 309,300		0.00%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gas Heat and 13 SEER AC	Install AC SEER = 16	5.39%	0	0	5,156	278	278	50	35,862	$ 116,760		0.00%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Home has 13 SEER Heat Pump	Install Heat Pump SEER = 16	0.42%	0	0	5,156	22	22	6	6,820	$ 8,250	Y	20.00%	1	2	4	5	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6
Home has electric strip heat	Install Heat Pump SEER = 16	0.49%	0	0	5,156	25	25	14	43,863	$ 60,000	Y	20.00%	3	6	8	11	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14
No programmable thermostat	Install programmable thermostat	50.00%	0	0	5,156	2,578	2,578	77	636,766	$ 257,800	Y	20.00%	15	31	46	62	77	77	77	77	77	77	77	77	77	77	77	77	77	77	77	77
Attic Insulation = R-11	Add another R-19 attic insulation	7.00%	0	0	5,156	361	361	61	90,792	$ 146,025	Y	20.00%	12	25	37	49	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61
Exposed Walls not insulated	Add R-11 wall insulation	6.00%	0	0	5,156	309	309	66	291,657	$ 405,563	Y	20.00%	13	26	40	53	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66
Floor over basement not insulate	Add R-19 wall insulation	10.00%	0	0	5,156	516	516	-34	-58,050	$ 101,394		0.00%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
House infiltration = 0.8 ACH	Reduce infiltration to 0.35 ACH	40.00%	0	0	5,156	2,062	2,062	317	804,953	$ 386,625	Y	20.00%	63	127	190	254	317	317	317	317	317	317	317	317	317	317	317	317	317	317	317	317
Single Pane Window B	Install Low E double pane window 2904	10.40%	0	0	5,156	536	536	96	221,502	$ 70,350	Y	20.00%	19	39	58	77	96	96	96	96	96	96	96	96	96	96	96	96	96	96	96	96
NO E&W Window Shading A	Add solar screens to E&W sides	65.00%	0	0	5,156	3,351	3,351	829	201,060	$ 324,209	Y	20.00%	166	332	498	663	829	829	829	829	829	829	829	829	829	829	829	829	829	829	829	829
NO E&W Window Shading B	Plant deciduous trees on E&W sides	48.75%	0	0	5,156	2,514	2,514	123	308,279	$ 848,475		0.00%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
No Compact Florescent Lamps	Use 3 more CFLs throughout the house	60.00%	0	0	5,156	3,094	3,094	84	771,334	$ 139,230	Y	20.00%	17	33	50	67	84	84	84	84	84	84	84	84	84	84	84	84	84	84	84	84
Refrigerator needs to be replace	Purchase Energy Star Refrigerator	7.80%	0	0	5,156	402	402	4	24,522	$ 80,400		0.00%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Refrigerator early retirement	Purchase Energy Star Refrigerator	27.00%	0	0	5,156	1,392	1,392	111	899,232	$ 69,600	Y	20.00%	22	45	67	89	111	111	111	111	111	111	111	111	111	111	111	111	111	111	111	111
Dishwasher to be replaced	Purchase Energy Star dishwasher	22.36%	0	0	5,156	1,153	1,153	69	85,322	$ 172,950		0.00%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Clothes washer to be replaced	Purchase Energy Star clothes washer	18.92%	0	0	5,156	976	976	107	146,400	$ 390,400		0.00%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
No low flow shower heads	Install low flow shower heads	10.00%	0	0	5,156	516	516	0	64,500	$ 10,320	Y	20.00%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hot water pipes not insulated	Insulate hot water pipes	85.00%	0	0	5,156	4,383	4,383	0	267,363	$ 416,385		0.00%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Electric water heater not wrappe	Wrap electric water heater	50.00%	0	0	5,156	2,578	2,578	0	500,132	$ 154,680	Y	20.00%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gas water heater not wrapped	Wrap gas water heater	71.00%	0	0	5,156	3,661	3,661	0	0	$ 219,660		0.00%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL DUPLEX DSM - CWL MANAGED (kW)													793	1,586	2,379	3,172	3,966	3,966	3,966	3,966	3,966	3,966	3,966	3,966	3,966	3,966	3,966	3,966	3,966	3,966	3,966	3,966
TOTAL DSM (kW)													0.79	1.59	2.38	3.17	3.97	3.97	3.97	3.97	3.97	3.97	3.97	3.97	3.97	3.97	3.97	3.97	3.97	3.97	3.97	3.97

CUSTOMER MANAGED DSM - DUPLEXES

DSM Option Description			Duplexes - Owned		Duplexes - Rented		Total System						2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
Potential Situation	Improvement	Max Raw Potential	Number of Customers	Maximum Potential	Number of Customers	Maximum Number of Installs	Total Installs	Total Potential kW Savings	Total Potential kWh Savings	Total Differential Cost	B/C >1 (Y)	Market Capture Rate																				
AC Refrigerant under charged	Add refrigerant	31.00%	0	0	5,156	0	0	0	0	$ -	Y	3.02%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AC Refrigerant over charged	Remove refrigerant	26.00%	0	0	5,156	0	0	0	0	$ -	Y	3.73%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Low Evaporator Airflow A	Increase duct sizes or add new ducts	60.00%	0	0	5,156	0	0	0	0	$ -	Y	1.06%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Low Evaporator Airflow B	Increase blower speed	12.00%	0	0	5,156	0	0	0	0	$ -	Y	10.00%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
High Duct Leakage (25%)	Reduce duct leakage to 5%	66.00%	0	0	5,156	0	0	0	0	$ -	Y	1.72%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Oversized AC Units A (New)	Size AC units to 100% of Manual J	0.64%	0	0	5,156	0	0	0	0	$ -	Y	1.26%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Oversized AC Units B (Replace)	Size AC units to 100% of Manual J	4.70%	0	0	5,156	0	0	0	0	$ -	Y	2.23%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
One Inch insul. On ducts in attic	Add two more inches of insulation	20.00%	0	0	5,156	0	0	0	0	$ -		0.00%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gas Heat and 13 SEER AC	Install AC SEER = 16	5.39%	0	0	5,156	0	0	0	0	$ -		0.00%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Home has 13 SEER Heat Pump	Install Heat Pump SEER = 16	0.42%	0	0	5,156	0	0	0	0	$ -	Y	1.20%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Home has electric strip heat	Install Heat Pump SEER = 16	0.49%	0	0	5,156	0	0	0	0	$ -	Y	0.30%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
No programmable thermostat	Install programmable thermostat	50.00%	0	0	5,156	0	0	0	0	$ -	Y	9.41%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Attic Insulation = R-11	Add another R-19 attic insulation	7.00%	0	0	5,156	0	0	0	0	$ -	Y	2.63%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Exposed Walls not insulated	Add R-11 wall insulation	6.00%	0	0	5,156	0	0	0	0	$ -	Y	0.68%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Floor over basement not insulate	Add R-19 wall insulation	10.00%	0	0	5,156	0	0	0	0	$ -		0.00%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
House infiltration = 0.8 ACH	Reduce infiltration to 0.35 ACH	40.00%	0	0	5,156	0	0	0	0	$ -	Y	6.97%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Single Pane Window B	Install Low E double pane window 2904	10.40%	0	0	5,156	0	0	0	0	$ -	Y	3.85%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
NO E&W Window Shading A	Add solar screens to E&W sides	65.00%	0	0	5,156	0	0	0	0	$ -	Y	1.48%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
NO E&W Window Shading B	Plant deciduous trees on E&W sides	48.75%	0	0	5,156	0	0	0	0	$ -		0.00%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
No Compact Florescent Lamps	Use 3 more CFLs throughout the house	60.00%	0	0	5,156	0	0	0	0	$ -	Y	3.01%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Refrigerator needs to be replaced	Purchase Energy Star Refrigerator	7.80%	0	0	5,156	0	0	0	0	$ -		0.00%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Refrigerator early retirement	Purchase Energy Star Refrigerator	27.00%	0	0	5,156	0	0	0	0	$ -	Y	8.68%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Dishwasher to be replaced	Purchase Energy Star dishwasher	22.36%	0	0	5,156	0	0	0	0	$ -		0.00%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Clothes washer to be replaced	Purchase Energy Star clothes washer	18.92%	0	0	5,156	0	0	0	0	$ -		0.00%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
No low flow shower heads	Install low flow shower heads	10.00%	0	0	5,156	0	0	0	0	$ -	Y	10.00%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hot water pipes not insulated	Insulate hot water pipes	85.00%	0	0	5,156	0	0	0	0	$ -		0.00%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Electric water heater not wrappe	Wrap electric water heater	50.00%	0	0	5,156	0	0	0	0	$ -	Y	10.00%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gas water heater not wrapped	Wrap gas water heater	71.00%	0	0	5,156	0	0	0	0	$ -		0.00%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL DUPLEX DSM - RESIDENTIAL MANAGED (kW)													0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL DSM (MW)													0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

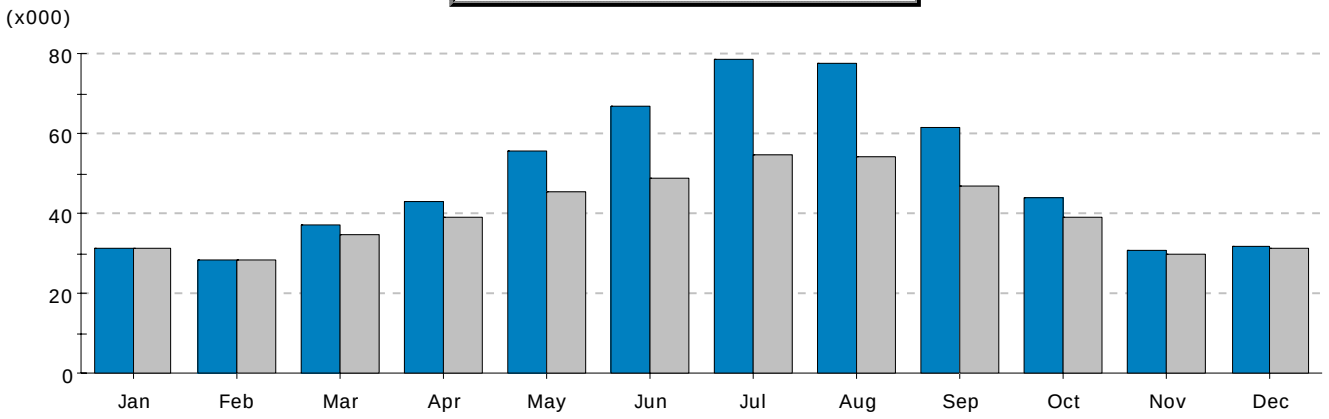
CWL MANAGED DSM - COMMERCIAL & INDUSTRIAL

Program Description		Total System																														
Potential Situation	Improvement	Total Potential kW Savings	Total Potential kWh Savings	Total Differential Cost	B/C >1 (Y)	Market Capture Rate	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
Inefficient HVAC	Install New HVAC	5,919	7,654,314	$ 16,509,122		0.00%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Inefficient Appliance	Install New Appliance	142	3,044,889	$ 7,760,387		0.00%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Inefficient Lighting	Install New Lighting	8,432	24,111,937	$ 7,118,992	Y	20.00%	1,686	3,373	5,059	6,746	8,432	8,432	8,432	8,432	8,432	8,432	8,432	8,432	8,432	8,432	8,432	8,432	8,432	8,432	8,432	8,432
Inefficient Machine Drive	Install New Machine Drive	1,835	11,253,470	$5,118,384		0.00%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Inefficient HVAC	Install New HVAC	318	1,952,620	$888,105		0.00%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Inefficient Lighting	Install New Lighting	249	1,524,744	$ 209,864	Y	20.00%	50	100	149	199	249	249	249	249	249	249	249	249	249	249	249	249	249	249	249	249
TOTAL COMMERCIAL DSM - CWL MANAGED (kW)							1,736	3,472	5,209	6,945	8,681	8,681	8,681	8,681	8,681	8,681	8,681	8,681	8,681	8,681	8,681	8,681	8,681	8,681	8,681	8,681
TOTAL DSM (MW)							2	3	5	7	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9

CUSTOMER MANAGED DSM - COMMERCIAL & INDUSTRIAL

Program Description		Total System					2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
Potential Situation	Improvement	Total Potential kW Savings	Total Potential kWh Savings	Total Differential Cost	B/C >1 (Y)	Market Capture Rate																				
Inefficient HVAC	Install New HVAC	5,919	7,654,314	$ 16,509,122	Y	6.67%	395	789	1,184	1,578	1,973	2,368	2,762	3,157	3,551	3,946	4,341	4,735	5,130	5,524	5,919	5,919	5,919	5,919	5,919	5,919
Inefficient Appliance	Install New Appliance	142	3,044,889	$ 7,760,387	Y	6.67%	9	19	28	38	47	57	66	76	85	95	104	114	123	133	142	142	142	142	142	142
Inefficient Lighting	Install New Lighting	8,432	24,111,937	$ 7,118,992	Y	6.67%	562	1,124	1,686	2,249	2,811	3,373	3,935	4,497	5,059	5,621	6,183	6,746	7,308	7,870	8,432	8,432	8,432	8,432	8,432	8,432
Inefficient Machine Drive	Install New Machine Drive	1,835	11,253,470	$ 5,118,384	Y	6.67%	122	245	367	489	612	734	856	979	1,101	1,223	1,346	1,468	1,590	1,713	1,835	1,835	1,835	1,835	1,835	1,835
Inefficient HVAC	Install New HVAC	318	1,952,620	$ 888,105	Y	6.67%	21	42	64	85	106	127	148	170	191	212	233	254	276	297	318	318	318	318	318	318
Inefficient Lighting	Install New Lighting	249	1,524,744	$ 209,864	Y	6.67%	17	33	50	66	83	100	116	133	149	166	183	199	216	232	249	249	249	249	249	249
TOTAL COMMERCIAL DSM - COMMERCIAL MANAGED (kW)							1,126	2,253	3,379	4,505	5,632	6,758	7,884	9,011	10,137	11,263	12,390	13,516	14,642	15,769	16,895	16,895	16,895	16,895	16,895	16,895
TOTAL DSM (MW)							1	2	3	5	6	7	8	9	10	11	12	14	15	16	17	17	17	17	17	17

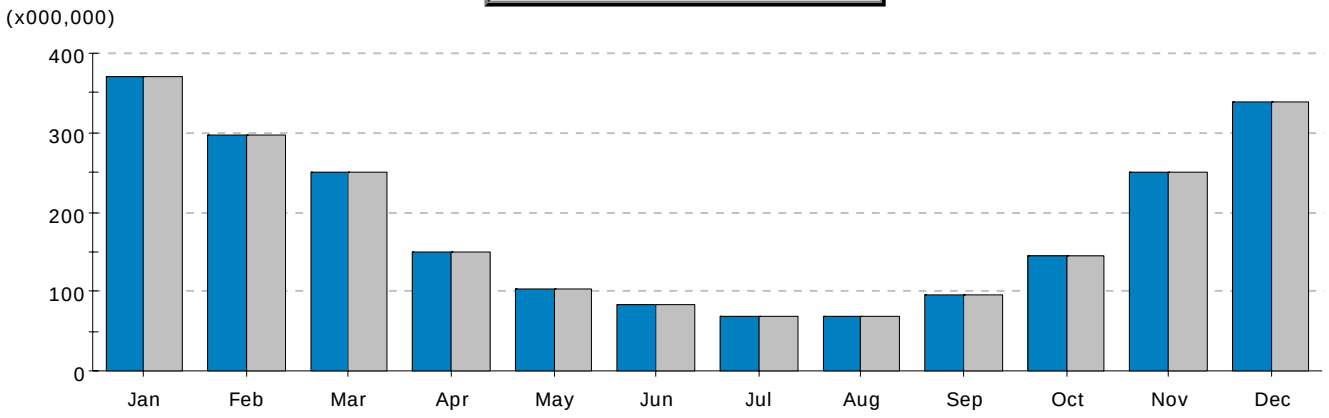
Electric Consumption (kWh)



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Run 1.	31.42	28.41	37.00	42.76	55.63	66.96	78.54	77.33	61.68	44.08	30.52	31.47	585.78
Run 2.	31.42	28.39	34.74	38.80	45.24	49.00	54.58	54.38	46.82	39.24	29.97	31.42	483.98
Run 3.													
Run 4.													
Run 5.													

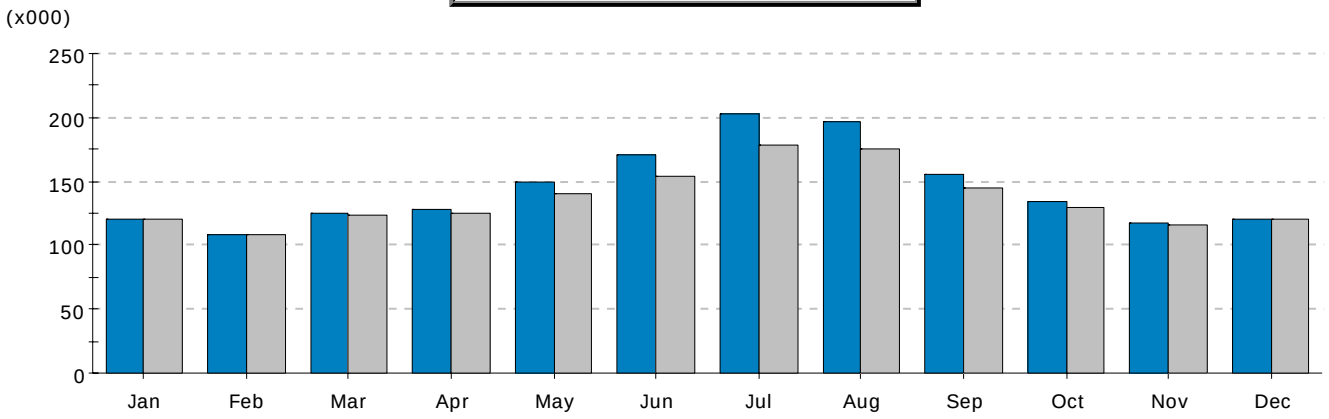
1. Columbia Bank - Baseline Design (02/05/08 @ 14:11)
2. Columbia Bank - Turbocor - Baseline Design (02/05/08 @ 14:09)

Gas Consumption (Btu)



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Run 1.	370.9	297.3	249.2	149.7	104.0	82.8	69.4	68.0	96.6	144.9	250.2	339.3	2,222.5
Run 2.	370.9	297.3	249.2	149.7	104.0	82.8	69.4	68.0	96.6	144.9	250.2	339.3	2,222.5
Run 3.													
Run 4.													
Run 5.													

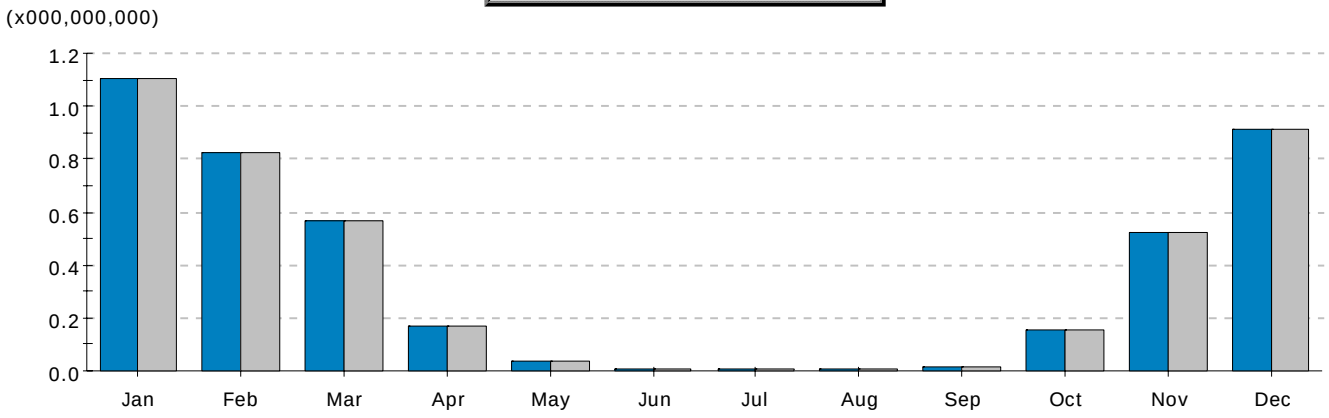
Electric Consumption (kWh)



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Run 1.	119.9	108.1	125.4	128.3	148.8	170.1	202.2	196.6	156.0	133.5	116.9	120.0	1,726.0
Run 2.	119.9	108.1	123.8	125.0	140.2	154.0	178.1	174.6	144.2	129.7	116.4	120.0	1,634.1
Run 3.													
Run 4.													
Run 5.													

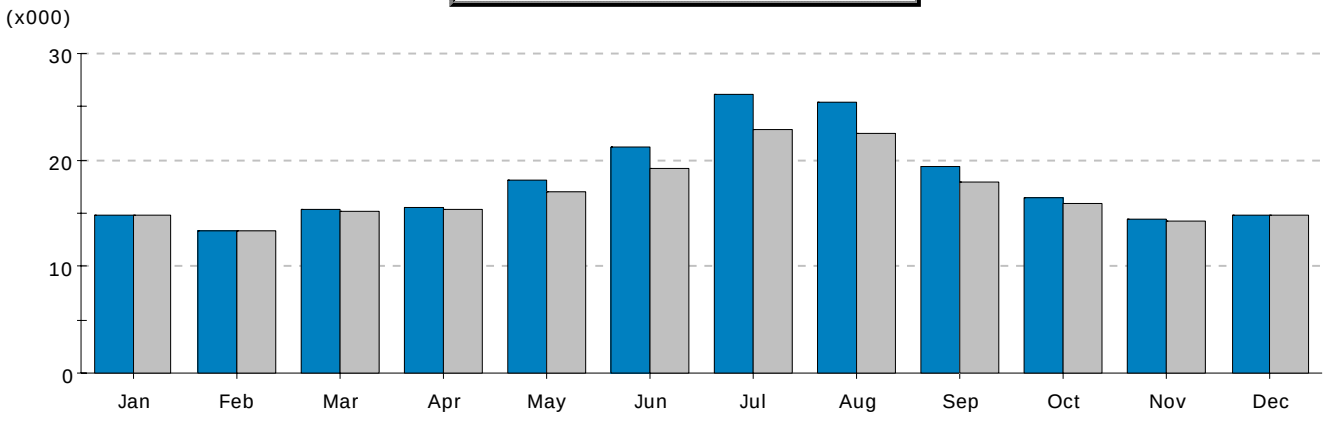
1. Columbia Discount Store - Baseline Design (02/05/08 @ 10:07)
2. Columbia Discount Store-EER11-6 - Baseline Design (02/05/08 @ 10:08)

Gas Consumption (Btu)



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Run 1.	1.11	0.82	0.56	0.17	0.04	0.01	0.00	0.00	0.01	0.15	0.52	0.91	4.32
Run 2.	1.11	0.82	0.56	0.17	0.04	0.01	0.00	0.00	0.01	0.15	0.52	0.91	4.32
Run 3.													
Run 4.													
Run 5.													

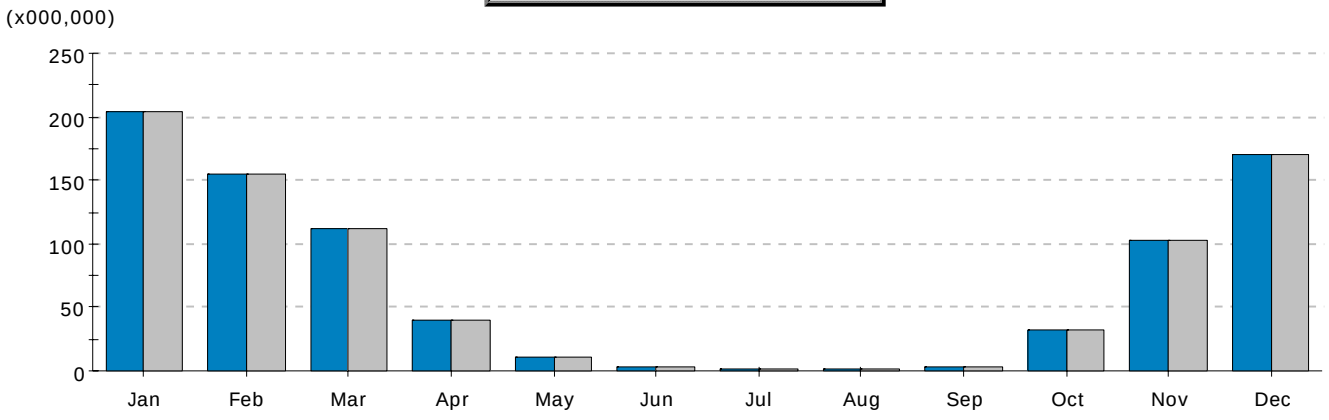
Electric Consumption (kWh)



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Run 1.	14.85	13.39	15.38	15.58	18.05	21.16	26.07	25.43	19.45	16.40	14.37	14.85	214.97
Run 2.	14.85	13.39	15.22	15.29	17.10	19.12	22.79	22.41	17.92	15.98	14.31	14.85	203.25
Run 3.													
Run 4.													
Run 5.													

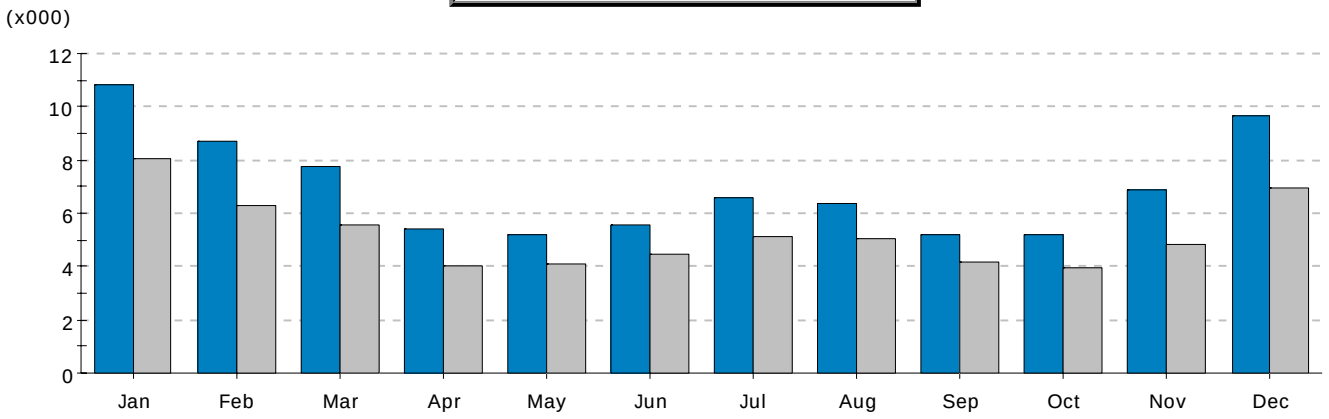
1. Columbia Discount Store-small - Baseline Design (02/05/08 @ 09:43)
2. Columbia Discount Store-small-EER12 - Baseline Design (02/05/08 @ 09:45)

Gas Consumption (Btu)



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Run 1.	204.07	155.52	112.30	40.22	11.06	2.67	1.01	1.02	3.27	31.97	102.79	170.78	836.67
Run 2.	204.07	155.52	112.30	40.22	11.06	2.67	1.01	1.02	3.27	31.97	102.79	170.78	836.67
Run 3.													
Run 4.													
Run 5.													

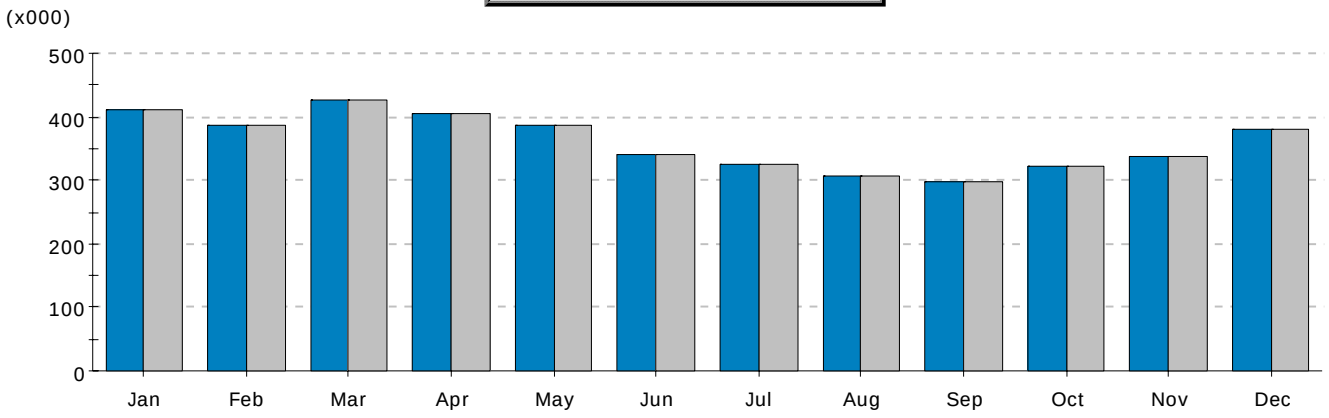
Electric Consumption (kWh)



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Run 1.	10.84	8.72	7.74	5.39	5.16	5.55	6.58	6.40	5.22	5.23	6.90	9.64	83.37
Run 2.	8.03	6.30	5.54	4.01	4.10	4.46	5.16	5.03	4.18	3.93	4.82	6.95	62.51
Run 3.													
Run 4.													
Run 5.													

1. Fast Food - Columbia - Baseline Design (09/24/07 @ 14:00)
2. Fast Food - HP - Columbia - Baseline Design (09/24/07 @ 14:03)

Gas Consumption (Btu)



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Run 1.	410.4	385.8	427.6	405.5	386.1	342.0	325.2	307.2	296.6	321.3	338.3	381.5	4,327.5
Run 2.	410.4	385.8	427.6	405.6	386.1	342.0	325.2	307.2	296.6	321.3	338.3	381.5	4,327.6
Run 3.													
Run 4.													
Run 5.													

Products that earn the ENERGY STAR prevent greenhouse gas emissions by meeting strict energy efficiency guidelines set by the U.S. Environmental Protection Agency and the U.S. Department of Energy.
www.energystar.gov

CHANGE FOR THE BETTER WITH ENERGY STAR

Life Cycle Cost Estimate for 1 ENERGY STAR Qualified Desktop/Side Computer(s)

This energy savings calculator was developed by the U.S. EPA and U.S. DOE and is provided for estimating purposes only. Actual energy savings may vary based on use and other factors.

Enter your own values in the gray boxes or use our default values.

Electricity Rate ($/kWh)	$0.101		
Does your current computer(s) have sleep settings activated?	No		
Will your new ENERGY STAR computer(s) have sleep settings activated?*	Yes		
	Quantity	**ENERGY STAR Qualified Unit**	**Conventional Unit**
		Initial cost per unit	Initial cost per unit
Computer(s)	1	$735	$735

**EPA strongly recommends that you consider power managing your computers, before power managing your computer at work consult your IT staff.*

Annual and Life Cycle Costs and Savings for 1 Computer(s)

	1 ENERGY STAR Qualified Units	1 Conventional Units	Savings with ENERGY STAR
Annual Operating Costs*			
Electricity costs	$8	$19	$10
Annual electricity consumption (kWh)	*84*	*187*	*103*
Maintenance costs	$0	$0	$0
Total	**$8**	**$19**	**$10**
Life Cycle Costs*			
Life cycle operating cost (electricity and maintenance)	$31	$68	$38
Electricity costs (lifetime)	$31	$68	$38
Maintenance costs (lifetime)	$0	$0	$0
Purchase price for 1 unit(s)	$735	$735	$0
Total	**$766**	**$803**	**$38**
		Simple payback of initial additional cost (years)†	**0.0**

** Calculator assumes that 100% of users turn off their computer(s) at night. Annual costs exclude the initial purchase price. All costs, except initial cost, are discounted over the products' lifetime using a real discount rate of 4%. See "Assumptions" to change factors including the discount rate night time turn off rate.*

†

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www.energystar.gov

CHANGE FOR THE BETTER WITH ENERGY STAR

Life Cycle Cost Estimate for 5 ENERGY STAR Qualified Copiers

This energy savings calculator was developed by the U.S. EPA and U.S. DOE and is provided for estimating purposes only. Actual energy savings may vary based on use and other factors.

Enter your own values in the gray boxes or use our default values.

Electricity Rate ($/kWh): $0.110

	Quantity	Speed (ipm*)	ENERGY STAR Qualified Unit Initial cost per unit	Conventional Unit Initial cost per unit
Low speed copiers (1-20 cpm)	1.00	19	$240	$240
Medium speed copiers (21-40 cpm)	1.00	34	$840	$840
High speed copiers (>40 cpm)	1.00	44	$4,797	$4,797
Color copier (<= 50 cpm)	1.00	44	$4,751	$4,751
Color copier (> 50 cpm)	1.00	54	$7,982	$7,982

*i pm = default number of A4 (8.5" x 11" single side) copies per minute

Annual and Life Cycle Costs and Savings for 5 Copiers

	5 ENERGY STAR Qualified Units	5 Conventional Units	Savings with ENERGY STAR
Annual Operating Costs*			
Electricity costs	$243	$739	$496
Annual electricity consumption (kWh)	*2,205*	*6,714*	*4,509*
Low speed copiers (1-20 ipm)	*146*	*158*	*12*
Medium speed copiers (21-40 ipm)	*302*	*660*	*358*
High speed copiers (>40 ipm)	*406*	*2,490*	*2,084*
Color Copier (<= 50 ipm)	*562*	*1,296*	*735*
Color Copier (> 50 ipm)	*790*	*2,110*	*1,320*
Maintenance costs	$0	$0	$0
Total	**$243**	**$739**	**$496**
Life Cycle Costs*			
Life cycle operating cost (electricity and maintenance)	$1,271	$3,872	$2,600
Purchase price for 5 unit(s)	$18,610	$18,610	$0
Total	**$19,882**	**$22,482**	**$2,600**
		Simple payback of initial additional cost (years)†	**0.0**

* *Annual costs exclude the initial purchase price. All costs, except initial cost, are discounted over the products' lifetime using a real discount rate of 4%. See "Assumptions" to change factors including the discount rate.*

† *A simple payback period of zero years means that the payback is immediate.*

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www.energystar.gov

CHANGE FOR THE BETTER WITH ENERGY STAR

Life Cycle Cost Estimate for 1 ENERGY STAR Qualified Fax Machines

This energy savings calculator was developed by the U.S. EPA and U.S. DOE and is provided for estimating purposes only. Actual energy savings may vary based on use and other factors.

Enter your own values in the gray boxes or use our default values.

Electricity Rate ($/kWh): $0.101

	Quantity	Speed (ipm)*	ENERGY STAR Qualified Unit initial cost per unit	Conventional Unit initial cost per unit
Fax - Monochrome	1	20	$81	$81

**ipm = images per minute (1 8.5" x 11" single side page per minute = 1 ipm)*

Annual and Life Cycle Costs and Savings for 1 Fax Machines

	1 ENERGY STAR Qualified Units	1 Conventional Units	Savings with ENERGY STAR
Annual Operating Costs*			
Electricity cost	$16	$32	$17
Annual electricity consumption (kWh)	*156*	*321*	*165*
Maintenance cost	$0	$0	$0
Total	**$16**	**$32**	**$17**
Life Cycle Costs*			
Life cycle operating cost (electricity and maintenance)	$57	$118	$60
Purchase price for 1 unit(s)	$81	$81	$0
Total	**$138**	**$198**	**$60**
Simple payback of initial additional cost (years)†			**0.0**

** Annual costs exclude the initial purchase price. All costs, except initial cost, are discounted over the products' lifetime using a real discount rate of 4%. See "Assumptions" to change factors including the discount rate.*

† A simple payback period of zero years means that the payback is immediate.

Summary of Benefits for 1 Fax Machines

Initial cost difference	**$0**

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CHANGE FOR THE BETTER WITH ENERGY STAR

Life Cycle Cost Estimate for 1 ENERGY STAR Qualified Computer Monitors

This energy savings calculator was developed by the U.S. EPA and U.S. DOE and is provided for estimating purposes only. Actual energy savings may vary based on use and other factors.

Enter your own values in the gray boxes or use our default values.

Electricity Rate ($/kWh)	$0.091		
	Quantity	**ENERGY STAR Qualified Unit**	**Conventional Unit**
		Initial cost per unit	Initial cost per unit
15" LCD	1	$280	$280
None	0	$0	$0
None	0	$0	$0

Annual and Life Cycle Costs and Savings for 1 Computer Monitors

	1 ENERGY STAR Qualified Units	1 Conventional Units	Savings with ENERGY STAR
Annual Operating Costs*			
Electricity costs	$5	$14	$9
Annual electricity consumption (kWh)	*54*	*153*	*99*
15" LCD	*54*	*153*	*99*
None	*0*	*0*	*0*
None	*0*	*0*	*0*
Maintenance costs	$0	$0	$0
Total	**$5**	**$14**	**$9**
Life Cycle Costs*			
Life cycle operating cost (electricity and maintenance)	$18	$51	$33
Purchase price for 1 unit(s)	$280	$280	$0
Total	**$298**	**$331**	**$33**
		Simple payback of initial additional cost (years)†	**0.0**

** Annual costs exclude the initial purchase price. All costs, except initial cost, are discounted over the products' lifetime using a real discount rate of 4%. See "Assumptions" to change factors including the discount rate.*

† A simple payback period of zero years means that the payback is immediate.

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CHANGE FOR THE BETTER WITH ENERGY STAR

Life Cycle Cost Estimate for 1 ENERGY STAR Qualified Printers

This energy savings calculator was developed by the U.S. EPA and U.S. DOE and is provided for estimating purposes only. Actual energy savings may vary based on use and other factors.

Enter your own values in the gray boxes or use our default values.

Electricity Rate ($/kWh): $0.101

	Quantity	ENERGY STAR Qualified Unit Initial cost per unit	Conventional Unit Initial cost per unit
Monochrome Laser Printers (31-40 ppm*)	1	$1,011	$574
None	0	$0	$0
None	0	$0	$0

*ppm = pages per minute

Annual and Life Cycle Costs and Savings for 1 Printers

	1 ENERGY STAR Qualified Units	1 Conventional Units	Savings with ENERGY STAR
Annual Operating Costs*			
Electricity costs	$61	$117	$56
Annual electricity consumption (kWh)	*606*	*1,164*	*559*
Monochrome Laser Printers (31-40 ppm*)	*606*	*1,164*	*559*
None	*0*	*0*	*0*
None	*0*	*0*	*0*
Maintenance costs	$0	$0	$0
Total	**$61**	**$117**	**$56**
Life Cycle Costs*			
Life cycle operating cost (electricity and maintenance)	$272	$523	$251
Electricity costs (lifetime)	$272	$523	$251
Maintenance costs (lifetime)	$0	$0	$0
Purchase price for 1 unit(s)	$1,011	$574	-$437
Total	**$1,283**	**$1,096**	**-$186**

Simple payback of initial additional cost (years)† **0.0**

** Annual costs exclude the initial purchase price. All costs, except initial cost, are discounted over the products' lifetime using a real discount rate of 4%. See "Assumptions" to change factors including the discount rate.*

Products that earn the ENERGY STAR prevent greenhouse gas emissions by meeting strict energy efficiency guidelines set by the U.S. Environmental Protection Agency and the U.S. Department of Energy.
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CHANGE FOR THE BETTER WITH ENERGY STAR

Life Cycle Cost Estimate for 1 ENERGY STAR Qualified Scanners

This energy savings calculator was developed by the U.S. EPA and U.S. DOE and is provided for estimating purposes only. Actual energy savings may vary based on use and other factors.

Enter your own values in the gray boxes or use our default values.

Number of units	1	
Electricity Rate ($/kWh)	$0.101	
	ENERGY STAR Qualified Unit	**Conventional Unit**
Initial cost per unit (estimated retail price)	$150	$150

Annual and Life Cycle Costs and Savings for 1 Scanners

	1 ENERGY STAR Qualified Units	1 Conventional Units	Savings with ENERGY STAR
Annual Operating Costs*			
Electricity cost	$8	$16	$7
Annual electricity consumption (kWh)	*84*	*155*	*71*
Maintenance cost	$0	$0	$0
Total	**$8**	**$16**	**$7**
Life Cycle Costs*			
Life cycle operating cost (electricity and maintenance)	$31	$57	$26
Purchase price for 1 unit(s)	$150	$150	$0
Total	**$181**	**$207**	**$26**
		Simple payback of initial additional cost (years)†	**0.0**

** Annual costs exclude the initial purchase price. All costs, except initial cost, are discounted over the products' lifetime using a real discount rate of 4%. See "Assumptions" to change factors including the discount rate.*

† A simple payback period of zero years means that the payback is immediate.

APPENDIX E

DSM PROGRAM DEFINITION AND ASSUMPTIONS

DSM Programs

The program costs evaluated in this study were based on the aggressive assumption that CWL would cover half the cost of the labor and materials required to perform the specific retrofit for the program (i.e. 50 percent rebate). No cost was included for CWL general administration and overhead costs as well as ongoing management, measurement, and verification costs for the specific programs. These costs would include CWL staff and expenses that would be allocated across multiple programs.

Including these costs would lower the marginal benefit of all of the programs. However, a majority of the programs have extremely positive benefit / cost ratios which provides margin for the program costs. Therefore, it is recommended that in setting the ultimate rebates CWL should consider an allowance for these program costs as they are established through the CWL budget process.

CWL currently has various residential, commercial and industrial DSM programs in place. The program descriptions presented below are provided to give general guidelines for adjustments, if any, to the existing programs and for the new programs recommended in this Study. Where applicable, the programs are identified by Portfolio A, B, and C as used in the Strategist analysis. The order of implementation of new programs should be such that the Portfolio A are focused on first, B second and C third due to A having the higher benefit cost ratios and C the lower.

1. Residential Home Energy Audit Program

In order for CWL to effectively implement the existing CWL programs as well as the selected residential DSM programs indicated in Table 5-1, the utility staff should begin an aggressive home energy audit campaign. In this home energy audit campaign, CWL staff or an outside firm would proactively call and schedule free home energy audits with each of its residential customers. The key steps to be completed in order to successfully implement the DSM improvements into CWL's residential customer class include the following:

a) Complete analysis of needed improvements
b) Implement DSM improvements recommended
c) Verify DSM improvements are completed and installed per CWL specifications
d) Compensate customer / owner for implementing DSM improvements

The energy audit should continue under its current form. It would cover a prescribed set of data which would be gathered by CWL staff or an outside firm. The data should be evaluated in each energy audit to provide inventory, condition assessments and facts about customer facilities to be used in DSM analysis.

2. Air Conditioner Replacement Program – (Existing)

- Strategist Model Name – NEW AC1 (Also found in Portfolio A)

CWL currently provides a rebate to customers who upgrade to a higher SEER air conditioning unit. The rebate paid to customers is based on the SEER rating and cooling capacity in TONS. These rebates are presented in the table below.

Air Conditioning Unit	2 TON	3 TON	4 TON	5 TON
SEER 14	$100	$100	$200	$300
SEER 15	$200	$300	$400	$600
SEER 16	$300	$500	$600	$800
SEER 17	$400	$600	$800	$1,000
SEER 18	$500	$700	$1,000	$1,200
SEER 19	$500	$800	$1,100	$1,400
SEER 20	$600	$900	$1,200	$1,600

Burns & McDonnell evaluated the energy and demand savings between purchasing a standard 13 SEER AC unit and a 16 SEER AC unit. Burns & McDonnell assumed an energy savings of 258 kWh, peak demand savings of 0.36 kW and utility incentive payment of $435.00. Given these assumptions, the Strategist analysis concluded that existing rebates being offered for AC unit upgrades are reasonable.

3. Heat Pump Replacement Program - (Existing)

- Strategist Model Name – HP 1 (Also found in Portfolio B)
- Strategist Model Name – HP 2 (Also found in Portfolio C)

CWL currently provides a rebate to customers who upgrade to a higher SEER heat pump unit. The rebate paid to customers is based on the SEER rating and heating capacity in TONS. These rebates are equal to those presented above for AC units.

Burns & McDonnell evaluated the energy and demand savings between purchasing a standard 13 SEER heat pump unit and a 16 SEER heat pump unit. Burns & McDonnell assumed an energy savings of 620 kWh, peak demand savings of 0.55 kW and utility incentive payment of $385.00. Given these assumptions, the Strategist analysis concluded that existing rebates being offered for AC unit upgrades are reasonable.

Burns & McDonnell also evaluated the potential situation in which a single family home had electric resistance heating and was considering the purchase of a new 16 SEER heat pump. By replacing the electric resistance heating system with a new 16 SEER heat pump it is estimated that an average annual energy savings of 3,509 kWh and 1.13 kW could be obtained. The utility incentive payment assumed for this improvement is $2,470 per installation. Given these assumptions, CWL should target structures with electric resistance heating due to the high level of energy savings that can be achieved per heat pump installation. Details regarding this DSM program's specifications can be found in the RLW Saturation Study in Appendix H.

4. Add refrigerant to undercharged AC system – (New)

- Strategist Model Name – ADD REF (Also found in Portfolio B)

Burns & McDonnell evaluated the potential situation in which a single family residential home AC system's refrigerant was undercharged. By adding refrigerant to the AC system it is estimated that an average annual energy savings of 448 kWh, and a peak demand reduction of 0.11 kW could be achieved. The utility incentive payment assumed for this improvement is $130.00 per occurrence. Details regarding this DSM program's specifications can be found in the RLW Saturation Study in Appendix H.

5. Remove refrigerant from over charged AC system – (New)

- Strategist Model Name – REM REF (Also found in Portfolio B)

Burns & McDonnell evaluated the potential situation in which a single family residential home AC system's refrigerant was overcharged. By removing refrigerant from the AC system it is estimated that an average annual energy savings of 100 kWh, and a peak demand reduction of 0.10 kW could be achieved. The utility incentive payment assumed for this improvement is $50.00 per occurrence. Details regarding this DSM program's specifications can be found in the RLW Saturation Study in Appendix H.

6. Increase blower speed due to low evaporator air flow – (New)

- Strategist Model Name – INCR BLW (Also found in Portfolio A)

Burns & McDonnell evaluated the potential situation in which a single family residential home had a low evaporator air flow. By increasing the blower speed it is estimated that an average annual energy savings of 630 kWh, and a peak demand reduction of 0.56 kW could be achieved. The utility incentive payment assumed for this improvement is $50.00 per occurrence. Details regarding this DSM program's specifications can be found in the RLW Saturation Study in Appendix H.

7. Increase duct size due to low evaporator air flow – (New)

- Strategist Model Name – INCR BLW (Also found in Portfolio B)

Burns & McDonnell evaluated the potential situation in which a single family residential home had a low evaporator air flow. By increasing duct size it is estimated that an average annual energy savings of 757 kWh, and a peak demand reduction of 0.75 kW could be achieved. The utility incentive payment assumed for this improvement is $490.00 per occurrence. Details regarding this DSM program's specifications can be found in the RLW Saturation Study in Appendix H.

8. Reduce duct leakage to 5% from 25% - (New)

- Strategist Model Name – RED LEAK (Also found in Portfolio C)

Burns & McDonnell evaluated the potential situation in which a single family residential home had a duct leakage of 25%. By reducing the duct leakage to 5% it is estimated that

an average annual energy savings of 533 kWh, and a peak demand reduction of 0.42 kW could be achieved. The utility incentive payment assumed for this improvement is $310.00 per occurrence. Details regarding this DSM program's specifications can be found in the RLW Saturation Study in Appendix H.

9. Size AC units to 100% of Manual J due to oversized AC units A - (New)

- Strategist Model Name – SIZE AC A (Also found in Portfolio B)

Burns & McDonnell evaluated the potential situation in which a single family residential home's AC units were oversized. The solution to this problem is to size the AC unit to 100% of Manual J. This would be applicable to new AC systems that are installed where there is no existing ductwork. The estimated annual savings is 246 kWh, with a peak demand reduction of 0.30 kW. The utility incentive payment assumed for this improvement is $160.00 per occurrence. Details regarding this DSM program's specifications can be found in the RLW Saturation Study in Appendix H.

10. Size AC units to 100% of Manual J due to oversized AC units B - (New)

- Strategist Model Name – SIZE AC B (Also found in Portfolio A)

Burns & McDonnell evaluated the potential situation in which a single family residential home's AC units were oversized. The solution to this problem is to size the AC unit to 100% of Manual J. This would be applicable to existing AC systems. The estimated annual savings is 738 kWh, with a peak demand reduction of 0.78 kW. The utility incentive payment assumed for this improvement is $110.00 per occurrence. Details regarding this DSM program's specifications can be found in the RLW Saturation Study in Appendix H.

11. Add two more inches of insulation to ducts in attics - (New)

- Strategist Model Name – ADD INS1 (Also found in Portfolio C)

Burns & McDonnell evaluated the potential situation in which a single family residential home's attic ducts only had 1 inch of insulation. By adding 2 inches of insulation to the ducts in the attic it is estimated that an average annual energy savings of 185 kWh, and a peak demand reduction of 0.16 kW could be achieved. The utility incentive payment assumed for this improvement is $310.00 per occurrence. Details regarding this DSM program's specifications can be found in the RLW Saturation Study in Appendix H.

12. Install new programmable thermostat - (New)

- Strategist Model Name – NEW THRM (Also found in Portfolio B)

Burns & McDonnell evaluated the potential situation in which a single family residential home did not have a programmable thermostat installed. By adding a new programmable thermostat it is estimated that an average annual energy savings of 494 kWh, and a peak demand reduction of 0.06 kW could be achieved. The utility incentive payment assumed for this improvement is $105.00 per occurrence. Details regarding this DSM program's specifications can be found in the RLW Saturation Study in Appendix H.

13. Install low E double pane windows - (New)

- Strategist Model Name – INST WIN (Also found in Portfolio A)

Burns & McDonnell evaluated the potential situation in which a single family residential home had single pane windows. By installing a low E double pane window in place of an existing single pane window it is estimated that an average annual energy savings of 1,102 kWh, and a peak demand reduction of 0.48 kW could be achieved. The utility incentive payment assumed for this improvement is $180.00 per window. Details regarding this DSM program's specifications can be found in the RLW Saturation Study in Appendix H.

14. Install new solar screens - (New)

- Strategist Model Name – ADD SCRN (Also found in Portfolio A)

Burns & McDonnell evaluated the potential situation in which a single family residential home had no east or west window shading. By installing solar screens to the east and west side of the house it is estimated that an average annual energy savings of 160 kWh, and a peak demand reduction of 0.66 kW could be achieved. The utility incentive payment assumed for this improvement is $135.00. Details regarding this DSM program's specifications can be found in the RLW Saturation Study in Appendix H.

15. Reduce air infiltration to 0.35 ACH - (New)

- Strategist Model Name – RED INF (Also found in Portfolio A)

Burns & McDonnell evaluated the potential situation in which a single family residential home had a house infiltration of approximately 0.8 ACH. By reducing the infiltration to 0.35 ACH it is estimated that an average annual energy savings of 1,041 kWh, and a peak demand reduction of 0.41 kW could be achieved. The utility incentive payment assumed for this improvement is $260.00 per occurrence. Details regarding this DSM program's specifications can be found in the RLW Saturation Study in Appendix H.

16. Add Attic Insulation - (New)

- Strategist Model Name – ADD INS2 (Also found in Portfolio C)

Burns & McDonnell evaluated the potential situation in which a single family residential home had an insulation R value of R-11. By installing additional insulation of R-19 and

thus achieving an R value of R-30 it is estimated that an average annual energy savings of 503 kWh, and a peak demand reduction of 0.34 kW could be achieved. The utility incentive payment assumed for this improvement is $415.00 per occurrence. Details regarding this DSM program's specifications can be found in the RLW Saturation Study in Appendix H.

17. Add R-11 Wall Insulation to Exposed Walls - (New)

- Strategist Model Name – ADD INS3 (Also found in Portfolio C)

Burns & McDonnell evaluated the potential situation in which a single family residential home did not have its exposed walls insulated. By adding R-11 wall insulation to the home it is estimated that an average annual energy savings of 2,517 kWh, and a peak demand reduction of 0.57 kW could be achieved. The utility incentive payment assumed for this improvement is $1,805.00 per occurrence. Details regarding this DSM program's specifications can be found in the RLW Saturation Study in Appendix H. It should be noted that achieving savings by increasing wall insulation vary greatly with the amount of insulation already in place, as well as the amount of extra insulation added. Whether this is cost effective depends more on the amount of existing insulation.

18. Refrigerator Early Retirement - (New)

- Strategist Model Name – NEW RFG2 (Also found in Portfolio A)

Burns & McDonnell evaluated the potential situation in which a homeowner is enticed into retiring an existing refrigerator before the end of its functional life. By removing the old inefficient refrigerator and replacing it with a new energy star refrigerator it is estimated that an average annual energy savings of 646 kWh, and a peak demand reduction of 0.08 kW could be achieved. The utility incentive payment assumed for this improvement is $25.00 per occurrence. This incentive payment is based on the cost to remove the refrigerator from the home and not the cost of a new refrigerator or the differential cost between a new energy star refrigerator and new base line model. Details regarding this DSM program's specifications can be found in the RLW Saturation Study in Appendix H.

19. Insulate Electric Water Heater Storage Tanks - (New)

- Strategist Model Name – HW HEAT (Also found in Portfolio B)

Burns & McDonnell evaluated the potential situation in which a single family residential home with an electric hot water heater did not have any insulation wrapping. By adding insulation to the electric hot water heater it is estimated that an average annual energy savings of 194 kWh and 0.02 kW of demand savings could be achieved. The utility incentive payment assumed for this improvement is $30.00 per occurrence. Details regarding this DSM program's specifications can be found in the RLW Saturation Study in Appendix H.

20. Install low flow shower heads – (New)

- Strategist Model Name – NEW SHWR (Also found in Portfolio A)

Burns & McDonnell evaluated the potential situation in which a single family residential home did not have a low flow shower head. By installing two new low flow shower heads per home it is estimated that an average annual energy savings of 125 kWh could be achieved. The utility incentive payment assumed for this improvement is $10.00 per occurrence. Details regarding this DSM program's specifications can be found in the RLW Saturation Study in Appendix H.

21. Install Solar Powered Lights - (New)

- Strategist Model Name – SOL LITE (Also found in Portfolio A)

Burns & McDonnell evaluated the potential situation in which a single family residential home had an average of 20 outdoor decorative lights. By replacing the existing outdoor decorative lights with solar powered outdoor decorative lights it is estimated that an average annual energy savings of 350 kWh could be achieved. The utility incentive payment assumed for these 20 outdoor decorative lights is $60.00.

The general assumptions for the energy savings for this program are as follows:

- Existing home has 20 outdoor lights
- Existing outdoor light connected load is 4.0 Watts
- Outdoor lights are on 12 hours per day 365 days per year
- Solar powered lights replace all existing outdoor lighting 350 kWh per year savings

22. Energy Star Dishwasher - (New)

- Strategist Model Name – NEW DWSH (Also found in Portfolio C)

Burns & McDonnell evaluated the potential situation in which a single family residential home was considering the replacement of their existing dishwasher. By purchasing an energy star dishwasher over a standard non-energy star dishwasher it is estimated that an average annual energy savings of 74 kWh could be achieved. The utility incentive payment assumed to cover this incremental cost is $75.00 per dishwasher. Details regarding this DSM program's specifications can be found in the RLW Saturation Study in Appendix H.

23. Energy Star Clothes washer - (New)

- Strategist Model Name – NEW CWSH (Also found in Portfolio C)

Burns & McDonnell evaluated the potential situation in which a single family residential home was considering the replacement of their existing clothes washer. By purchasing an

energy star clothes washer over a standard non-energy star clothes washer it is estimated that an average annual energy savings of 150 kWh could be achieved. The utility incentive payment assumed to cover this incremental cost is $205.00 per clothes washer. Details regarding this DSM program's specifications can be found in the RLW Saturation Study in Appendix H.

24. New Home Energy Star Rebates – (Existing)

Burns & McDonnell did not specifically evaluate this existing program in the integrated resource planning study.

25. Tree Power – (Existing)

- Strategist Model Name – NEW TREE

CWL currently offers its Tree Power program to promote energy conservation through energy-efficient landscaping. When a customer signs up for the program, CWL will visit the property and suggest the best places for shade trees. The customer will receive a packet with the planting diagram and a coupon for a free 6-10 foot tall shade tree. There is a limit of one tree per electric meter which is a $39.00 value. CWL could continue this program, but should follow up periodically to see that the trees are planted and growing as expected. Energy consumption of participants whose trees are growing should be checked to see if energy savings can be identified.

The tree program as modeled by Burns & McDonnell did not pass the screening.

26. Super Saver Loans Program – (Existing)

Burns & McDonnell did not specifically evaluate this existing program in the integrated resource planning study. We believe it should be continued to encourage customers to replace their older air conditioners with newer, more efficient units.

27. Load Management Program – (Existing)

- Strategist Model Name – RES DLC

Burns & McDonnell evaluated the existing CWL load management program to determine whether or not the program was providing an economic benefit to the utility. Based on the parameters and assumptions provided by CWL and presented below the existing program is over compensating the customers who utilize the service and receive the 5.0 percent discount off their bill.

<u>Benefit Assumptions</u>

- 0.557 kW demand reduction per meter per month

Cost Assumptions

- Average credit to customer per year is $30.00 (5% of $150 per month for 4 months)
- $105 per switch installation cost

Given these assumptions, the analysis showed that the benefit to cost ratio is less than one when included with all the other DSM programs evaluated in this Study. If CWL is to continue this program then it should provide a bill credit to the customer which is equivalent to the peak demand savings CWL is receiving from not purchasing capacity in the market. The bill credit should be evaluated on an annual basis to ensure the peaking capacity cost to CWL is greater than the capacity credit paid to each customer in order to recover the switch cost.

28. Compact Florescent Lights – (Existing)

- Strategist Model Name – ADD 3CFL (Also found in Portfolio B)

CWL currently has an existing compact florescent light (CFL) program to provide a $2.00 rebate per bulb to each customer. A maximum of 6 bulbs per visit per customer is allowed. This program has a tremendous amount of success with over 20,000 bulbs being sold between 2004 and 2007.

Burns & McDonnell evaluated the potential situation in which a single family residential home had three existing 60 Watt incandescent bulbs in their house. By purchasing three 15 Watt CFLs and replacing the incandescent bulbs it is estimated that an average annual energy savings of 249 kWh and a peak demand reduction of 0.03 kW per home could be achieved. The utility incentive payment recommended to compensate the customers for this cost is to provide a coupon for the full cost of the three bulbs. Details regarding this DSM program's specifications can be found in the RLW Saturation Study in Appendix H.

29. Commercial HVAC Retrofits –(New)

- Strategist Model Name – COM HVAC (Also found in Portfolio C)

Burns & McDonnell evaluated the potential for commercial DSM using HVAC retrofits. The diversity of commercial buildings in terms of size, age, layout, etc. led the analysis team to use an area weighted approach. The analysis assumed that the most common HVAC units in use include 5, 10, and 20 ton packaged units as well as 80 ton water cooled chillers for larger applications. The analysis assumed an average of 500 sq ft per ton of cooling. Computer models of typical commercial buildings were created. The team ran models with low and then high efficiency equipment to determine the savings. The potential rate of implementation for different building types was based on benchmarking using the EPA Portfolio Manager. Buildings with low benchmark were

assumed to have higher potential than more energy efficient building with higher benchmarks. Further details on this analysis can be found in Section 4.3.4.1 of the IRP.

This program is recommended. Candidate buildings could receive an energy audit from CWL personnel or a qualified third party. Depending on the complexity of the retrofit the savings calculations could range from simple engineering calculations to full computer models with programs such as eQUEST. The calculations or models will include appropriate equipment efficiencies, operating schedules, etc. to best show the existing as well as post retrofit conditions. It is recommended that the retrofit produce some demand savings during CWL peak period. The rebate could be based on the annual kWh savings. A one time credit of no more than $0.86 per kWh times the estimated kWh saved in one year could be provided.

30. Commercial Appliance Retrofits – (New)

- Strategist Model Name – COM APP

Burns & McDonnell evaluated the potential for commercial DSM using appliance retrofits. The diversity of commercial buildings in terms of size, age, layout, etc. led the analysis team to use an area weighted approach. The analysis assumed that the most common appliances in commercial buildings include computers, monitors, printers, copiers, fax machines, scanners and refrigerators. The analysis team estimated the quantity per 1,000 sq ft of these appliances in various building types. The team then used ENERGY STAR Appliance Savings Calculators to determine savings. The potential rate of implementation for different building types was 20%. Further details on this analysis can be found in Section 4.3.4.2 of the IRP.

The results of the integrated analysis show that the commercial appliance retrofit program is not beneficial when included with all of the programs that make up Portfolios A, B, and C. For this program to be beneficial under the same assumed energy and demand savings (benefits), the costs must be reduced to less than the 50 percent rebate that was assumed in this study. If CWL wants to include the Commercial Appliance Retrofit program, it is recommended that the rebate (cost to CWL) should start at no greater than $0.51 per kWh times the annual kWh savings estimated in one year.

31. Commercial Lighting Retrofits – (Existing)

- Strategist Model Name - COM LITE (Also found in Portfolio A)

Burns & McDonnell evaluated the potential for commercial DSM using lighting retrofits. The diversity of commercial buildings in terms of size, age, layout, etc. led the analysis team to use an area weighted approach. The analysis assumed that the most common lighting retrofit in commercial buildings include replacing T12 fluorescent lamps and magnetic ballasts with T8 fluorescent lamps and electronic ballasts. A second common retrofit is replacing incandescent lamps with compact fluorescent lamps. This is especially true for hotel and motel rooms. Based on vast retrofit experience the typical lighting loads for pre and post retrofits were used to determine savings and cost per 1,000 sq ft or per hotel/motel room. The potential rate of implementation for different building

types was based on benchmarking using the EPA Portfolio Manager. Buildings with low benchmark were assumed to have higher potential than more energy efficient building with higher benchmarks. Further details on this analysis can be found in Section 4.3.4.3 of the IRP.

CWL currently has a pilot program offering lighting rebates for customers paying demand fees (e.g., Large General Service (rate "D") customers and Industrial Service (rate "I")). A minimum 10 kW demand reduction is required. CWL will pay the lesser of one half the installation cost or $100 per kW reduction. The maximum rebate for a location is $5,000. By removing the cap and expanding the lighting rebate to other commercial customers the utility could see further reduction in peak demand as well as overall energy consumed. The rebate could also be based on the annual kWh savings. A one time credit of $0.10 per kWh times the estimated kWh saved in one year could be provided.

32. Industrial Machine Drive Retrofits – (New)

- Strategist Model Name – IND 1 (Also found in Portfolio B)

Burns & McDonnell evaluated the potential for industrial DSM using machine drive retrofits. The true industrial customer base accounts for approximately 11% of the CWL energy use. Two of the larger facilities are part of companies with aggressive, corporate wide energy management programs. Therefore the industrial DSM opportunities are much smaller than those associated with residential and commercial customers. Due to the vast diversity in industrial processes and building types the analysis team used data from the Energy Information Agency (EIA). The EIA provides the percentage of total energy use that is attributed to a particular end use system. Machine drive accounts for 51.4% of the total use. Potential energy savings for aggressive DSM measures often bring 10% to 18% savings. The analysis team used 12% for this analysis. Further details can be found in Section 4.5 of the IRP.

A program for Industrial Machine Drive Retrofits is recommended. Many motor drive applications are constant speed and thus similar to lighting in that there is a fixed load and known operating schedule. A rebate program that is similar to the Lighting Incentive Program is recommended. CWL could pay the lesser of one half the installation cost or $100 per kW reduction. A maximum rebate amount would need to be determined by CWL based on budget constraints and demand reduction goals. The rebate could also be based on the annual kWh savings. A one time credit of $0.18 per kWh times the estimated kWh saved in one year could be provided.

33. Industrial Facility HVAC Retrofits – (New)

- Strategist Model Name - IND 2 (Also found in Portfolio B)

Burns & McDonnell evaluated the potential for industrial DSM using facility HVAC retrofits. The true industrial customer base accounts for approximately 11% of the CWL energy use. Two of the larger facilities are part of companies with aggressive, corporate wide energy management programs. Therefore the industrial DSM opportunities are

much smaller than those associated with residential and commercial customers. Due to the vast diversity in industrial processes and building types the analysis team used data from the Energy Information Agency (EIA). The EIA provides the percentage of total energy use that is attributed to a particular end use system. For this analysis the team focused on end uses that relied heavily on electric consumption rather than natural gas. Facility HVAC systems account for 8.9% of the total use. Potential energy savings for aggressive DSM measures often bring 10% to 18% savings. The analysis team used 12% for this analysis. Further details can be found in Section 4.5 of the IRP.

This program is recommended. Candidate buildings could receive an energy audit of the HVAC systems from CWL personnel or a qualified third party. Depending on the complexity of the retrofit the savings calculations could range from simple engineering calculations to full computer models with programs such as eQUEST. The calculations or models will include appropriate equipment efficiencies, operating schedules, etc. to best show the existing as well as post retrofit conditions. It is recommended that the retrofit produce some demand savings during CWL peak period. The rebate will be based on the annual kWh savings. A one time credit of $0.18 per kWh times the estimated kWh saved in one year could be provided.

34. Industrial Facility Lighting Retrofits – (Existing)

- Strategist Model Name - IND 3 (Also found in Portfolio A)

Burns & McDonnell evaluated the potential for industrial DSM using facility HVAC retrofits. The true industrial customer base accounts for approximately 11% of the CWL energy use. Two of the larger facilities are part of companies with aggressive, corporate wide energy management programs. Therefore the industrial DSM opportunities are much smaller than those associated with residential and commercial customers. Due to the vast diversity in industrial processes and building types the analysis team used data from the Energy Information Agency (EIA). The EIA provides the percentage of total energy use that is attributed to a particular end use system. For this analysis the team focused on end uses that relied heavily on electric consumption rather than natural gas. Facility lighting systems account for 7.0% of the total use. Potential energy savings for aggressive DSM measures often bring 10% to 18% savings. The analysis team used 12% for this analysis. Further details can be found in Section 4.5 of the IRP.

CWL currently has a pilot program offering lighting rebates for customers paying demand fees (e.g., Large General Service (rate “D”) customers and Industrial Service (rate “I”)). A minimum 10 kW demand reduction is required. CWL will pay the lesser of one half the installation cost or $100 per kW reduction. The maximum rebate for a location is $5,000. This program should match the Commercial Lighting Program.

APPENDIX F

INFORMATION FOR CONSIDERATION OF CODES FOR NEW CONSTRUCTION

Appendix F

Information for Consideration of Codes for New Construction

The DSM analysis has focused on the existing stock of buildings in the CWL service territory. It is clear that there is potential for major reductions in demand from these facilities. However, these reductions will require significant amounts of investments and incentives for their implementation. Retrofits might involve extensive envelope modifications or the installation of new, high efficiency HVAC equipment. A parallel effort that Columbia and CWL could explore is improving the efficiency of new homes and commercial buildings with increased code requirements and incentives. The differential cost in increasing the insulation value of a wall or the efficiency of an air-conditioning system during new construction is far less than compared to retrofitting existing facilities.

The current codes used for new construction include the International Residential Code homes and the International Building Code for commercial buildings. In terms of energy efficiency the emphasis of these codes is on the envelope of the building. They require minimum insulation values that do represent improvements over older facilities. However, they are not aggressive enough to provide major reductions in the forecasted load for CWL.

Many of the resources used for the residential and commercial DSM analysis used tools and information from the EPA ENERGY STAR program. Several of the DSM programs referred to ENERGY STAR appliances and equipment. CWL is using the Home Performance with ENERGY STAR program with existing homes. This is a national program for existing homes with the goal to bring them up to ENERGY STAR standards. It involves a whole building approach to the home evaluation. Rebates and loans are available to participants in this program. The existing commercial building stock was evaluated using the benchmarking tool Profile Manager. The Target Finder option of this tool was used to determine the amount of energy reduction required to obtain the ENERGY Star ranking.

Other ENERGY STAR tools available from the EPA concern new homes and commercial buildings. The following sections will address these tools that might be used to establish codes and incentives for more energy efficient new construction in Columbia.

Residential Buildings

The EPA has established an ENERGY STAR Qualified Home designation for new home construction. Homes that achieve the ENERGY STAR Qualified Home designation are at least 15% more energy efficient than homes built to the 2004 International Residential Code (IRC). Furthermore these homes have energy saving features that make them 20-30% more efficient than homes built with standard practices. Any home three stories or less can earn the ENERGY STAR label if it has been verified to meet EPA's guidelines, including: single family, attached, and low-rise multi-family homes; manufactured homes; systems-built homes (e.g., SIP, ICF, or modular construction); log homes, concrete homes; and even existing retrofitted homes.

An ENERGY STAR Qualified Home meets stringent energy efficiency requirements. The ENERGY STAR Qualified Home label can be displayed to show compliance. Benefits to the ENERGY STAR Qualified Home owner include lower utility bills, improved indoor air quality and efficient appliances. There is also inherent value associated with the home in case of resale as the home is identified as an energy efficient and well constructed building. Builders of these homes can be listed on the ENERGY STAR website.

Figure F-1: ENERGY STAR logo

The areas addressed by the ENERGY STAR Qualified Home program follow:

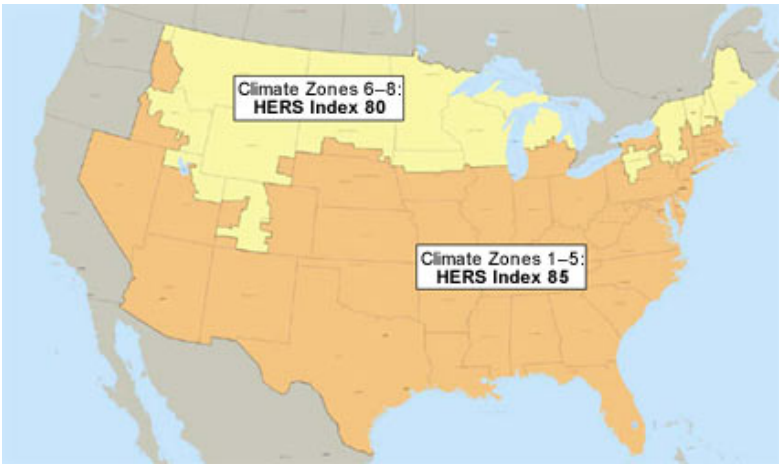
- **Effective Insulation** – criteria for the proper quantity, installation and inspection of insulation
- **High Performance Windows** – windows that use technologies for improved frame insulation and coatings that are designed to lower solar cooling loads in the summer and decrease heat loss during the winter
- **Tight Envelope Construction and Duct Systems** – improved envelope and duct construction to reduce infiltration of unconditioned outside air and to efficiently deliver conditioned air throughout the home

- **Efficient Heating and Cooling Equipment** – higher efficiency equipment lowers utility costs, improves indoor temperature and humidity control, and is quieter
- **Efficient Products** – ENERGY STAR qualified products include appliances, lighting and high efficiency water heaters
- **Third-Party Verification** – Home Energy Raters are trained professionals who rate the new home based on a review of plans and home inspections

ENERGY STAR homes have been inspected and tested by a third-party Home Energy Rater. Home Energy Raters consult with builders in the selection of the most appropriate energy-efficient features for a home. They also review plans and inspect and test the home during and after construction to verify that the home meets EPA's strict guidelines for energy efficiency. The Rater scores the homes design based on the Home Energy Rating System (HERS) Index.

The HERS Index is a scoring system established by the Residential Energy Services Network (RESNET). The reference home is one built to the specification of the 2006 International Energy Conservation Code. Lower scores indicate higher efficiency homes with the HERS Reference Home scoring a HERS Index of 100 and a net zero energy home a HERS Index score of 0. Each 1-point decrease in the HERS Index corresponds to a 1% reduction in energy consumption compared to the HERS Reference Home. The required HERS Index for an ENERGY STAR Qualified Home is based on the climate zone as indicated on the following map. A new home in Columbia requires a HERS Index of 85 or lower.

Figure F-2: Map of climate zones and required HERS Index scores



Commercial Buildings

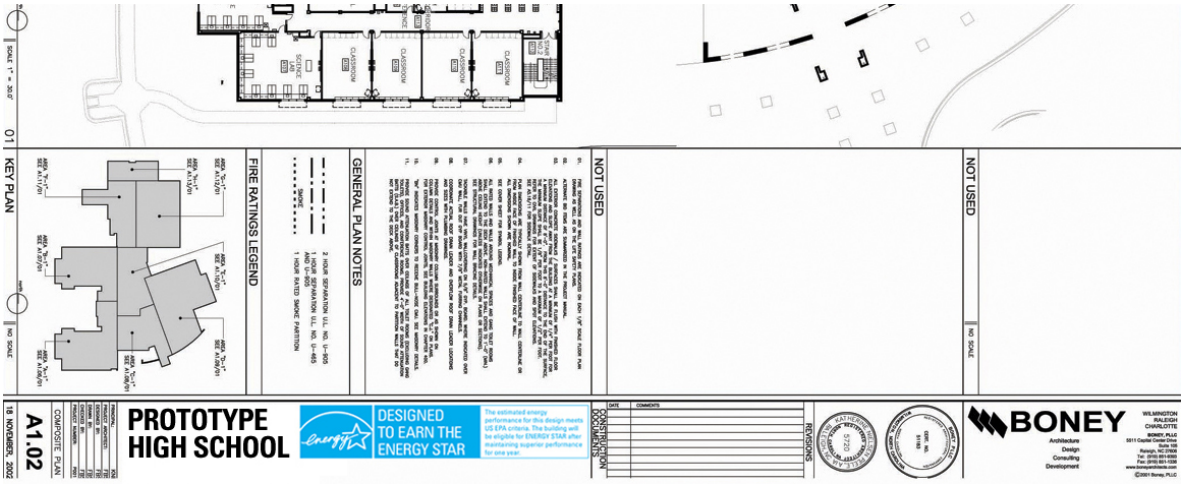
The EPA has put considerable effort into developing the ENERGY STAR benchmarking tool for existing buildings which has been an integral part of the DSM analysis of CWLs existing commercial building stock. This analysis illustrated that a substantial reduction in electric use is required for the existing commercial building stock if an energy efficiency benchmark goal of ENERGY STAR 69 or ENERGY STAR 75 is desired. Once again these goals represent the minimum requirement for the energy portion of LEED-EB and for the certification of ENERGY STAR respectively. In many cases these goal would be cost prohibitive as entire envelope or HVAC systems may need to be redone. Codes and incentives to improve new commercial buildings would provide great benefit with costs limited to the incremental cost of standard versus high efficiency material, construction and equipment.

The EPA has developed initiatives to improve the design of new commercial buildings. The designation of ENERGY STAR Partner has been widely used for manufacturers of appliances and HVAC equipment as well as energy service providers. Through the ENERGY STAR Challenge program architects are encouraged to become ENERGY STAR Partners and design buildings that will be able to meet the ENERGY STAR benchmarking goal of 75 after occupancy. In order to recognize these efforts the EPA has established the "Designed to Earn the ENERGY STAR".

There are several steps in achieving the Designed to Earn the ENERGY STAR designation. First the Architect of Record must be an ENERGY STAR partner. Next a target value for energy use is determined. One of the features of the EPA Portfolio Manager website is the Target Finder program. This was used during the IRP to determine the energy consumption that the existing CWL commercial stock would need to reduce to in order to meet an ENERGY STAR rank of 75. In similar manner the design team uses Target Finder to determine the level of energy consumption for their design that would achieve ENERGY STAR 75. The target would be based on the type of building, size, number of people, operating schedule, etc. Parallel to this effort the design team would use a building simulation program to model their building as designed. The monthly energy values derived from the model are then entered into the Portfolio Manager program to determine a predicted ENERGY STAR rank for the design. If the design has a predicted ENERGY STAR value of 75 or higher it meets the criteria and is eligible for the Designed to Earn the ENERGY STAR label.

Once it is established the design will meet ENERGY STAR 75 ranking an application can be processed. This includes a Design Intent document that is generated by the Target Finder program and an application form from the architect of record. The building must be at least to 95% completion with construction drawings available. Any building that is generating utility bills is not eligible. The EPA reviews the application and if accepted will send the Architect of Record an electronic file of the Designed to Earn the ENERGY STAR logo. This can be used on used in the title block of drawings (see figure below) or on the cover of contract documents.

Figure F-3: Designed to Earn the ENERGY STAR logo in drawing title block



Once the building has been in operation and has at least 12 months of utility bills the owner can benchmark the building with Portfolio Manager and determine the ENERGY STAR rank. If it achieves a rank of 75 or better it qualifies for the ENERGY STAR building label.

The Designed to Earn the ENERGY STAR brings benefits to the Architect, builder and owner. The architect and builder are recognized as using best practices in design and construction in order to produce energy efficient and well constructed buildings. They can be listed on the EPA ENERGY STAR website as ENERGY STAR Partners. The owner will have an energy efficient building that has good indoor air quality and is well constructed. A company or corporation with ENERGY STAR building(s) can publicize this fact to show they are not only concerned, but are doing something, about energy efficiency and sustainability. The owner of an ENERGY STAR building that leases space can market the energy efficiency and quality of their space.

The Designed to Earn the ENERGY STAR program could be part of new building construction. A copy of the EPA Building Energy Performance Specification is included following this discussion. It is an example of energy performance targets in contract documents.

Application Letter & Instructions for Designed to Earn the ENERGY STAR Graphic

Eligibility Requirements

To receive the Designed to Earn the ENERGY STAR graphic, projects must meet the following requirements:

1. Projects must achieve an EPA energy performance rating of 75 or higher from Target Finder (the rated design must include all fuel sources, equipment loads, and ***total*** estimated energy use specified in building design). A rating of 75 means that the proposed design is intended to perform in the top 25 percent of similar operating buildings. *The special application graphic may only be associated with the project stated in the application letter and displayed only on those building plans and contract documents.*
2. Projects must have at least 95% of the Construction Documents completed.
3. The Architect of Record's firm must be an ENERGY STAR partner. Join now.

Completing the Application Letter

The application letter must be printed on the Architect of Record's firm's letterhead, have all insert fields completed, and be signed by a firm official to be eligible to receive the Designed to Earn the ENERGY STAR graphic. If any participating architecture/engineering firms on the project are ENERGY STAR partners, include the firm name and its affiliation with the project (attach a separate page, if necessary). Consulting architects/engineers that prepare the Statement of Energy Design Intent, and other firms included as part of design team and are ENERGY STAR partners, will be listed on the Commercial Building Design Web pages under "Design Projects".

Validating Energy Design Intent:

Print the *Statement of Energy Design Intent (*from Target Finder*)* and complete the following sections:

- ***Building Owner/Company***—This is necessary for EPA to request permission to display information about the building project.
- ***Professional Verification***—Verify that the estimated energy use for the building design is accurate, and certify its eligibility for the Designed to Earn the ENERGY STAR graphic. Include contact information, signature, and stamp of the verifying individual. Also provide contact information for the Architect of Record below the verifier's information.

Sending Documents to EPA

Mail the original *Letter of Agreement* and *Statement of Energy Design Intent* (no photocopies) to:

By Express mail

Re: Designed to Earn the ENERGY STAR
K. P. Butler
ENERGY STAR Commercial Building Design
US Environmental Protection Agency
1310 L Street, NW (902C)
Washington, DC 20005

By USPS mail

Re: Designed to Earn the ENERGY STAR
K. P. Butler
ENERGY STAR Commercial Building Design
U.S. Environmental Protection Agency
1200 Pennsylvania Avenue, NW (6202J)
Washington, DC 20460

Receiving the Designed to Earn the ENERGY STAR graphic

EPA will notify the Architect of Record with in 10 business days after receiving their application. An e-mail containing the Designed to Earn the ENERGY STAR graphic file confirms that your application and Statement of Energy Design Intent were accepted. Please contact buildingdesign@cadmusgroup.com if you have questions about your application.

[Print on Architect of Record company letterhead]

< Date >

☐ ***By Express mail***

Re: Designed to Earn the ENERGY STAR
K. P. Butler
ENERGY STAR Commercial Building Design
US Environmental Protection Agency
1310 L Street, NW (902C)
Washington, DC 20005

☐ ***By USPS mail***

Re: Designed to Earn the ENERGY STAR
K. P. Butler
ENERGY STAR Commercial Building Design
U.S. Environmental Protection Agency
1200 Pennsylvania Avenue, NW (6202J)
Washington, DC 20460

Dear Ms. Butler:

As the Architect of Record, we are submitting a Statement of Energy Design Intent (SEDI) for the ***<INSERT building name>***, located in ***<INSERT city and state>***, owned by ***<INSERT owner name>***. We proudly submit this SEDI, which states our best estimate of the intended energy use for *all* specified systems, equipment, and strategies for this project. This project achieved an EPA rating of 75 or greater, and we understand that the Designed to Earn the ENERGY STAR special application graphic can only be displayed on the building plans for this project. As an ENERGY STAR partner, we also consent to adhere to EPA's Logo Identity Guidelines.

The estimated energy use has been included as part of the Contract Documents and/or Owner/Architect Contract. Our firm has also demonstrated the ability to design and specify buildings with enhanced energy performance by stating energy goals in the Supplementary General Conditions Section of the Specification. Our firm understands that after the facility is built and operating for more than one (1) year, the owner may wish to apply for the ENERGY STAR label for the building. Our firm, if requested by the owner, will assist with the application for the ENERGY STAR.

We agree to collaborate with EPA on a case study about the project's design energy use strategies and goals, to be posted on the ENERGY STAR Web site. I can be reached at **<Insert phone #>** and by e-mail **<Insert e-mail address>**.

We look forward to promoting our commitment to designing buildings that meet EPA's energy performance criteria to help lower energy demand and prevent greenhouse gas emissions.

Sincerely,

<Signature>
<Name>
<Title>
<Architect of Record, Firm Name>

Enclosures:
(1) Statement of Energy Design Intent
(2) List of other A&E firms participating on this project that are ENERGY STAR partners

OMB No.2060-0347

STATEMENT OF ENERGY DESIGN INTENT

September 5, 2007

FACILITY INFORMATION

Facility Name and Location
School
Dallas, TX - United States 75202

Facility Characteristics
K-12 School 90,000 Sq. Ft.
Total Gross Floor Area 90,000 Sq. Ft.

Design Energy (kBtu)[1]
Electricity 2,217,800
Natural Gas 600,000

Building _____
Owner/Company _____
Address _____
_____
Contact Name _____
Phone _____
Email _____

DESIGN ENERGY PERFO

	DESIGN	ENERGY STAR
Energy		
EPA Energy Performance Rating (1 – 100)	88	75
Percent Energy Reduction (%)[2]	36	20
Site Energy Use Intensity (kBtu/sf/yr)	31.3	39.4
Total Annual Site Energy (kBtu)	2,817,800	3,543,974
Total Annual Energy Cost ($)	$ 49,156	$ 61,824
Pollution Emissions (1000 lbs/yr)		
CO_2	846	1,060

PROFESSIONAL VERIFICATION

Licensed Architect/Engineer
Prepared By _____
Firm Name _____
Address _____
_____
Phone _____
Email _____

Architect of Record (if different from above)
Name _____
Firm Name _____
Phone _____
Email _____

Professional Stamp
Signature & Date

The facility was designed and specified to meet the Design Energy performance calculations shown on this Statement of Energy Design Intent.

[1] Target Finder uses data fro
equipm
[2] Percent energy reduced is

This

STATEMENT OF ENERGY DESIGN INTENT

September 5, 2007

Facility Name and Location

School
Dallas, TX - United States 75202

Facility Characteristics (Detail)

K-12 School

Gross Floor Area	Number of Students	Number of PCs	Operating Hours/Week	Cooking Facility	% Air-Conditioned	% Heated	Months	Ventilated
90000 Sq. Ft.	600	100	70 Hours	Yes	100	100	10	Yes

Additional

The Building Energy Performance Specification for Designing and Operating Buildings that meet ENERGY STAR® Criteria.

The following text specifies that the design shall result in a facility that's designed to earn the Environmental Protection Agency's (EPA) ENERGY STAR®. The design may be eligible to receive the ENERGY STAR special application graphic, which denotes that the estimated energy use is intended to be in the top 25% as compared to the U.S. building stock. Once the building is built and operating for at least one year, it may qualify to receive the ENERGY STAR plaque.

The *architecture firm of record* can apply to for the "Designed to Earn the ENERGY STAR" graphic from EPA, for a specified project. The design firm must demonstrate that the final estimate of the building's energy use corresponds to a rating of 75 or better using the U.S. EPA's Energy Performance Rating from the Internet based tool Target Finder.

The EPA energy performance rating is derived from fuel consumption data of existing commercial buildings, which includes the total energy use associated with the buildings. Therefore, design energy use must include all fuel sources and *total* estimated energy use for building design. An incomplete design energy use profile could result in a high but inaccurate rating. Gaps in energy analysis must be addressed in order for the rating to be a useful indicator of future performance.

The *building owner* can apply for the ENERGY STAR plaque by demonstrating that, after at least one year of operation, the building energy consumption from utility bills must (1) rate 75 or higher by using the U.S. EPA's Energy Performance Rating from the Internet based tool Portfolio Manager; and (2) meet specific indoor environmental quality standards.

Instructions for using this document

This document may be modified to suit various conditions. A client may use it in a request for proposal, or it may be incorporated in the contractual arrangement between client and architecture firm, construction documents and/or in a lease agreement. The specification includes language for both building design and the occupied building.

Use the document to state energy goals in Construction Documents and include the language in the Supplementary General Conditions Section.

Including this building energy performance specification signals a commitment to design, build, and operate a building with superior energy performance—one whose energy use, greenhouse gas emissions, and costs-to-operate are lower than 75% of comparable buildings nationwide.

The Building Energy Performance Specification for Designing and Operating Buildings that meet ENERGY STAR® Criteria.

1) Recommended Designer Scope of Work or Request for Proposal Language:

   a) Pre-Design or Programming Phase: The designer shall assist the owner in developing a scope of work, project budget and schedule, and assemble a multi-disciplinary team to execute an integrated design approach and to establish an energy performance target that exceeds the ENERGY STAR rating of 75, generated by from the U.S. EPA's Energy Performance Rating tool Target Finder, on the http://www.energystar.gov/newbuildingdesign Web page. All references to the use of the EPA energy performance rating system and Target Finder are dependent on the building being one of the space types handled by Target Finder. The design team shall conduct a comprehensive charrette to address architecture, energy and environmental issues.

   b) Schematic Design Phase: Design team members shall explore strategies to achieve an EPA rating of 75 or greater.

   c) Design Development: Design team members shall fine tune original design strategies and methodologies. Energy performance shall be adjusted and evaluated using U.S. EPA's Target Finder for each phase of design development.

   d) Construction Documents.

      i) Design team members shall fully develop and document energy performance strategies and methodologies for the project. Design team shall review progress and adjust strategies and systems to meet or exceed ENERGY STAR criteria for building design.

      ii) Specification Content: The Specifications in the Project Manual shall include and reference the "Statement of Energy Design Intent," generated from U.S. EPA's Target Finder, at completion construction documents. A copy of the original Statement of Energy Design Intent shall be included and sealed by a licensed architect or engineer as evidence in the application to U.S. EPA, showing that the energy design intent meets or exceeds ENERGY STAR standards.

      iii) The architect of record shall apply for the "Designed to Earn the ENERGY STAR" graphic. This graphic shall be affixed in the drawing's title block and may also be affixed to other related Construction Documents for the specified project.

2) Recommended Specification Language:

   a) Summary, Administration, or Supplementary General Conditions Section:

      i) This project is designed to achieve an EPA rating of 75 or higher. The designer has filed a Statement of Energy Design Intent, generated from Target Finder, with the U.S. EPA. The Contractor shall adhere to products, methods, and quality levels specified in the construction documents. Any proposed substitutions must be submitted according to the procedures defined herein. Substitutions that may alter the energy performance goals of the project will not be approved. No substitutions are permitted without approval of the design team.

   b) Commissioning or Administration Section:

      i) The owner has employed a Commissioning Agent (independent of the design team) that shall provide documented confirmation that building systems function in compliance with energy performance goals set forth in the Project Documents to satisfy the owner's operational needs. The Contractor shall assist the Commissioning Agent by performing testing, and documenting procedures necessary to verify compliance with intended operation of specified systems. The Contractor's Commissioning responsibilities are indicated within the drawings and individual specification sections.

The Building Energy Performance Specification for Designing and Operating Buildings that meet ENERGY STAR® Criteria.

ii) The Commissioning Agent shall measure and track actual energy consumption of the building's systems to determine if energy performance goals are being achieved and maintained. The Contractor will make needed adjustments and corrections prior to expiration of the ___ year warranty period.

c) Post Occupancy:

i) ENERGY STAR Building Certification shall be achieved within 14 months of reaching 95% occupancy if the building is one of the space types handled by EPA's energy performance rating system. The building's annual energy use shall be benchmarked (rated) against its peers using Portfolio Manager at http://www.energystar.gov/index.cfm?c=evaluate_performance.bus_portfoliomanager A copy of the original "Statement of Energy Performance" shall be included and sealed by a professional engineer as evidence in the application to U.S. EPA, showing that the energy performance meets or exceeds ENERGY STAR standards.

APPENDIX G

STRATEGIST INTEGRATED ANALYSIS OUTPUT

Columbia Water Light Department
Integrated Resource Planning
Project 46806

Description	Data Item	Units	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027
Columbia	ENERGY REQUIREMENTS	GWH	1,221	1,244	1,266	1,292	1,317	1,340	1,362	1,388	1,414	1,436	1,458	1,484	1,511	1,533	1,563	1,594	1,629	1,655	1,686	1,717
Columbia	PEAK DEMAND	MW	278.0	284.0	289.0	295.0	300.0	306.0	311.0	317.0	322.0	328.0	333.0	339.0	344.0	350.0	357.0	364.0	371.0	378.0	385.0	392.0
	MARKET PURCHASE ENERGY	GWH	299	132	72	341	521	173	187	105	116	124	122	133	138	152	135	154	178	200	228	257
THEORETICAL CO2	MARKET PURCHASE ENERGY	TONS	149,550	66,195	35,996	170,729	260,744	86,303	93,615	52,334	58,058	62,131	60,819	66,513	68,932	76,008	67,632	77,044	88,948	100,063	113,817	128,625
	COST OF MARKET PURCHASE ENERGY	$000	$18,206	$8,557	$4,893	$21,415	$34,990	$12,160	$13,679	$7,681	$8,979	$9,802	$9,356	$10,370	$10,935	$12,044	$11,071	$12,758	$14,910	$16,929	$19,573	$22,371
Columbia Energy Center	FIRM CAPACITY	MW	72.0	72.0	72.0	72.0	72.0	72.0	72.0	72.0	72.0	72.0	72.0	72.0	72.0	72.0	72.0	72.0	72.0	72.0	72.0	72.0
Combined Heat and Power :2011	FIRM CAPACITY	MW	0.0	0.0	0.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
CWL Unit 5	FIRM CAPACITY	MW	16.5	16.5	16.5	16.5	16.5	16.5	16.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CWL Unit 6	FIRM CAPACITY	MW	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5
CWL Unit 7	FIRM CAPACITY	MW	22.0	22.0	22.0	22.0	22.0	22.0	22.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CWL Unit 8	FIRM CAPACITY	MW	35.0	35.0	35.0	35.0	35.0	35.0	35.0	35.0	35.0	35.0	35.0	35.0	35.0	35.0	35.0	35.0	35.0	35.0	35.0	35.0
Distributed Generation	FIRM CAPACITY	MW	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0
Iatan 2	FIRM CAPACITY	MW	0.0	0.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0
Market Purchase	FIRM CAPACITY	MW	0.0	0.6	0.0	36.4	42.1	0.0	0.0	0.2	5.4	11.0	0.0	5.7	10.9	17.2	20.2	27.7	35.2	42.7	50.1	58.1
Nearman Creek	FIRM CAPACITY	MW	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0
Prairie State Energy Campus	FIRM CAPACITY	MW	0.0	0.0	0.0	0.0	0.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0
Sikeston	FIRM CAPACITY	MW	66.0	66.0	66.0	66.0	66.0	66.0	66.0	66.0	66.0	66.0	66.0	66.0	66.0	66.0	66.0	66.0	66.0	66.0	66.0	66.0
Supercritical Pulverized Coal :2015	FIRM CAPACITY	MW	0.0	0.0	0.0	0.0	0.0	0.0	0.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0
Wartsila:2011	FIRM CAPACITY	MW	0.0	0.0	0.0	16.8	16.8	16.8	16.8	16.8	16.8	16.8	16.8	16.8	16.8	16.8	16.8	16.8	16.8	16.8	16.8	16.8
Wartsila:2015	FIRM CAPACITY	MW	0.0	0.0	0.0	0.0	0.0	0.0	0.0	16.8	16.8	16.8	16.8	16.8	16.8	16.8	16.8	16.8	16.8	16.8	16.8	16.8
Wartsila:2018	FIRM CAPACITY	MW	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	16.8	16.8	16.8	16.8	16.8	16.8	16.8	16.8	16.8	16.8
	SUBTOTAL CAPACITY	**MW**	252.0	252.6	272.0	330.2	335.9	343.8	343.8	347.3	352.5	358.1	363.9	369.6	374.8	381.1	384.1	391.6	399.1	406.6	414.0	422.0
Columbia Energy Center	GENERATION	GWH	25	21	14	9	12	15	15	15	16	16	10	12	13	14	13	14	14	15	15	15
Combined Heat and Power :2011	GENERATION	GWH	0	0	0	25	27	26	26	25	25	25	26	26	27	27	26	26	27	27	27	27
CWL Unit 5	GENERATION	GWH	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CWL Unit 6	GENERATION	GWH	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CWL Unit 7	GENERATION	GWH	27	24	18	14	20	20	20	1	0	0	0	0	0	0	0	0	0	0	0	0
CWL Unit 8	GENERATION	GWH	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Distributed Generation	GENERATION	GWH	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Iatan 2	GENERATION	GWH	0	0	146	147	148	147	147	147	147	147	147	147	147	147	147	147	147	147	146	146
Nearman Creek	GENERATION	GWH	82	64	41	62	89	67	68	51	53	53	56	59	61	63	56	58	60	61	63	63
Prairie State Energy Campus	GENERATION	GWH	0	0	0	0	0	368	368	368	369	368	368	368	369	368	368	368	369	368	368	368
Sikeston	GENERATION	GWH	418	390	318	359	413	380	380	409	411	408	411	411	413	409	393	393	394	389	385	382
Supercritical Pulverized Coal :2015	GENERATION	GWH	0	0	0	0	0	0	0	103	106	107	110	113	115	117	107	110	111	113	114	115
Wartsila:2011	GENERATION	GWH	0	0	0	21	27	28	29	18	18	18	15	16	18	19	17	18	18	19	19	19
Wartsila:2015	GENERATION	GWH	0	0	0	0	0	0	0	23	23	24	19	21	23	24	22	23	23	24	24	24
Wartsila:2018	GENERATION	GWH	0	0	0	0	0	0	0	0	0	0	24	26	28	30	27	28	28	29	30	30
	SUBTOTAL GENERATION	**GWH**	553	500	538	637	736	1,052	1,055	1,160	1,170	1,166	1,187	1,198	1,215	1,219	1,177	1,185	1,192	1,193	1,192	1,189
Columbia Energy Center	GENERATOR CAPACITY FACTOR	%	4.00%	3.32%	2.18%	1.36%	1.89%	2.39%	2.46%	2.31%	2.47%	2.50%	1.63%	1.83%	2.12%	2.28%	2.11%	2.20%	2.22%	2.33%	2.34%	2.31%
Combined Heat and Power :2011	GENERATOR CAPACITY FACTOR	%				57.16%	60.69%	59.34%	59.72%	57.29%	57.56%	57.68%	58.74%	59.61%	60.41%	61.10%	59.73%	60.22%	60.45%	60.84%	61.09%	61.23%
CWL Unit 6	GENERATOR CAPACITY FACTOR	%	0.16%	0.14%	0.10%	0.06%	0.06%	0.11%	0.11%	0.11%	0.12%	0.12%	0.08%	0.09%	0.11%	0.12%	0.12%	0.12%	0.12%	0.12%	0.12%	0.11%
CWL Unit 7	GENERATOR CAPACITY FACTOR	%	13.78%	12.60%	9.29%	7.51%	10.16%	10.32%	10.52%													
CWL Unit 8	GENERATOR CAPACITY FACTOR	%	0.42%	0.35%	0.23%	0.14%	0.17%	0.26%	0.27%	0.27%	0.29%	0.29%	0.20%	0.22%	0.26%	0.28%	0.27%	0.28%	0.28%	0.29%	0.29%	0.28%
Distributed Generation	GENERATOR CAPACITY FACTOR	%	0.10%	0.09%	0.07%	0.04%	0.03%	0.06%	0.06%	0.07%	0.07%	0.07%	0.05%	0.06%	0.07%	0.07%	0.07%	0.08%	0.07%	0.07%	0.07%	0.07%
Iatan 2	GENERATOR CAPACITY FACTOR	%			83.49%	83.82%	84.02%	83.83%	83.83%	83.98%	83.95%	83.92%	83.93%	83.91%	83.93%	83.84%	83.66%	83.64%	83.82%	83.77%	83.58%	83.37%
Nearman Creek	GENERATOR CAPACITY FACTOR	%	46.69%	36.27%	23.47%	35.39%	50.71%	38.16%	38.94%	29.06%	30.17%	30.32%	32.05%	33.41%	34.70%	36.02%	32.08%	33.32%	34.15%	35.10%	35.75%	36.03%
Prairie State Energy Campus	GENERATOR CAPACITY FACTOR	%						84.02%	84.02%	84.02%	84.04%	84.02%	84.02%	84.02%	84.04%	84.02%	84.02%	84.02%	84.04%	84.02%	84.02%	84.02%
Sikeston	GENERATOR CAPACITY FACTOR	%	72.08%	67.42%	55.08%	62.01%	71.32%	65.67%	65.78%	70.75%	70.92%	70.48%	71.09%	71.02%	71.20%	70.76%	68.00%	67.92%	67.91%	67.26%	66.62%	66.01%
Supercritical Pulverized Coal :2015	GENERATOR CAPACITY FACTOR	%								47.18%	48.32%	48.75%	50.35%	51.48%	52.50%	53.65%	48.81%	50.00%	50.51%	51.69%	52.20%	52.40%
Wartsila:2011	GENERATOR CAPACITY FACTOR	%				14.06%	18.07%	19.36%	19.64%	11.94%	12.28%	12.42%	9.98%	10.87%	12.04%	12.77%	11.63%	12.14%	12.26%	12.78%	12.86%	12.82%
Wartsila:2015	GENERATOR CAPACITY FACTOR	%								15.48%	15.85%	16.03%	12.84%	13.94%	15.29%	16.20%	14.76%	15.37%	15.46%	16.04%	16.19%	16.24%
Wartsila:2018	GENERATOR CAPACITY FACTOR	%											16.41%	17.69%	19.15%	20.22%	18.45%	19.17%	19.30%	19.96%	20.21%	20.34%
Columbia Energy Center	TOTAL O AND M COST	$000	$5,301	$5,426	$5,548	$5,677	$5,826	$5,978	$6,128	$6,279	$6,438	$6,600	$6,926	$7,102	$7,284	$7,469	$7,653	$7,846	$8,042	$8,245	$8,451	$8,662
Combined Heat and Power :2011	TOTAL O AND M COST	$000	$0	$0	$0	$417	$457	$459	$476	$470	$488	$502	$527	$551	$577	$599	$603	$626	$649	$671	$694	$717
CWL Unit 6	TOTAL O AND M COST	$000	$1,524	$1,547	$1,592	$1,637	$1,686	$1,740	$1,792	$1,846	$1,902	$1,959	$2,015	$2,076	$2,140	$2,204	$2,271	$2,339	$2,409	$2,481	$2,556	$2,632
CWL Unit 7	TOTAL O AND M COST	$000	$2,222	$2,194	$2,083	$2,049	$2,261	$2,337	$2,419	$173	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
CWL Unit 8	TOTAL O AND M COST	$000	$379	$385	$396	$408	$420	$433	$446	$460	$473	$488	$502	$517	$533	$549	$565	$582	$600	$618	$636	$655
Distributed Generation	TOTAL O AND M COST	$000	$13	$12	$10	$5	$4	$10	$10	$11	$12	$13	$9	$11	$13	$14	$15	$16	$16	$16	$17	$16
Iatan 2	TOTAL O AND M COST	$000	$0	$0	$2,882	$2,978	$3,080	$3,160	$3,255	$3,357	$3,465	$3,560	$3,667	$3,776	$3,898	$4,004	$4,116	$4,239	$4,383	$4,503	$4,630	$4,759
Market Purchase	TOTAL O AND M COST	$000	$0	$40	$0	$2,386	$2,842	$0	$0	$12	$408	$858	$0	$473	$932	$1,519	$1,835	$2,589	$3,387	$4,231	$5,122	$6,115
Nearman Creek	TOTAL O AND M COST	$000	$4,689	$4,532	$4,279	$4,871	$5,634	$5,374	$5,620	$5,437	$5,705	$5,937	$6,254	$6,570	$6,903	$7,243	$7,319	$7,681	$8,043	$8,417	$8,795	$9,165
Prairie State Energy Campus	TOTAL O AND M COST	$000	$0	$0	$0	$0	$0	$4,412	$4,545	$4,681	$4,828	$4,966	$5,115	$5,269	$5,434	$5,589	$5,757	$5,930	$6,116	$6,291	$6,480	$6,674
Sikeston	TOTAL O AND M COST	$000	$18,064	$18,236	$17,737	$19,258	$21,121	$21,360	$22,293	$23,851	$24,919	$25,909	$27,105	$28,264	$29,538	$30,726	$31,654	$33,024	$34,498	$35,875	$37,347	$38,889
Supercritical Pulverized Coal :2015	TOTAL O AND M COST	$000	$0	$0	$0	$0	$0	$0	$0	$2,932	$3,068	$3,172	$3,332	$3,478	$3,633	$3,786	$3,680	$3,846	$3,993	$4,164	$4,314	$4,455
Wartsila:2011	TOTAL O AND M COST	$000	$0	$0	$0	$329	$393	$422	$438	$339	$355	$367	$339	$364	$395	$419	$412	$433	$449	$472	$488	$502

Columbia Water Light Department
Integrated Resource Planning
Project 46806

Description	Data Item	Units	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027
Wartsila:2015	TOTAL O AND M COST	$000	$0	$0	$0	$0	$0	$0	$0	$391	$409	$423	$385	$415	$451	$479	$468	$493	$510	$536	$555	$573
Wartsila:2018	TOTAL O AND M COST	$000	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$442	$476	$516	$549	$534	$563	$584	$613	$636	$658
Columbia Energy Center	FIXED O AND M COSTS	$000	$5,257	$5,388	$5,523	$5,661	$5,803	$5,948	$6,096	$6,249	$6,405	$6,565	$6,903	$7,076	$7,253	$7,434	$7,620	$7,811	$8,006	$8,206	$8,411	$8,621
CWL Unit 6	FIXED O AND M COSTS	$000	$1,516	$1,540	$1,587	$1,634	$1,683	$1,734	$1,786	$1,839	$1,894	$1,951	$2,010	$2,070	$2,132	$2,196	$2,262	$2,330	$2,400	$2,472	$2,546	$2,622
CWL Unit 7	FIXED O AND M COSTS	$000	$1,516	$1,540	$1,587	$1,634	$1,683	$1,734	$1,786	$156	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
CWL Unit 8	FIXED O AND M COSTS	$000	$378	$384	$396	$408	$420	$432	$445	$459	$472	$487	$501	$516	$532	$548	$564	$581	$598	$616	$635	$654
Iatan 2	FIXED O AND M COSTS	$000	$0	$0	$586	$604	$622	$640	$660	$679	$700	$721	$742	$765	$788	$811	$836	$861	$887	$913	$941	$969
Market Purchase	FIXED O AND M COSTS	$000	$0	$40	$0	$2,386	$2,842	$0	$0	$12	$408	$858	$0	$473	$932	$1,519	$1,835	$2,589	$3,387	$4,231	$5,122	$6,115
Nearman Creek	FIXED O AND M COSTS	$000	$3,218	$3,347	$3,481	$3,620	$3,765	$3,916	$4,072	$4,235	$4,405	$4,581	$4,764	$4,955	$5,153	$5,359	$5,573	$5,796	$6,028	$6,269	$6,520	$6,781
Prairie State Energy Campus	FIXED O AND M COSTS	$000	$0	$0	$0	$0	$0	$2,417	$2,490	$2,564	$2,641	$2,721	$2,802	$2,886	$2,973	$3,062	$3,154	$3,249	$3,346	$3,446	$3,550	$3,656
Sikeston	FIXED O AND M COSTS	$000	$10,933	$11,480	$12,054	$12,656	$13,289	$13,953	$14,651	$15,384	$16,153	$16,961	$17,809	$18,699	$19,634	$20,616	$21,646	$22,729	$23,865	$25,058	$26,311	$27,627
Supercritical Pulverized Coal :2015	FIXED O AND M COSTS	$000	$0	$0	$0	$0	$0	$0	$0	$1,189	$1,224	$1,261	$1,299	$1,338	$1,378	$1,419	$1,462	$1,506	$1,551	$1,597	$1,645	$1,695
Wartsila:2011	FIXED O AND M COSTS	$000	$0	$0	$0	$146	$151	$155	$160	$165	$170	$175	$180	$185	$191	$197	$203	$209	$215	$221	$228	$235
Wartsila:2015	FIXED O AND M COSTS	$000	$0	$0	$0	$0	$0	$0	$0	$165	$170	$175	$180	$185	$191	$197	$203	$209	$215	$221	$228	$235
Wartsila:2018	FIXED O AND M COSTS	$000	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$180	$185	$191	$197	$203	$209	$215	$221	$228	$235
	TOTAL FIXED OM COST	**$000**	$22,818	$23,720	$25,213	$28,749	$30,257	$30,930	$32,146	$33,096	$34,642	$36,454	$37,370	$39,334	$41,347	$43,554	$45,560	$48,077	$50,713	$53,474	$56,365	$59,445
Columbia Energy Center	VARIABLE O AND M COSTS	$/MWH	$1.74	$1.79	$1.83	$1.88	$1.93	$1.97	$2.02	$2.07	$2.13	$2.18	$2.23	$2.29	$2.35	$2.40	$2.47	$2.53	$2.59	$2.65	$2.72	$2.79
Combined Heat and Power :2011	VARIABLE O AND M COSTS	$/MWH	$0.00	$0.00	$0.00	$16.67	$17.16	$17.67	$18.20	$18.75	$19.31	$19.89	$20.48	$21.10	$21.73	$22.38	$23.06	$23.75	$24.46	$25.19	$25.95	$26.73
CWL Unit 6	VARIABLE O AND M COSTS	$/MWH	$43.67	$44.39	$45.73	$47.07	$48.48	$49.95	$51.46	$53.05	$54.64	$56.28	$57.98	$59.72	$61.49	$63.35	$65.25	$67.21	$69.22	$71.28	$73.43	$75.63
CWL Unit 7	VARIABLE O AND M COSTS	$/MWH	$26.52	$26.94	$27.74	$28.66	$29.43	$30.32	$31.23	$31.74	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
CWL Unit 8	VARIABLE O AND M COSTS	$/MWH	$0.94	$0.95	$0.98	$1.02	$1.04	$1.07	$1.11	$1.14	$1.18	$1.21	$1.25	$1.29	$1.32	$1.36	$1.40	$1.45	$1.49	$1.53	$1.58	$1.63
Distributed Generation	VARIABLE O AND M COSTS	$/MWH	$192.95	$196.27	$202.14	$207.53	$214.19	$220.77	$227.46	$234.40	$241.51	$248.73	$256.24	$263.91	$271.72	$279.97	$288.26	$296.97	$305.86	$315.02	$324.53	$334.20
Iatan 2	VARIABLE O AND M COSTS	$/MWH	$0.00	$0.00	$15.70	$16.17	$16.65	$17.16	$17.67	$18.20	$18.75	$19.31	$19.89	$20.48	$21.10	$21.73	$22.38	$23.06	$23.75	$24.46	$25.19	$25.95
Nearman Creek	VARIABLE O AND M COSTS	$/MWH	$17.93	$18.65	$19.39	$20.17	$20.98	$21.81	$22.69	$23.59	$24.54	$25.52	$26.54	$27.60	$28.71	$29.85	$31.05	$32.29	$33.58	$34.93	$36.32	$37.78
Prairie State Energy Campus	VARIABLE O AND M COSTS	$/MWH	$0.00	$0.00	$0.00	$0.00	$0.00	$5.42	$5.58	$5.75	$5.92	$6.10	$6.29	$6.47	$6.67	$6.87	$7.07	$7.29	$7.50	$7.73	$7.96	$8.20
Sikeston	VARIABLE O AND M COSTS	$/MWH	$17.06	$17.33	$17.85	$18.41	$18.94	$19.51	$20.09	$20.70	$21.32	$21.96	$22.62	$23.30	$23.99	$24.71	$25.45	$26.22	$27.01	$27.82	$28.65	$29.51
Supercritical Pulverized Coal :2015	VARIABLE O AND M COSTS	$/MWH	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$16.87	$17.38	$17.90	$18.43	$18.99	$19.56	$20.14	$20.75	$21.37	$22.01	$22.67	$23.35	$24.05
Wartsila:2011	VARIABLE O AND M COSTS	$/MWH	$0.00	$0.00	$0.00	$8.84	$9.08	$9.35	$9.63	$9.93	$10.23	$10.53	$10.85	$11.17	$11.51	$11.85	$12.21	$12.58	$12.95	$13.34	$13.74	$14.15
Wartsila:2015	VARIABLE O AND M COSTS	$/MWH	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$9.93	$10.23	$10.53	$10.85	$11.17	$11.51	$11.85	$12.21	$12.58	$12.95	$13.34	$13.74	$14.15
Wartsila:2018	VARIABLE O AND M COSTS	$/MWH	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$10.85	$11.17	$11.51	$11.85	$12.21	$12.58	$12.95	$13.34	$13.74	$14.15
Columbia Energy Center	VARIABLE O AND M COSTS	$000	$44	$37	$25	$16	$23	$30	$31	$30	$33	$34	$23	$26	$31	$35	$33	$35	$36	$39	$40	$41
Combined Heat and Power :2011	VARIABLE O AND M COSTS	$000	$0	$0	$0	$417	$457	$459	$476	$470	$488	$502	$527	$551	$577	$599	$603	$626	$649	$671	$694	$717
CWL Unit 6	VARIABLE O AND M COSTS	$000	$8	$7	$5	$3	$3	$6	$6	$7	$7	$8	$5	$6	$8	$8	$8	$9	$9	$9	$10	$10
CWL Unit 7	VARIABLE O AND M COSTS	$000	$706	$654	$497	$415	$578	$603	$633	$17	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
CWL Unit 8	VARIABLE O AND M COSTS	$000	$1	$1	$1	$0	$1	$1	$1	$1	$1	$1	$1	$1	$1	$1	$1	$1	$1	$1	$1	$1
Distributed Generation	VARIABLE O AND M COSTS	$000	$13	$12	$10	$5	$4	$10	$10	$11	$12	$13	$9	$11	$13	$14	$15	$16	$16	$16	$17	$16
Iatan 2	VARIABLE O AND M COSTS	$000	$0	$0	$2,296	$2,375	$2,458	$2,520	$2,595	$2,678	$2,765	$2,839	$2,924	$3,011	$3,111	$3,192	$3,281	$3,378	$3,497	$3,590	$3,689	$3,790
Nearman Creek	VARIABLE O AND M COSTS	$000	$1,471	$1,185	$798	$1,250	$1,869	$1,459	$1,548	$1,201	$1,301	$1,356	$1,490	$1,615	$1,750	$1,884	$1,745	$1,885	$2,015	$2,148	$2,275	$2,385
Prairie State Energy Campus	VARIABLE O AND M COSTS	$000	$0	$0	$0	$0	$0	$1,995	$2,055	$2,117	$2,187	$2,246	$2,313	$2,382	$2,461	$2,527	$2,603	$2,681	$2,770	$2,845	$2,930	$3,018
Sikeston	VARIABLE O AND M COSTS	$000	$7,131	$6,756	$5,683	$6,601	$7,832	$7,407	$7,641	$8,467	$8,766	$8,948	$9,296	$9,565	$9,904	$10,110	$10,007	$10,295	$10,633	$10,816	$11,036	$11,262
Supercritical Pulverized Coal :2015	VARIABLE O AND M COSTS	$000	$0	$0	$0	$0	$0	$0	$0	$1,743	$1,844	$1,911	$2,033	$2,141	$2,255	$2,367	$2,218	$2,340	$2,442	$2,566	$2,669	$2,760
Wartsila:2011	VARIABLE O AND M COSTS	$000	$0	$0	$0	$183	$242	$266	$278	$174	$185	$192	$159	$179	$205	$223	$209	$225	$234	$251	$260	$267
Wartsila:2015	VARIABLE O AND M COSTS	$000	$0	$0	$0	$0	$0	$0	$0	$226	$239	$248	$205	$229	$260	$283	$265	$284	$295	$315	$327	$338
Wartsila:2018	VARIABLE O AND M COSTS	$000	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$262	$291	$325	$353	$332	$355	$369	$392	$408	$424
	TOTAL VAR OM COST	**$000**	$9,374	$8,653	$9,315	$11,266	$13,467	$14,755	$15,276	$17,144	$17,828	$18,299	$19,248	$20,009	$20,899	$21,596	$21,321	$22,131	$22,966	$23,660	$24,357	$25,027
Columbia Energy Center	TOTAL FUEL COST	$000	$3,471	$2,915	$1,933	$1,221	$1,794	$2,241	$2,366	$2,314	$2,589	$2,666	$1,714	$1,923	$2,215	$2,382	$2,220	$2,331	$2,382	$2,514	$2,586	$2,611
Combined Heat and Power :2011	TOTAL FUEL COST	$000	$0	$0	$0	$1,563	$1,729	$1,669	$1,728	$1,746	$1,840	$1,870	$1,899	$1,918	$1,931	$1,953	$1,932	$1,955	$1,987	$2,011	$2,065	$2,116
CWL Unit 6	TOTAL FUEL COST	$000	$34	$30	$22	$13	$13	$25	$25	$28	$31	$32	$21	$24	$28	$30	$30	$31	$31	$31	$32	$31
CWL Unit 7	TOTAL FUEL COST	$000	$1,488	$1,394	$1,057	$878	$1,224	$1,275	$1,337	$36	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
CWL Unit 8	TOTAL FUEL COST	$000	$191	$163	$109	$65	$83	$131	$137	$144	$160	$165	$110	$124	$144	$155	$149	$155	$157	$165	$169	$167
Distributed Generation	TOTAL FUEL COST	$000	$13	$12	$10	$5	$4	$10	$10	$12	$13	$14	$10	$11	$14	$15	$16	$17	$17	$17	$18	$17
Prairie State Energy Campus	TOTAL FUEL COST	$000	$0	$0	$0	$0	$0	$3,165	$3,254	$3,345	$3,448	$3,535	$3,634	$3,735	$3,851	$3,947	$4,058	$4,172	$4,301	$4,408	$4,532	$4,659
Supercritical Pulverized Coal :2015	TOTAL FUEL COST	$000	$0	$0	$0	$0	$0	$0	$0	$2,025	$2,138	$2,212	$2,348	$2,468	$2,594	$2,718	$2,542	$2,677	$2,788	$2,924	$3,036	$3,133
Wartsila:2011	TOTAL FUEL COST	$000	$0	$0	$0	$1,988	$2,699	$2,866	$2,992	$1,897	$2,048	$2,101	$1,678	$1,822	$2,006	$2,128	$1,951	$2,046	$2,096	$2,199	$2,267	$2,311
Wartsila:2015	TOTAL FUEL COST	$000	$0	$0	$0	$0	$0	$0	$0	$2,464	$2,646	$2,716	$2,165	$2,340	$2,552	$2,703	$2,482	$2,596	$2,648	$2,766	$2,860	$2,934
Wartsila:2018	TOTAL FUEL COST	$000	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$2,771	$2,975	$3,200	$3,380	$3,109	$3,245	$3,312	$3,448	$3,575	$3,678
	TOTAL REC FUEL COST	**$000**	$5,197	$4,514	$3,130	$5,734	$7,546	$11,382	$11,849	$14,010	$14,912	$15,310	$16,351	$17,340	$18,535	$19,411	$18,489	$19,224	$19,717	$20,485	$21,140	$21,656
AmerenUE PPA	MAXIMUM TRANSACTION CAPACITY	MW	60.0	65.0	70.0	70.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Bluegrass Ridge	MAXIMUM TRANSACTION CAPACITY	MW	6.3	6.3	6.3	6.3	6.3	6.3	6.3	6.3	6.3	6.3	6.3	6.3	6.3	6.3	6.3	6.3	6.3	6.3	6.3	6.3
Landfill Gas	MAXIMUM TRANSACTION CAPACITY	MW	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2
RPS Landfill Gas	MAXIMUM TRANSACTION CAPACITY	MW	0.0	0.0	0.0	0.0	0.0	7.0	7.5	8.0	8.5	9.0	9.5	10.0	10.5	11.0	11.5	12.0	12.5	13.0	13.5	13.5
RPS Wind	MAXIMUM TRANSACTION CAPACITY	MW	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.0	5.0	5.0	5.0	5.0	35.0	35.0	35.0	35.0	35.0	35.0

Columbia Water Light Department
Integrated Resource Planning
Project 46806

Description	Data Item	Units	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027
AmerenUE PPA	FIRM CAPACITY	MW	60.0	65.0	70.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Bluegrass Ridge	FIRM CAPACITY	MW	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9
Landfill Gas	FIRM CAPACITY	MW	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2
RPS Landfill Gas	FIRM CAPACITY	MW	0.0	0.0	0.0	0.0	0.0	7.0	7.5	8.0	8.5	9.0	9.5	10.0	10.5	11.0	11.5	12.0	12.5	13.0	13.5	13.5
RPS Wind	FIRM CAPACITY	MW	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.8	0.8	0.8	0.8	0.8	5.3	5.3	5.3	5.3	5.3	5.3
	SUBTOT FIRM PURCHASE CAP	**MW**	66.1	71.1	76.1	6.1	6.1	13.1	13.6	14.1	14.6	15.9	16.4	16.9	17.4	17.9	22.9	23.4	23.9	24.4	24.9	24.9
	TOTAL FIRM CAPACITY	**MW**	318.1	323.8	348.1	336.3	342.0	356.9	357.4	361.4	367.1	374.0	380.3	386.5	392.2	399.0	407.0	415.0	423.0	431.0	438.9	446.9
AmerenUE PPA	TRANSACTION ENERGY TAKEN	GWH	308	551	595	254	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bluegrass Ridge	TRANSACTION ENERGY TAKEN	GWH	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18
Landfill Gas	TRANSACTION ENERGY TAKEN	GWH	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42
RPS Landfill Gas	TRANSACTION ENERGY TAKEN	GWH	0	0	0	0	0	55	59	63	67	71	75	79	83	87	91	95	99	103	107	111
RPS Wind	TRANSACTION ENERGY TAKEN	GWH	0	0	0	0	0	0	0	0	0	14	14	14	14	14	100	100	100	100	100	100
	SUBTOTAL TRANS ENERGY	**GWH**	368	611	655	314	60	116	119	123	127	146	150	154	158	161	251	255	259	263	267	271
	TOTAL ENERGY	**GWH**	1,221	1,244	1,266	1,292	1,317	1,340	1,362	1,388	1,414	1,436	1,458	1,484	1,511	1,533	1,563	1,594	1,629	1,655	1,686	1,717
AmerenUE PPA	TRANSACTION CAPACITY FACTOR	%	100.00%	100.00%	100.00%	100.00%																
Bluegrass Ridge	TRANSACTION CAPACITY FACTOR	%	32.52%	32.50%	32.50%	32.50%	32.52%	32.50%	32.50%	32.50%	32.52%	32.50%	32.50%	32.50%	32.52%	32.50%	32.50%	32.50%	32.52%	32.50%	32.50%	32.50%
Landfill Gas	TRANSACTION CAPACITY FACTOR	%	92.23%	92.49%	92.49%	92.49%	92.23%	92.49%	92.49%	92.49%	92.23%	92.49%	92.49%	92.49%	92.23%	92.49%	92.49%	92.49%	92.23%	92.49%	92.49%	92.49%
RPS Landfill Gas	TRANSACTION CAPACITY FACTOR	%						90.46%	90.46%	90.46%	90.21%	90.46%	90.46%	90.46%	90.21%	90.46%	90.46%	90.46%	90.21%	90.46%	90.46%	93.81%
RPS Wind	TRANSACTION CAPACITY FACTOR	%										32.50%	32.50%	32.50%	32.52%	32.50%	32.50%	32.50%	32.52%	32.50%	32.50%	32.50%
AmerenUE PPA	TOTAL TRANSACTION COST	$000	$15,565	$28,052	$30,799	$13,236	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Bluegrass Ridge	TOTAL TRANSACTION COST	$000	$1,234	$1,229	$1,229	$1,229	$1,234	$1,229	$1,229	$1,229	$1,234	$1,229	$1,229	$1,229	$1,234	$1,229	$1,229	$1,229	$1,234	$1,229	$1,229	$1,229
Landfill Gas	TOTAL TRANSACTION COST	$000	$2,443	$2,443	$2,443	$2,443	$2,443	$2,443	$2,443	$2,443	$2,443	$2,443	$2,443	$2,443	$2,443	$2,443	$2,443	$2,443	$2,443	$2,443	$2,443	$2,443
RPS Landfill Gas	TOTAL TRANSACTION COST	$000	$0	$0	$0	$0	$0	$3,328	$3,566	$3,804	$4,041	$4,279	$4,517	$4,754	$4,992	$5,230	$5,468	$5,705	$5,943	$6,181	$6,418	$6,656
RPS Wind	TOTAL TRANSACTION COST	$000	$0	$0	$0	$0	$0	$0	$0	$0	$0	$1,355	$1,355	$1,355	$1,359	$1,355	$9,485	$9,485	$9,516	$9,485	$9,485	$9,485
AmerenUE PPA	TRANSACTION ENERGY COST	$000	$15,208	$27,339	$29,857	$12,798	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Bluegrass Ridge	TRANSACTION ENERGY COST	$000	$1,234	$1,229	$1,229	$1,229	$1,234	$1,229	$1,229	$1,229	$1,234	$1,229	$1,229	$1,229	$1,234	$1,229	$1,229	$1,229	$1,234	$1,229	$1,229	$1,229
Landfill Gas	TRANSACTION ENERGY COST	$000	$2,443	$2,443	$2,443	$2,443	$2,443	$2,443	$2,443	$2,443	$2,443	$2,443	$2,443	$2,443	$2,443	$2,443	$2,443	$2,443	$2,443	$2,443	$2,443	$2,443
RPS Landfill Gas	TRANSACTION ENERGY COST	$000	$0	$0	$0	$0	$0	$3,328	$3,566	$3,804	$4,041	$4,279	$4,517	$4,754	$4,992	$5,230	$5,468	$5,705	$5,943	$6,181	$6,418	$6,656
RPS Wind	TRANSACTION ENERGY COST	$000	$0	$0	$0	$0	$0	$0	$0	$0	$0	$1,273	$1,273	$1,273	$1,277	$1,273	$8,911	$8,911	$8,942	$8,911	$8,911	$8,911
	TOTAL PURCH EN COST	**$000**	$18,885	$31,012	$33,530	$16,471	$3,677	$7,001	$7,239	$7,476	$7,718	$9,225	$9,463	$9,700	$9,947	$10,176	$18,052	$18,289	$18,562	$18,765	$19,002	$19,240
AmerenUE PPA	TRANSACTION CAPACITY COST	$000	$357	$713	$942	$438	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
RPS Wind	TRANSACTION CAPACITY COST	$000	$0	$0	$0	$0	$0	$0	$0	$0	$0	$82	$82	$82	$82	$82	$574	$574	$574	$574	$574	$574
	TOTAL PURCH CAP COST	**$000**	$357	$713	$942	$438	$0	$0	$0	$0	$0	$82	$82	$82	$82	$82	$574	$574	$574	$574	$574	$574
	TOTAL FIXED COSTS	**$000**	$23,175	$24,433	$26,155	$29,186	$30,257	$30,930	$32,146	$33,096	$34,642	$36,536	$37,452	$39,416	$41,429	$43,636	$46,134	$48,651	$51,287	$54,048	$56,939	$60,019
AmerenUE PPA (Theoretical)	CO2	TONS	2,424	4,337	4,681	1,996	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Columbia Energy Center	CO2	TONS	19,222	15,925	10,463	6,512	9,055	11,473	11,764	11,075	11,845	11,983	7,789	8,767	10,182	10,922	10,100	10,552	10,663	11,143	11,188	11,054
Combined Heat and Power :2011	CO2	TONS	0	0	0	8,124	8,649	8,434	8,489	8,143	8,203	8,199	8,349	8,472	8,609	8,684	8,489	8,560	8,615	8,648	8,683	8,702
CWL Unit 6	CO2	TONS	189	164	119	67	64	127	127	133	141	143	97	110	129	138	137	140	138	141	141	133
CWL Unit 7	CO2	TONS	42,425	38,669	28,510	23,052	31,261	31,671	32,304	850	0	0	0	0	0	0	0	0	0	0	0	0
CWL Unit 8	CO2	TONS	1,249	1,046	685	403	501	780	794	803	852	863	582	657	773	828	784	813	818	850	852	829
Iatan 2	CO2	TONS	0	0	145,438	145,956	146,667	145,975	145,962	146,194	146,559	146,109	146,124	146,093	146,522	145,987	145,696	145,674	146,352	145,875	145,580	145,250
Nearman Creek	CO2	TONS	93,320	72,310	46,794	70,543	101,369	76,074	77,621	57,939	60,308	60,447	63,880	66,592	69,354	71,812	63,958	66,412	68,263	69,972	71,271	71,825
Prairie State Energy Campus	CO2	TONS	0	0	0	0	0	373,598	373,598	373,598	374,706	373,598	373,598	373,598	374,706	373,598	373,598	373,598	374,706	373,598	373,598	373,594
Sikeston	CO2	TONS	448,447	418,326	341,745	384,741	443,724	407,433	408,108	438,991	441,252	437,312	441,085	440,647	442,961	439,003	421,890	421,393	422,525	417,300	413,370	409,553
Supercritical Pulverized Coal :2015	CO2	TONS	0	0	0	0	0	0	0	108,232	111,151	111,832	115,499	118,089	120,749	123,068	111,972	114,695	116,190	118,573	119,731	120,200
Wartsila:2011	CO2	TONS	0	0	0	11,175	14,404	15,387	15,613	9,489	9,787	9,869	7,935	8,644	9,600	10,155	9,245	9,648	9,773	10,156	10,221	10,187
Wartsila:2015	CO2	TONS	0	0	0	0	0	0	0	12,309	12,635	12,744	10,210	11,078	12,187	12,876	11,732	12,215	12,319	12,749	12,870	12,913
Wartsila:2018	CO2	TONS	0	0	0	0	0	0	0	0	0	0	13,046	14,063	15,261	16,076	14,669	15,239	15,385	15,865	16,062	16,166
	TOTAL CO2	**TONS**	607,277	550,777	578,436	652,568	755,695	1,070,950	1,074,377	1,167,754	1,177,441	1,173,100	1,188,194	1,196,810	1,211,034	1,213,146	1,172,269	1,178,939	1,185,747	1,184,869	1,183,565	1,180,405
CWL Unit 7	Hg	LBS	3.510	3.199	2.359	1.907	2.586	2.620	2.672	0.070	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
CWL Unit 8	Hg	LBS	0.152	0.128	0.084	0.049	0.060	0.096	0.097	0.099	0.105	0.106	0.072	0.081	0.095	0.102	0.097	0.101	0.101	0.105	0.105	0.102

Columbia Water Light Department
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Description	Data Item	Units	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027
Iatan 2	Hg	LBS	0.000	0.000	0.060	0.060	0.061	0.060	0.060	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.060	0.060	0.061	0.060	0.060	0.060
Nearman Creek	Hg	LBS	3.030	2.348	1.519	2.290	3.291	2.470	2.520	1.881	1.958	1.963	2.074	2.162	2.252	2.332	2.077	2.156	2.216	2.272	2.314	2.332
Prairie State Energy Campus	Hg	LBS	0.000	0.000	0.000	0.000	0.000	6.965	6.965	6.965	6.986	6.965	6.965	6.965	6.986	6.965	6.965	6.965	6.986	6.965	6.965	6.965
Sikeston	Hg	LBS	18.103	16.887	13.796	15.531	17.912	16.447	16.474	17.721	17.812	17.653	17.806	17.788	17.881	17.722	17.031	17.011	17.056	16.846	16.687	16.533
Supercritical Pulverized Coal :2015	Hg	LBS	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.722	0.741	0.746	0.770	0.787	0.805	0.820	0.746	0.765	0.775	0.790	0.798	0.801
	TOTAL Hg	**LBS**	24.795	22.561	17.818	19.838	23.911	28.658	28.790	27.519	27.663	27.493	27.747	27.844	28.080	28.001	26.976	27.058	27.195	27.038	26.930	26.793
Columbia Energy Center	NOx	TONS	6	5	3	2	3	4	4	4	4	4	3	3	3	4	3	3	3	4	4	4
Combined Heat and Power :2011	NOx	TONS	0	0	0	0	1	1	1	0	0	0	0	1	1	1	1	1	1	1	1	1
CWL Unit 7	NOx	TONS	109	100	73	59	81	82	83	2	0	0	0	0	0	0	0	0	0	0	0	0
CWL Unit 8	NOx	TONS	5	4	3	2	2	3	3	3	3	3	2	3	3	3	3	3	3	3	3	3
Iatan 2	NOx	TONS	0	0	54	54	54	54	54	54	54	54	54	54	54	54	54	54	54	54	54	54
Nearman Creek	NOx	TONS	195	151	98	147	212	159	162	121	126	126	133	139	145	150	133	139	142	146	149	150
Prairie State Energy Campus	NOx	TONS	0	0	0	0	0	121	121	121	121	121	121	121	121	121	121	121	121	121	121	121
Sikeston	NOx	TONS	461	430	352	396	456	419	420	452	454	450	454	453	456	452	434	433	435	429	425	421
Supercritical Pulverized Coal :2015	NOx	TONS	0	0	0	0	0	0	0	20	21	21	21	22	22	23	21	21	22	22	22	22
Wartsila:2011	NOx	TONS	0	0	0	2	2	2	2	2	2	2	1	1	2	2	1	2	2	2	2	2
Wartsila:2015	NOx	TONS	0	0	0	0	0	0	0	2	2	2	2	2	2	2	2	2	2	2	2	2
Wartsila:2018	NOx	TONS	0	0	0	0	0	0	0	0	0	0	2	2	2	3	2	2	2	3	3	3
	TOTAL NOx	**TONS**	776	690	583	662	811	844	850	781	787	783	794	801	811	813	776	781	787	786	785	782
CWL Unit 7	SO2	TONS	295	269	198	160	218	220	225	6	0	0	0	0	0	0	0	0	0	0	0	0
CWL Unit 8	SO2	TONS	17	14	10	6	7	11	11	11	12	12	8	9	11	12	11	11	11	12	12	12
Iatan 2	SO2	TONS	0	0	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	60
Nearman Creek	SO2	TONS	351	272	176	265	381	286	292	218	227	227	240	250	261	270	241	250	257	263	268	270
Prairie State Energy Campus	SO2	TONS	0	0	0	0	0	315	315	315	316	315	315	315	316	315	315	315	316	315	315	315
Sikeston	SO2	TONS	1,276	1,190	972	1,094	1,262	1,159	1,161	1,249	1,255	1,244	1,255	1,253	1,260	1,249	1,200	1,199	1,202	1,187	1,176	1,165
Supercritical Pulverized Coal :2015	SO2	TONS	0	0	0	0	0	0	0	16	16	17	17	17	18	18	17	17	17	18	18	18
Wartsila:2011	SO2	TONS	0	0	0	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Wartsila:2015	SO2	TONS	0	0	0	0	0	0	0	1	1	1	0	0	0	1	0	0	1	1	1	1
Wartsila:2018	SO2	TONS	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1
	TOTAL SO2	**TONS**	1,939	1,746	1,417	1,587	1,930	2,053	2,065	1,876	1,888	1,877	1,897	1,908	1,928	1,926	1,845	1,854	1,866	1,857	1,851	1,841
NOx	SYSTEM EFFLUENT EXPENSE	$000	$0	$1,272	$1,108	$1,302	$1,710	$2,005	$2,197	$2,197	$2,333	$2,525	$2,786	$3,057	$3,370	$3,082	$2,684	$2,468	$2,269	$2,067	$1,884	$1,712
CO2	SYSTEM EFFLUENT EXPENSE	$000	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
SO2	SYSTEM EFFLUENT EXPENSE	$000	-$2,111	-$2,884	-$1,223	-$1,319	-$913	-$795	-$840	$543	$600	$623	$735	$832	$972	$1,049	$825	$934	$1,068	$1,117	$1,180	$1,228
Hg	SYSTEM EFFLUENT EXPENSE	$000	$0	$0	$174	$202	$254	$342	$374	$389	$412	$445	$489	$534	$586	$636	$667	$729	$798	$863	$936	$1,015
	TOTAL GASSES	**$000**	-$2,111	-$1,612	$58	$185	$1,051	$1,551	$1,731	$3,128	$3,344	$3,593	$4,010	$4,422	$4,927	$4,767	$4,177	$4,130	$4,135	$4,047	$4,000	$3,955
	TOTAL VARIABLE COST	**$000**	$49,551	$51,124	$50,926	$55,070	$60,731	$46,849	$49,772	$49,440	$52,782	$56,229	$58,427	$61,842	$65,244	$67,993	$73,109	$76,533	$80,291	$83,886	$88,072	$92,249
	PeakLoad	(MW)	278.0	284.0	289.0	295.0	300.0	306.0	311.0	317.0	322.0	328.0	333.0	339.0	344.0	350.0	357.0	364.0	371.0	378.0	385.0	392.0
	Reserves	(MW)	38.92	39.76	40.46	41.3	42	42.84	43.54	44.38	45.08	45.92	46.62	47.46	48.16	49	49.98	50.96	51.94	52.92	53.9	54.88
	TotalCapacityResponsibility	(MW)	316.9	323.8	329.5	336.3	342.0	348.8	354.5	361.4	367.1	373.9	379.6	386.5	392.2	399.0	407.0	415.0	422.9	430.9	438.9	446.9
(Wind 15% Firm)	TotalFirmResources	(MW)	318.1	323.8	348.1	336.3	342.0	356.9	357.4	361.4	367.1	374.0	380.3	386.5	392.2	399.0	407.0	415.0	423.0	431.0	438.9	446.9
	ReserveSurplus(Deficit)	(MW)	1.2	0.0	18.7	0.0	0.0	8.1	2.9	0.0	0.0	0.0	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	ReserveMargin	(%)	14.44%	14.01%	20.47%	14.01%	14.01%	16.65%	14.93%	14.01%	14.01%	14.01%	14.20%	14.01%	14.01%	14.01%	14.01%	14.01%	14.01%	14.01%	14.01%	14.01%
New Capacity Investment	CHP	$000	$0	$0	$0	$1,247	$1,247	$1,247	$1,247	$1,247	$1,247	$1,247	$1,247	$1,247	$1,247	$0	$0	$0	$0	$0	$0	$0
	SCPC1 DebtService	$000	$0	$0	$0	$0	$0	$0	$0	$6,781	$6,781	$6,781	$6,781	$6,781	$6,781	$6,781	$6,781	$6,781	$6,781	$6,781	$6,781	$6,781
	Wart1 DebtService	$000	$0	$0	$0	$1,624	$1,624	$1,624	$1,624	$1,624	$1,624	$1,624	$1,624	$1,624	$1,624	$1,624	$1,624	$1,624	$1,624	$1,624	$1,624	$1,624
	Wart2 DebtService	$000	$0	$0	$0	$0	$0	$0	$0	$1,828	$1,828	$1,828	$1,828	$1,828	$1,828	$1,828	$1,828	$1,828	$1,828	$1,828	$1,828	$1,828
	Wart3 DebtService	$000	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$1,997	$1,997	$1,997	$1,997	$1,997	$1,997	$1,997	$1,997	$1,997	$1,997
	Total Fixed Costs	($000)	$23,175	$24,433	$26,155	$29,186	$30,257	$30,930	$32,146	$33,096	$34,642	$36,536	$37,452	$39,416	$41,429	$43,636	$46,134	$48,651	$51,287	$54,048	$56,939	$60,019
	Total Variable Costs	($000)	$44,354	$46,610	$47,795	$49,337	$53,185	$35,467	$37,923	$35,430	$37,870	$40,919	$42,076	$44,502	$46,708	$48,583	$54,620	$57,308	$60,573	$63,401	$66,932	$70,593
	Total Fuel Costs	($000)	$5,197	$4,514	$3,130	$5,734	$7,546	$11,382	$11,849	$14,010	$14,912	$15,310	$16,351	$17,340	$18,535	$19,411	$18,489	$19,224	$19,717	$20,485	$21,140	$21,656
	Total Investment Costs	($000)	$0	$0	$0	$2,871	$2,871	$2,871	$2,871	$11,479	$11,479	$11,479	$13,476	$13,476	$13,476	$12,229	$12,229	$12,229	$12,229	$12,229	$12,229	$12,229
	Total Costs	($000)	$72,726	$75,556	$77,080	$87,128	$93,860	$80,649	$84,789	$94,015	$98,903	$104,245	$109,356	$114,735	$120,149	$123,859	$131,473	$137,413	$143,807	$150,163	$157,240	$164,497

20-Year NPV @ 5.5% ($000): $1,229,845

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Description	Data Item	Units	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027
Columbia	ENERGY REQUIREMENTS	GWH	1,221	1,238	1,254	1,274	1,294	1,311	1,327	1,347	1,367	1,383	1,399	1,426	1,452	1,474	1,505	1,535	1,570	1,597	1,627	1,658
Columbia	PEAK DEMAND	MW	278.0	282.1	285.3	289.4	292.5	296.7	299.8	304.0	307.1	311.2	314.4	320.4	325.4	331.4	338.4	345.4	352.4	359.4	366.4	373.4
	MARKET PURCHASE ENERGY	GWH	299	128	67	329	498	151	160	93	101	105	110	124	133	131	117	135	157	178	203	229
THEORETICAL CO2	MARKET PURCHASE ENERGY	TONS	149,550	64,228	33,291	164,563	249,004	75,564	80,144	46,655	50,285	52,430	55,143	61,934	66,425	65,395	58,699	67,341	78,556	88,822	101,369	114,690
	COST OF MARKET PURCHASE ENERGY	$000	$18,203	$8,268	$4,484	$20,502	$33,173	$10,398	$11,397	$6,727	$7,564	$7,991	$8,611	$9,947	$11,106	$10,233	$9,581	$11,116	$13,142	$15,008	$17,400	$19,861
Columbia Energy Center	FIRM CAPACITY	MW	72.0	72.0	72.0	72.0	72.0	72.0	72.0	72.0	72.0	72.0	72.0	72.0	72.0	72.0	72.0	72.0	72.0	72.0	72.0	72.0
Combined Heat and Power :2011	FIRM CAPACITY	MW	0.0	0.0	0.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
CWL Unit 5	FIRM CAPACITY	MW	16.5	16.5	16.5	16.5	16.5	16.5	16.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CWL Unit 6	FIRM CAPACITY	MW	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5
CWL Unit 7	FIRM CAPACITY	MW	22.0	22.0	22.0	22.0	22.0	22.0	22.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CWL Unit 8	FIRM CAPACITY	MW	35.0	35.0	35.0	35.0	35.0	35.0	35.0	35.0	35.0	35.0	35.0	35.0	35.0	35.0	35.0	35.0	35.0	35.0	35.0	35.0
Distributed Generation	FIRM CAPACITY	MW	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0
Iatan 2	FIRM CAPACITY	MW	0.0	0.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0
Market Purchase	FIRM CAPACITY	MW	0.0	0.0	0.0	16.3	19.0	0.0	0.0	0.0	0.0	0.0	0.0	3.5	8.7	0.0	1.2	8.7	16.2	23.7	31.1	39.1
Nearman Creek	FIRM CAPACITY	MW	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0
Prairie State Energy Campus	FIRM CAPACITY	MW	0.0	0.0	0.0	0.0	0.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0
Sikeston	FIRM CAPACITY	MW	66.0	66.0	66.0	66.0	66.0	66.0	66.0	66.0	66.0	66.0	66.0	66.0	66.0	66.0	66.0	66.0	66.0	66.0	66.0	66.0
Supercritical Pulverized Coal :2015	FIRM CAPACITY	MW	0.0	0.0	0.0	0.0	0.0	0.0	0.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0
Wartsila:2011	FIRM CAPACITY	MW	0.0	0.0	0.0	16.8	16.8	16.8	16.8	16.8	16.8	16.8	16.8	16.8	16.8	16.8	16.8	16.8	16.8	16.8	16.8	16.8
Wartsila:2021	FIRM CAPACITY	MW	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	16.8	16.8	16.8	16.8	16.8	16.8	16.8
	SUBTOTAL CAPACITY	**MW**	252.0	252.0	272.0	310.1	312.8	343.8	343.8	330.3	330.3	330.3	330.3	333.8	339.0	347.1	348.3	355.8	363.3	370.8	378.2	386.2
Columbia Energy Center	GENERATION	GWH	25	21	13	8	12	14	15	23	24	24	25	26	28	19	17	18	18	19	20	20
Combined Heat and Power :2011	GENERATION	GWH	0	0	0	25	27	26	26	24	25	25	25	25	25	26	25	26	26	26	26	26
CWL Unit 5	GENERATION	GWH	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CWL Unit 6	GENERATION	GWH	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CWL Unit 7	GENERATION	GWH	27	24	17	14	20	19	20	1	0	0	0	0	0	0	0	0	0	0	0	0
CWL Unit 8	GENERATION	GWH	1	1	1	0	1	1	1	1	1	1	1	2	2	1	1	1	1	1	1	1
Distributed Generation	GENERATION	GWH	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Iatan 2	GENERATION	GWH	0	0	146	147	148	147	147	147	147	147	147	147	147	147	147	147	147	147	146	146
Nearman Creek	GENERATION	GWH	82	63	40	61	89	64	65	45	47	47	47	49	52	57	50	52	54	56	57	59
Prairie State Energy Campus	GENERATION	GWH	0	0	0	0	0	368	368	368	369	368	368	368	369	368	368	368	369	368	368	368
Sikeston	GENERATION	GWH	418	389	314	355	413	377	377	403	404	400	403	403	406	404	386	387	388	385	382	379
Supercritical Pulverized Coal :2015	GENERATION	GWH	0	0	0	0	0	0	0	96	99	99	101	104	106	111	99	102	105	107	109	110
Wartsila:2011	GENERATION	GWH	0	0	0	20	27	28	28	21	22	22	23	24	25	21	19	20	20	21	21	21
Wartsila:2021	GENERATION	GWH	0	0	0	0	0	0	0	0	0	0	0	0	0	27	24	25	26	27	27	28
	SUBTOTAL GENERATION	**GWH**	553	498	532	631	736	1,044	1,047	1,130	1,139	1,133	1,140	1,148	1,161	1,182	1,136	1,146	1,154	1,156	1,158	1,158
Columbia Energy Center	GENERATOR CAPACITY FACTOR	%	4.00%	3.29%	2.11%	1.33%	1.88%	2.29%	2.35%	3.58%	3.83%	3.85%	3.92%	4.18%	4.44%	3.02%	2.70%	2.85%	2.89%	3.04%	3.09%	3.13%
Combined Heat and Power :2011	GENERATOR CAPACITY FACTOR	%				56.96%	60.69%	58.81%	59.18%	55.86%	56.04%	56.07%	56.27%	56.75%	57.31%	59.21%	57.81%	58.36%	58.35%	58.93%	59.27%	59.50%
CWL Unit 6	GENERATOR CAPACITY FACTOR	%	0.16%	0.14%	0.10%	0.06%	0.06%	0.11%	0.11%	0.19%	0.20%	0.20%	0.20%	0.22%	0.23%	0.15%	0.15%	0.15%	0.15%	0.15%	0.16%	0.15%
CWL Unit 7	GENERATOR CAPACITY FACTOR	%	13.78%	12.53%	9.05%	7.35%	10.16%	9.96%	10.15%													
CWL Unit 8	GENERATOR CAPACITY FACTOR	%	0.42%	0.35%	0.23%	0.13%	0.17%	0.25%	0.26%	0.44%	0.46%	0.47%	0.48%	0.51%	0.54%	0.36%	0.34%	0.35%	0.36%	0.37%	0.37%	0.37%
Distributed Generation	GENERATOR CAPACITY FACTOR	%	0.10%	0.09%	0.07%	0.04%	0.03%	0.06%	0.06%	0.11%	0.12%	0.12%	0.12%	0.13%	0.14%	0.09%	0.09%	0.09%	0.09%	0.09%	0.09%	0.09%
Iatan 2	GENERATOR CAPACITY FACTOR	%			83.43%	83.79%	84.02%	83.83%	83.83%	83.96%	83.94%	83.91%	83.94%	83.92%	83.93%	83.85%	83.71%	83.66%	83.85%	83.80%	83.62%	83.33%
Nearman Creek	GENERATOR CAPACITY FACTOR	%	46.69%	35.83%	22.74%	34.79%	50.71%	36.67%	37.29%	25.93%	26.49%	26.55%	26.76%	28.14%	29.71%	32.48%	28.67%	29.92%	30.52%	31.70%	32.65%	33.48%
Prairie State Energy Campus	GENERATOR CAPACITY FACTOR	%						84.02%	84.02%	84.02%	84.04%	84.02%	84.02%	84.02%	84.04%	84.02%	84.02%	84.02%	84.04%	84.02%	84.02%	84.02%
Sikeston	GENERATOR CAPACITY FACTOR	%	72.08%	67.28%	54.38%	61.44%	71.32%	65.16%	65.26%	69.68%	69.73%	69.21%	69.73%	69.74%	70.01%	69.96%	66.78%	66.89%	67.00%	66.51%	66.01%	65.48%
Supercritical Pulverized Coal :2015	GENERATOR CAPACITY FACTOR	%								43.75%	45.03%	45.01%	45.99%	47.47%	48.48%	50.67%	45.22%	46.68%	47.65%	49.02%	49.84%	50.41%
Wartsila:2011	GENERATOR CAPACITY FACTOR	%				13.84%	18.07%	18.82%	19.11%	14.60%	14.97%	15.00%	15.35%	16.11%	16.92%	14.28%	12.68%	13.34%	13.59%	14.20%	14.42%	14.59%
Wartsila:2021	GENERATOR CAPACITY FACTOR	%														18.39%	16.37%	17.19%	17.38%	18.17%	18.49%	18.71%
Columbia Energy Center	TOTAL O AND M COST	$000	$5,301	$5,426	$5,548	$5,677	$5,826	$5,976	$6,126	$6,296	$6,457	$6,618	$6,959	$7,136	$7,319	$7,480	$7,662	$7,856	$8,053	$8,257	$8,464	$8,676
Combined Heat and Power :2011	TOTAL O AND M COST	$000	$0	$0	$0	$416	$457	$455	$472	$459	$475	$488	$505	$524	$547	$581	$584	$607	$627	$650	$674	$696
CWL Unit 6	TOTAL O AND M COST	$000	$1,524	$1,547	$1,592	$1,637	$1,686	$1,740	$1,792	$1,850	$1,907	$1,964	$2,023	$2,084	$2,148	$2,207	$2,273	$2,341	$2,411	$2,484	$2,559	$2,635
CWL Unit 7	TOTAL O AND M COST	$000	$2,222	$2,191	$2,070	$2,040	$2,261	$2,316	$2,396	$184	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
CWL Unit 8	TOTAL O AND M COST	$000	$379	$385	$396	$408	$420	$433	$446	$460	$474	$488	$503	$518	$534	$549	$566	$583	$600	$618	$637	$656
Distributed Generation	TOTAL O AND M COST	$000	$13	$12	$10	$6	$4	$10	$10	$19	$21	$22	$22	$24	$26	$17	$18	$19	$20	$20	$21	$20
Iatan 2	TOTAL O AND M COST	$000	$0	$0	$2,881	$2,978	$3,080	$3,160	$3,255	$3,357	$3,464	$3,559	$3,667	$3,776	$3,899	$4,004	$4,119	$4,240	$4,384	$4,504	$4,631	$4,757
Market Purchase	TOTAL O AND M COST	$000	$0	$0	$0	$1,071	$1,286	$0	$0	$0	$0	$0	$0	$291	$745	$0	$111	$814	$1,559	$2,347	$3,182	$4,117
Nearman Creek	TOTAL O AND M COST	$000	$4,689	$4,518	$4,254	$4,850	$5,634	$5,317	$5,555	$5,307	$5,547	$5,768	$6,009	$6,316	$6,651	$7,058	$7,133	$7,489	$7,829	$8,209	$8,598	$8,997
Prairie State Energy Campus	TOTAL O AND M COST	$000	$0	$0	$0	$0	$0	$4,412	$4,545	$4,681	$4,828	$4,966	$5,115	$5,269	$5,434	$5,589	$5,757	$5,930	$6,116	$6,291	$6,480	$6,674
Sikeston	TOTAL O AND M COST	$000	$18,064	$18,221	$17,665	$19,197	$21,121	$21,303	$22,233	$23,723	$24,771	$25,747	$26,926	$28,092	$29,372	$30,611	$31,475	$32,868	$34,355	$35,754	$37,245	$38,798
Supercritical Pulverized Coal :2015	TOTAL O AND M COST	$000	$0	$0	$0	$0	$0	$0	$0	$2,805	$2,943	$3,025	$3,155	$3,312	$3,460	$3,655	$3,517	$3,691	$3,854	$4,031	$4,194	$4,350

Columbia Water Light Department
Integrated Resource Planning
Project 46806

Description	Data Item	Units	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027
Wartsila:2011	TOTAL O AND M COST	$000	$0	$0	$0	$326	$393	$414	$431	$378	$395	$407	$425	$450	$478	$446	$430	$456	$475	$500	$519	$539
Wartsila:2021	TOTAL O AND M COST	$000	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$517	$497	$527	$547	$578	$602	$624
Columbia Energy Center	FIXED O AND M COSTS	$000	$5,257	$5,388	$5,523	$5,661	$5,803	$5,948	$6,096	$6,249	$6,405	$6,565	$6,903	$7,076	$7,253	$7,434	$7,620	$7,811	$8,006	$8,206	$8,411	$8,621
CWL Unit 6	FIXED O AND M COSTS	$000	$1,516	$1,540	$1,587	$1,634	$1,683	$1,734	$1,786	$1,839	$1,894	$1,951	$2,010	$2,070	$2,132	$2,196	$2,262	$2,330	$2,400	$2,472	$2,546	$2,622
CWL Unit 7	FIXED O AND M COSTS	$000	$1,516	$1,540	$1,587	$1,634	$1,683	$1,734	$1,786	$156	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
CWL Unit 8	FIXED O AND M COSTS	$000	$378	$384	$396	$408	$420	$432	$445	$459	$472	$487	$501	$516	$532	$548	$564	$581	$598	$616	$635	$654
Iatan 2	FIXED O AND M COSTS	$000	$0	$0	$586	$604	$622	$640	$660	$679	$700	$721	$742	$765	$788	$811	$836	$861	$887	$913	$941	$969
Market Purchase	FIXED O AND M COSTS	$000	$0	$0	$0	$1,071	$1,286	$0	$0	$0	$0	$0	$0	$291	$745	$0	$111	$814	$1,559	$2,347	$3,182	$4,117
Nearman Creek	FIXED O AND M COSTS	$000	$3,218	$3,347	$3,481	$3,620	$3,765	$3,916	$4,072	$4,235	$4,405	$4,581	$4,764	$4,955	$5,153	$5,359	$5,573	$5,796	$6,028	$6,269	$6,520	$6,781
Prairie State Energy Campus	FIXED O AND M COSTS	$000	$0	$0	$0	$0	$0	$2,417	$2,490	$2,564	$2,641	$2,721	$2,802	$2,886	$2,973	$3,062	$3,154	$3,249	$3,346	$3,446	$3,550	$3,656
Sikeston	FIXED O AND M COSTS	$000	$10,933	$11,480	$12,054	$12,656	$13,289	$13,953	$14,651	$15,384	$16,153	$16,961	$17,809	$18,699	$19,634	$20,616	$21,646	$22,729	$23,865	$25,058	$26,311	$27,627
Supercritical Pulverized Coal :2015	FIXED O AND M COSTS	$000	$0	$0	$0	$0	$0	$0	$0	$1,189	$1,224	$1,261	$1,299	$1,338	$1,378	$1,419	$1,462	$1,506	$1,551	$1,597	$1,645	$1,695
Wartsila:2011	FIXED O AND M COSTS	$000	$0	$0	$0	$146	$151	$155	$160	$165	$170	$175	$180	$185	$191	$197	$203	$209	$215	$221	$228	$235
Wartsila:2021	FIXED O AND M COSTS	$000	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$197	$203	$209	$215	$221	$228	$235
	TOTAL FIXED OM COST	**$000**	$22,818	$23,680	$25,213	$27,434	$28,701	$30,930	$32,146	$32,919	$34,065	$35,422	$37,011	$38,781	$40,778	$41,839	$43,634	$46,093	$48,669	$51,369	$54,197	$57,212
Columbia Energy Center	VARIABLE O AND M COSTS	$/MWH	$1.74	$1.79	$1.83	$1.88	$1.93	$1.97	$2.02	$2.07	$2.13	$2.18	$2.23	$2.29	$2.35	$2.40	$2.47	$2.53	$2.59	$2.65	$2.72	$2.79
Combined Heat and Power :2011	VARIABLE O AND M COSTS	$/MWH	$0.00	$0.00	$0.00	$16.67	$17.16	$17.67	$18.20	$18.75	$19.31	$19.89	$20.49	$21.10	$21.73	$22.38	$23.06	$23.75	$24.46	$25.19	$25.95	$26.73
CWL Unit 6	VARIABLE O AND M COSTS	$/MWH	$43.67	$44.39	$45.73	$47.06	$48.48	$49.95	$51.45	$53.03	$54.62	$56.25	$57.93	$59.66	$61.44	$63.32	$65.23	$67.18	$69.19	$71.26	$73.39	$75.59
CWL Unit 7	VARIABLE O AND M COSTS	$/MWH	$26.52	$26.94	$27.74	$28.67	$29.43	$30.32	$31.23	$31.74	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
CWL Unit 8	VARIABLE O AND M COSTS	$/MWH	$0.94	$0.95	$0.98	$1.02	$1.04	$1.07	$1.11	$1.14	$1.18	$1.21	$1.25	$1.28	$1.32	$1.36	$1.40	$1.45	$1.49	$1.53	$1.58	$1.63
Distributed Generation	VARIABLE O AND M COSTS	$/MWH	$192.95	$196.27	$202.14	$207.47	$214.19	$220.77	$227.41	$234.35	$241.40	$248.62	$255.99	$263.65	$271.52	$279.86	$288.16	$296.85	$305.78	$314.91	$324.40	$334.08
Iatan 2	VARIABLE O AND M COSTS	$/MWH	$0.00	$0.00	$15.70	$16.17	$16.65	$17.16	$17.67	$18.20	$18.75	$19.31	$19.89	$20.48	$21.10	$21.73	$22.38	$23.06	$23.75	$24.46	$25.19	$25.95
Nearman Creek	VARIABLE O AND M COSTS	$/MWH	$17.93	$18.65	$19.39	$20.17	$20.98	$21.81	$22.69	$23.59	$24.54	$25.52	$26.54	$27.60	$28.71	$29.85	$31.05	$32.29	$33.58	$34.93	$36.32	$37.78
Prairie State Energy Campus	VARIABLE O AND M COSTS	$/MWH	$0.00	$0.00	$0.00	$0.00	$0.00	$5.42	$5.58	$5.75	$5.92	$6.10	$6.29	$6.47	$6.67	$6.87	$7.07	$7.29	$7.50	$7.73	$7.96	$8.20
Sikeston	VARIABLE O AND M COSTS	$/MWH	$17.06	$17.33	$17.85	$18.41	$18.94	$19.51	$20.09	$20.70	$21.32	$21.96	$22.62	$23.29	$23.99	$24.71	$25.45	$26.22	$27.00	$27.82	$28.65	$29.51
Supercritical Pulverized Coal :2015	VARIABLE O AND M COSTS	$/MWH	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$16.87	$17.38	$17.90	$18.44	$18.99	$19.56	$20.14	$20.75	$21.37	$22.01	$22.67	$23.35	$24.05
Wartsila:2011	VARIABLE O AND M COSTS	$/MWH	$0.00	$0.00	$0.00	$8.85	$9.08	$9.35	$9.63	$9.93	$10.22	$10.53	$10.85	$11.17	$11.51	$11.85	$12.21	$12.58	$12.95	$13.34	$13.74	$14.15
Wartsila:2021	VARIABLE O AND M COSTS	$/MWH	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$11.85	$12.21	$12.58	$12.95	$13.34	$13.74	$14.15
Columbia Energy Center	VARIABLE O AND M COSTS	$000	$44	$37	$24	$16	$23	$29	$30	$47	$52	$53	$55	$60	$66	$46	$42	$45	$47	$51	$53	$55
Combined Heat and Power :2011	VARIABLE O AND M COSTS	$000	$0	$0	$0	$416	$457	$455	$472	$459	$475	$488	$505	$524	$547	$581	$584	$607	$627	$650	$674	$696
CWL Unit 6	VARIABLE O AND M COSTS	$000	$8	$7	$5	$3	$3	$6	$6	$11	$12	$12	$13	$14	$16	$11	$10	$11	$12	$12	$13	$13
CWL Unit 7	VARIABLE O AND M COSTS	$000	$706	$650	$484	$406	$578	$582	$611	$28	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
CWL Unit 8	VARIABLE O AND M COSTS	$000	$1	$1	$1	$0	$1	$1	$1	$2	$2	$2	$2	$2	$2	$2	$1	$2	$2	$2	$2	$2
Distributed Generation	VARIABLE O AND M COSTS	$000	$13	$12	$10	$6	$4	$10	$10	$19	$21	$22	$22	$24	$26	$17	$18	$19	$20	$20	$21	$20
Iatan 2	VARIABLE O AND M COSTS	$000	$0	$0	$2,295	$2,374	$2,458	$2,520	$2,595	$2,677	$2,764	$2,839	$2,925	$3,012	$3,111	$3,193	$3,283	$3,379	$3,498	$3,591	$3,691	$3,789
Nearman Creek	VARIABLE O AND M COSTS	$000	$1,471	$1,170	$773	$1,229	$1,869	$1,402	$1,482	$1,072	$1,142	$1,187	$1,245	$1,361	$1,498	$1,699	$1,560	$1,692	$1,801	$1,940	$2,078	$2,216
Prairie State Energy Campus	VARIABLE O AND M COSTS	$000	$0	$0	$0	$0	$0	$1,995	$2,055	$2,117	$2,187	$2,246	$2,313	$2,382	$2,461	$2,527	$2,603	$2,681	$2,770	$2,845	$2,930	$3,018
Sikeston	VARIABLE O AND M COSTS	$000	$7,131	$6,742	$5,611	$6,541	$7,832	$7,350	$7,582	$8,339	$8,618	$8,787	$9,118	$9,393	$9,738	$9,996	$9,828	$10,139	$10,490	$10,696	$10,933	$11,171
Supercritical Pulverized Coal :2015	VARIABLE O AND M COSTS	$000	$0	$0	$0	$0	$0	$0	$0	$1,617	$1,718	$1,764	$1,857	$1,974	$2,082	$2,235	$2,055	$2,185	$2,303	$2,434	$2,549	$2,655
Wartsila:2011	VARIABLE O AND M COSTS	$000	$0	$0	$0	$180	$242	$259	$271	$213	$226	$232	$245	$265	$287	$249	$228	$247	$260	$279	$292	$304
Wartsila:2021	VARIABLE O AND M COSTS	$000	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$321	$294	$318	$332	$357	$374	$390
	TOTAL VAR OM COST	**$000**	$9,374	$8,620	$9,202	$11,171	$13,466	$14,607	$15,114	$16,599	$17,216	$17,632	$18,298	$19,012	$19,835	$20,875	$20,507	$21,327	$22,161	$22,876	$23,607	$24,328
Columbia Energy Center	TOTAL FUEL COST	$000	$3,471	$2,888	$1,868	$1,198	$1,794	$2,144	$2,260	$3,603	$4,041	$4,121	$4,185	$4,438	$4,698	$3,169	$2,853	$3,030	$3,117	$3,298	$3,444	$3,563
Combined Heat and Power :2011	TOTAL FUEL COST	$000	$0	$0	$0	$1,557	$1,729	$1,654	$1,712	$1,702	$1,791	$1,818	$1,820	$1,826	$1,833	$1,893	$1,870	$1,894	$1,918	$1,948	$2,003	$2,056
CWL Unit 6	TOTAL FUEL COST	$000	$34	$30	$22	$13	$13	$24	$25	$45	$51	$52	$52	$55	$59	$38	$37	$39	$40	$40	$42	$42
CWL Unit 7	TOTAL FUEL COST	$000	$1,488	$1,386	$1,029	$860	$1,224	$1,231	$1,289	$60	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
CWL Unit 8	TOTAL FUEL COST	$000	$191	$162	$106	$64	$83	$126	$132	$230	$258	$264	$267	$283	$302	$201	$187	$197	$202	$211	$219	$222
Distributed Generation	TOTAL FUEL COST	$000	$13	$12	$10	$6	$4	$10	$10	$19	$21	$22	$23	$25	$28	$19	$19	$21	$21	$22	$23	$22
Prairie State Energy Campus	TOTAL FUEL COST	$000	$0	$0	$0	$0	$0	$3,165	$3,254	$3,345	$3,448	$3,535	$3,634	$3,735	$3,851	$3,947	$4,058	$4,172	$4,301	$4,408	$4,532	$4,659
Supercritical Pulverized Coal :2015	TOTAL FUEL COST	$000	$0	$0	$0	$0	$0	$0	$0	$1,878	$1,992	$2,042	$2,144	$2,276	$2,396	$2,567	$2,355	$2,499	$2,630	$2,773	$2,899	$3,014
Wartsila:2011	TOTAL FUEL COST	$000	$0	$0	$0	$1,956	$2,699	$2,784	$2,908	$2,327	$2,502	$2,543	$2,596	$2,713	$2,833	$2,383	$2,131	$2,252	$2,327	$2,449	$2,547	$2,635
Wartsila:2021	TOTAL FUEL COST	$000	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$3,072	$2,755	$2,907	$2,981	$3,139	$3,270	$3,384
	TOTAL REC FUEL COST	**$000**	$5,197	$4,478	$3,035	$5,653	$7,546	$11,138	$11,589	$13,210	$14,105	$14,397	$14,720	$15,351	$15,999	$17,290	$16,266	$17,012	$17,536	$18,289	$18,978	$19,597
AmerenUE PPA	MAXIMUM TRANSACTION CAPACITY	MW	60	65	70	70	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bluegrass Ridge	MAXIMUM TRANSACTION CAPACITY	MW	6.30000019	6.3	6.3	6.3	6.3	6.3	6.3	6.3	6.3	6.3	6.3	6.3	6.3	6.3	6.3	6.3	6.3	6.3	6.3	6.3
Landfill Gas	MAXIMUM TRANSACTION CAPACITY	MW	5.19999981	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2
RPS Landfill Gas	MAXIMUM TRANSACTION CAPACITY	MW	0	0	0	0	0	7	7.5	8	8.5	9	9.5	10	10.5	11	11.5	12	12.5	13	13.5	13.5
RPS Wind	MAXIMUM TRANSACTION CAPACITY	MW	0	0	0	0	0	0	0	0	0	5	5	5	5	5	35	35	35	35	35	35

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Description	Data Item	Units	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027
AmerenUE PPA	FIRM CAPACITY	MW	60.0	65.0	70.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Bluegrass Ridge	FIRM CAPACITY	MW	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9
Landfill Gas	FIRM CAPACITY	MW	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2
RPS Landfill Gas	FIRM CAPACITY	MW	0.0	0.0	0.0	0.0	0.0	7.0	7.5	8.0	8.5	9.0	9.5	10.0	10.5	11.0	11.5	12.0	12.5	13.0	13.5	13.5
RPS Wind	FIRM CAPACITY	MW	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.8	0.8	0.8	0.8	0.8	5.3	5.3	5.3	5.3	5.3	5.3
	SUBTOT FIRM PURCHASE CAP	**MW**	66.1	71.1	76.1	6.1	6.1	13.1	13.6	14.1	14.6	15.9	16.4	16.9	17.4	17.9	22.9	23.4	23.9	24.4	24.9	24.9
	TOTAL FIRM CAPACITY	**MW**	318.1	323.1	348.1	316.3	319.0	356.9	357.4	344.4	344.9	346.2	346.7	350.7	356.4	365.0	371.2	379.2	387.2	395.2	403.1	411.1
AmerenUE PPA	TRANSACTION ENERGY TAKEN	GWH	308	551	595	254	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bluegrass Ridge	TRANSACTION ENERGY TAKEN	GWH	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18
Landfill Gas	TRANSACTION ENERGY TAKEN	GWH	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42
RPS Landfill Gas	TRANSACTION ENERGY TAKEN	GWH	0	0	0	0	0	55	59	63	67	71	75	79	83	87	91	95	99	103	107	111
RPS Wind	TRANSACTION ENERGY TAKEN	GWH	0	0	0	0	0	0	0	0	0	14	14	14	14	14	100	100	100	100	100	100
	SUBTOTAL TRANS ENERGY	**GWH**	368	611	655	314	60	116	119	123	127	146	150	154	158	161	251	255	259	263	267	271
	TOTAL ENERGY	**GWH**	1,221	1,238	1,254	1,274	1,294	1,311	1,327	1,347	1,367	1,383	1,399	1,426	1,452	1,474	1,505	1,535	1,570	1,597	1,627	1,658
AmerenUE PPA	TRANSACTION CAPACITY FACTOR	%	100.00%	100.00%	100.00%	100.00%																
Bluegrass Ridge	TRANSACTION CAPACITY FACTOR	%	32.52%	32.50%	32.50%	32.50%	32.52%	32.50%	32.50%	32.50%	32.52%	32.50%	32.50%	32.50%	32.52%	32.50%	32.50%	32.50%	32.52%	32.50%	32.50%	32.50%
Landfill Gas	TRANSACTION CAPACITY FACTOR	%	92.23%	92.49%	92.49%	92.49%	92.23%	92.49%	92.49%	92.49%	92.23%	92.49%	92.49%	92.49%	92.23%	92.49%	92.49%	92.49%	92.23%	92.49%	92.49%	92.49%
RPS Landfill Gas	TRANSACTION CAPACITY FACTOR	%						90.46%	90.46%	90.46%	90.21%	90.46%	90.46%	90.46%	90.21%	90.46%	90.46%	90.46%	90.21%	90.46%	90.46%	93.81%
RPS Wind	TRANSACTION CAPACITY FACTOR	%										32.50%	32.50%	32.50%	32.52%	32.50%	32.50%	32.50%	32.52%	32.50%	32.50%	32.50%
AmerenUE PPA	TOTAL TRANSACTION COST	$000	$15,565	$28,052	$30,799	$13,236	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Bluegrass Ridge	TOTAL TRANSACTION COST	$000	$1,234	$1,229	$1,229	$1,229	$1,234	$1,229	$1,229	$1,229	$1,234	$1,229	$1,229	$1,229	$1,234	$1,229	$1,229	$1,229	$1,234	$1,229	$1,229	$1,229
Landfill Gas	TOTAL TRANSACTION COST	$000	$2,443	$2,443	$2,443	$2,443	$2,443	$2,443	$2,443	$2,443	$2,443	$2,443	$2,443	$2,443	$2,443	$2,443	$2,443	$2,443	$2,443	$2,443	$2,443	$2,443
RPS Landfill Gas	TOTAL TRANSACTION COST	$000	$0	$0	$0	$0	$0	$3,328	$3,566	$3,804	$4,041	$4,279	$4,517	$4,754	$4,992	$5,230	$5,468	$5,705	$5,943	$6,181	$6,418	$6,656
RPS Wind	TOTAL TRANSACTION COST	$000	$0	$0	$0	$0	$0	$0	$0	$0	$0	$1,355	$1,355	$1,355	$1,359	$1,355	$9,485	$9,485	$9,516	$9,485	$9,485	$9,485
AmerenUE PPA	TRANSACTION ENERGY COST	$000	$15,208	$27,339	$29,857	$12,798	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Bluegrass Ridge	TRANSACTION ENERGY COST	$000	$1,234	$1,229	$1,229	$1,229	$1,234	$1,229	$1,229	$1,229	$1,234	$1,229	$1,229	$1,229	$1,234	$1,229	$1,229	$1,229	$1,234	$1,229	$1,229	$1,229
Landfill Gas	TRANSACTION ENERGY COST	$000	$2,443	$2,443	$2,443	$2,443	$2,443	$2,443	$2,443	$2,443	$2,443	$2,443	$2,443	$2,443	$2,443	$2,443	$2,443	$2,443	$2,443	$2,443	$2,443	$2,443
RPS Landfill Gas	TRANSACTION ENERGY COST	$000	$0	$0	$0	$0	$0	$3,328	$3,566	$3,804	$4,041	$4,279	$4,517	$4,754	$4,992	$5,230	$5,468	$5,705	$5,943	$6,181	$6,418	$6,656
RPS Wind	TRANSACTION ENERGY COST	$000	$0	$0	$0	$0	$0	$0	$0	$0	$0	$1,273	$1,273	$1,273	$1,277	$1,273	$8,911	$8,911	$8,942	$8,911	$8,911	$8,911
	TOTAL PURCH EN COST	**$000**	$18,885	$31,012	$33,530	$16,471	$3,677	$7,001	$7,239	$7,476	$7,718	$9,225	$9,463	$9,700	$9,947	$10,176	$18,052	$18,289	$18,562	$18,765	$19,002	$19,240
AmerenUE PPA	TRANSACTION CAPACITY COST	$000	$357	$713	$942	$438	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
RPS Wind	TRANSACTION CAPACITY COST	$000	$0	$0	$0	$0	$0	$0	$0	$0	$0	$82	$82	$82	$82	$82	$574	$574	$574	$574	$574	$574
	TOTAL PURCH CAP COST	**$000**	$357	$713	$942	$438	$0	$0	$0	$0	$0	$82	$82	$82	$82	$82	$574	$574	$574	$574	$574	$574
	TOTAL FIXED COSTS	**$000**	$23,175	$24,393	$26,155	$27,872	$28,701	$30,930	$32,146	$32,919	$34,065	$35,504	$37,093	$38,863	$40,860	$41,921	$44,208	$46,667	$49,243	$51,943	$54,771	$57,786
AmerenUE PPA (Theoretical)	CO2	TONS	2,424	4,337	4,681	1,996	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Columbia Energy Center	CO2	TONS	19,222	15,783	10,121	6,394	9,054	10,990	11,255	17,154	18,405	18,448	18,788	20,001	21,333	14,450	12,921	13,651	13,883	14,543	14,822	14,992
Combined Heat and Power :2011	CO2	TONS	0	0	0	8,096	8,649	8,359	8,411	7,939	7,986	7,969	7,998	8,066	8,168	8,416	8,216	8,295	8,316	8,375	8,424	8,456
CWL Unit 6	CO2	TONS	189	164	118	68	64	123	124	217	233	235	236	252	270	177	170	177	177	179	182	178
CWL Unit 7	CO2	TONS	42,425	38,452	27,764	22,574	31,257	30,583	31,148	1,412	0	0	0	0	0	0	0	0	0	0	0	0
CWL Unit 8	CO2	TONS	1,249	1,039	668	399	501	751	766	1,273	1,362	1,370	1,391	1,485	1,591	1,067	982	1,032	1,045	1,083	1,096	1,091
Iatan 2	CO2	TONS	0	0	145,355	145,906	146,667	145,974	145,962	146,172	146,544	146,095	146,131	146,102	146,529	146,001	145,784	145,712	146,395	145,923	145,640	145,196
Nearman Creek	CO2	TONS	93,320	71,415	45,334	69,358	101,355	73,108	74,342	51,684	52,952	52,919	53,353	56,104	59,386	64,750	57,154	59,635	61,015	63,192	65,091	66,742
Prairie State Energy Campus	CO2	TONS	0	0	0	0	0	373,598	373,598	373,598	374,706	373,598	373,598	373,598	374,706	373,598	373,598	373,598	374,706	373,598	373,598	373,594
Sikeston	CO2	TONS	448,447	417,446	337,426	381,175	443,725	404,302	404,923	432,338	433,806	429,434	432,631	432,726	435,557	434,037	414,347	414,998	416,841	412,655	409,544	406,254
Supercritical Pulverized Coal :2015	CO2	TONS	0	0	0	0	0	0	0	100,357	103,567	103,252	105,486	108,897	111,507	116,235	103,720	107,080	109,601	112,450	114,328	115,632
Wartsila:2011	CO2	TONS	0	0	0	11,000	14,403	14,962	15,187	11,609	11,930	11,924	12,202	12,808	13,483	11,354	10,081	10,602	10,831	11,289	11,462	11,594
Wartsila:2021	CO2	TONS	0	0	0	0	0	0	0	0	0	0	0	0	0	14,618	13,013	13,663	13,853	14,447	14,695	14,874
	TOTAL CO2	**TONS**	607,277	548,635	571,467	646,966	755,675	1,062,749	1,065,715	1,143,753	1,151,492	1,145,244	1,151,813	1,160,038	1,172,531	1,184,701	1,139,987	1,148,444	1,156,664	1,157,734	1,158,880	1,158,602

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Description	Data Item	Units	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027
CWL Unit 7	Hg	LBS	3.510	3.181	2.297	1.868	2.586	2.530	2.577	0.117	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
CWL Unit 8	Hg	LBS	0.152	0.127	0.082	0.049	0.060	0.092	0.094	0.158	0.169	0.170	0.172	0.184	0.197	0.132	0.122	0.128	0.129	0.134	0.135	0.134
Iatan 2	Hg	LBS	0.000	0.000	0.060	0.060	0.061	0.060	0.060	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.060	0.060	0.061	0.060	0.060	0.060
Nearman Creek	Hg	LBS	3.030	2.319	1.472	2.252	3.291	2.374	2.414	1.678	1.719	1.718	1.732	1.822	1.928	2.102	1.856	1.936	1.981	2.052	2.113	2.167
Prairie State Energy Campus	Hg	LBS	0.000	0.000	0.000	0.000	0.000	6.965	6.965	6.965	6.986	6.965	6.965	6.965	6.986	6.965	6.965	6.965	6.986	6.965	6.965	6.965
Sikeston	Hg	LBS	18.103	16.851	13.621	15.387	17.912	16.321	16.346	17.453	17.512	17.335	17.464	17.468	17.583	17.521	16.726	16.753	16.827	16.658	16.532	16.400
Supercritical Pulverized Coal :2015	Hg	LBS	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.669	0.690	0.688	0.703	0.726	0.743	0.775	0.691	0.714	0.731	0.750	0.762	0.771
	TOTAL Hg	**LBS**	24.795	22.478	17.532	19.616	23.910	28.342	28.456	27.100	27.136	26.937	27.097	27.225	27.497	27.555	26.420	26.556	26.714	26.618	26.569	26.497
Columbia Energy Center	NOx	TONS	6	5	3	2	3	4	4	6	6	6	6	7	7	5	4	4	5	5	5	5
CWL Unit 7	NOx	TONS	109	99	72	58	81	79	80	4	0	0	0	0	0	0	0	0	0	0	0	0
CWL Unit 8	NOx	TONS	5	4	3	2	2	3	3	5	5	5	5	6	6	4	4	4	4	4	4	4
Iatan 2	NOx	TONS	0	0	54	54	54	54	54	54	54	54	54	54	54	54	54	54	54	54	54	54
Nearman Creek	NOx	TONS	195	149	95	145	212	153	155	108	111	110	111	117	124	135	119	124	127	132	136	139
Prairie State Energy Campus	NOx	TONS	0	0	0	0	0	121	121	121	121	121	121	121	121	121	121	121	121	121	121	121
Sikeston	NOx	TONS	461	429	347	392	456	416	416	445	446	442	445	445	448	446	426	427	429	424	421	418
Supercritical Pulverized Coal :2015	NOx	TONS	0	0	0	0	0	0	0	19	19	19	20	20	21	22	19	20	20	21	21	21
Wartsila:2011	NOx	TONS	0	0	0	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Wartsila:2021	NOx	TONS	0	0	0	0	0	0	0	0	0	0	0	0	0	2	2	2	2	2	2	2
	TOTAL NOx	**TONS**	776	687	573	654	810	831	836	762	765	760	765	772	784	791	751	758	765	765	766	767
CWL Unit 7	SO2	TONS	295	268	193	157	218	213	217	10	0	0	0	0	0	0	0	0	0	0	0	0
CWL Unit 8	SO2	TONS	17	14	9	6	7	10	11	18	19	19	20	21	22	15	14	14	15	15	15	15
Iatan 2	SO2	TONS	0	0	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	60
Nearman Creek	SO2	TONS	351	269	171	261	381	275	280	194	199	199	201	211	223	244	215	224	230	238	245	251
Prairie State Energy Campus	SO2	TONS	0	0	0	0	0	315	315	315	316	315	315	315	316	315	315	315	316	315	315	315
Sikeston	SO2	TONS	1,276	1,187	960	1,084	1,262	1,150	1,152	1,230	1,234	1,222	1,231	1,231	1,239	1,235	1,179	1,181	1,186	1,174	1,165	1,156
Supercritical Pulverized Coal :2015	SO2	TONS	0	0	0	0	0	0	0	15	15	15	16	16	17	17	15	16	16	17	17	17
Wartsila:2011	SO2	TONS	0	0	0	0	1	1	1	0	0	0	0	1	1	0	0	0	0	0	0	0
Wartsila:2021	SO2	TONS	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1
	TOTAL SO2	**TONS**	1,939	1,738	1,393	1,569	1,930	2,025	2,035	1,843	1,845	1,831	1,843	1,855	1,879	1,887	1,799	1,812	1,824	1,820	1,819	1,815
NOx	SYSTEM EFFLUENT EXPENSE	$000	$0	$1,265	$1,090	$1,287	$1,710	$1,975	$2,162	$2,147	$2,268	$2,452	$2,685	$2,950	$3,258	$3,002	$2,602	$2,397	$2,205	$2,014	$1,841	$1,681
CO2	SYSTEM EFFLUENT EXPENSE	$000	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
SO2	SYSTEM EFFLUENT EXPENSE	$000	-$2,111	-$2,891	-$1,250	-$1,346	-$913	-$848	-$901	$468	$498	$507	$583	$672	$809	$909	$646	$755	$877	$933	$1,006	$1,074
Hg	SYSTEM EFFLUENT EXPENSE	$000	$0	$0	$171	$200	$254	$338	$369	$383	$404	$436	$477	$522	$574	$626	$654	$716	$783	$850	$924	$1,003
	TOTAL GASSES	**$000**	-$2,111	-$1,625	$10	$141	$1,051	$1,465	$1,630	$2,998	$3,170	$3,395	$3,746	$4,144	$4,641	$4,537	$3,902	$3,868	$3,865	$3,797	$3,771	$3,758
	TOTAL VARIABLE COST	**$000**	$49,548	$50,752	$50,261	$53,939	$58,913	$44,609	$46,970	$47,011	$49,773	$52,639	$54,838	$58,154	$61,527	$63,111	$68,307	$71,612	$75,266	$78,734	$82,759	$86,784
	PeakLoad	(MW)	278.0	282.1	285.3	289.4	292.5	296.7	299.8	304.0	307.1	311.2	314.4	320.4	325.4	331.4	338.4	345.4	352.4	359.4	366.4	373.4
	Reserves	(MW)	38.9	39.5	39.9	40.5	41.0	41.5	42.0	42.6	43.0	43.6	44.0	44.9	45.6	46.4	47.4	48.4	49.3	50.3	51.3	52.3
	Peak Adjust for DSM Load Mgmt Capacity	(MW)	9.3	10.8	12.2	13.7	14.5	14.5	14.5	14.5	14.5	14.5	14.5	14.5	14.5	14.5	14.5	14.5	14.5	14.5	14.5	14.5
	TotalCapacityResponsibility	(MW)	307.6	310.8	313.0	316.2	319.0	323.7	327.3	332.0	335.6	340.3	343.9	350.7	356.4	363.3	371.2	379.2	387.2	395.2	403.2	411.1
(Wind 15% Firm)	TotalFirmResources	(MW)	318.1	323.1	348.1	316.3	319.0	356.9	357.4	344.4	344.9	346.2	346.7	350.7	356.4	365.0	371.2	379.2	387.2	395.2	403.1	411.1
	ReserveSurplus(Deficit)	(MW)	10.5	12.3	35.1	0.0	(0.0)	33.2	30.2	12.4	9.4	5.9	2.8	(0.0)	(0.0)	1.7	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)
	ReserveMargin	(%)	17.79%	18.36%	26.32%	14.02%	13.99%	25.20%	24.06%	18.09%	17.05%	15.90%	14.90%	14.00%	14.00%	14.53%	14.00%	14.00%	14.00%	14.00%	14.00%	14.00%
New Capacity Investment	CHP	$000	$0	$0	$0	$1,247	$1,247	$1,247	$1,247	$1,247	$1,247	$1,247	$1,247	$1,247	$1,247	$0	$0	$0	$0	$0	$0	$0
	SCPC1 DebtService	$000	$0	$0	$0	$0	$0	$0	$0	$6,781	$6,781	$6,781	$6,781	$6,781	$6,781	$6,781	$6,781	$6,781	$6,781	$6,781	$6,781	$6,781
	Wart1 DebtService	$000	$0	$0	$0	$1,624	$1,624	$1,624	$1,624	$1,624	$1,624	$1,624	$1,624	$1,624	$1,624	$1,624	$1,624	$1,624	$1,624	$1,624	$1,624	$1,624
	Wart2 DebtService	$000	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$2,182	$2,182	$2,182	$2,182	$2,182	$2,182	$2,182
	Total Fixed Costs	($000)	$23,175	$24,393	$26,155	$27,872	$28,701	$30,930	$32,146	$32,919	$34,065	$35,504	$37,093	$38,863	$40,860	$41,921	$44,208	$46,667	$49,243	$51,943	$54,771	$57,786
	Total Variable Costs	($000)	$35,278	$37,961	$38,355	$37,481	$38,279	$19,259	$20,673	$17,638	$18,869	$21,040	$22,262	$24,247	$26,163	$25,442	$32,046	$33,800	$36,113	$38,130	$40,751	$43,454
	Total Fuel Costs	($000)	$5,197	$4,478	$3,035	$5,653	$7,546	$11,138	$11,589	$13,210	$14,105	$14,397	$14,720	$15,351	$15,999	$17,290	$16,266	$17,012	$17,536	$18,289	$18,978	$19,597
	Total Investment Costs	($000)	$0	$0	$0	$2,871	$2,871	$2,871	$2,871	$9,652	$9,652	$9,652	$9,652	$9,652	$9,652	$10,587	$10,587	$10,587	$10,587	$10,587	$10,587	$10,587
	Total Costs	($000)	$63,650	$66,832	$67,545	$73,877	$77,397	$64,197	$67,279	$73,419	$76,690	$80,592	$83,726	$88,113	$92,673	$95,239	$103,107	$108,066	$113,479	$118,948	$125,086	$131,423

20-Year NPV @ 5.5% ($000): $1,187,254

Columbia Water Light Department
Integrated Resource Planning
Project 46806

Description	Data Item	Units	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027
Columbia	ENERGY REQUIREMENTS	GWH	1,221	1,244	1,266	1,292	1,317	1,340	1,362	1,388	1,414	1,436	1,458	1,484	1,511	1,533	1,563	1,594	1,629	1,655	1,686	1,717
Columbia	PEAK DEMAND	MW	278.0	284.0	289.0	295.0	300.0	306.0	311.0	317.0	322.0	328.0	333.0	339.0	344.0	350.0	357.0	364.0	371.0	378.0	385.0	392.0
	MARKET PURCHASE ENERGY	GWH	299	132	72	341	521	173	187	243	255	208	215	227	192	208	199	219	238	255	237	256
THEORETICAL CO2	MARKET PURCHASE ENERGY	TONS	149,550	66,195	35,996	170,729	260,744	86,303	93,615	121,342	127,640	104,201	107,584	113,721	95,816	103,760	99,699	109,615	118,939	127,721	118,349	128,211
	COST OF MARKET PURCHASE ENERGY	$000	$18,206	$8,557	$4,893	$21,415	$34,990	$12,160	$13,679	$18,418	$20,502	$17,059	$18,141	$19,797	$17,244	$18,944	$18,856	$21,097	$23,439	$25,792	$24,454	$27,025
Columbia Energy Center	FIRM CAPACITY	MW	72.0	72.0	72.0	72.0	72.0	72.0	72.0	72.0	72.0	72.0	72.0	72.0	72.0	72.0	72.0	72.0	72.0	72.0	72.0	72.0
Combined Heat and Power :2011	FIRM CAPACITY	MW	0.0	0.0	0.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
CWL Unit 5	FIRM CAPACITY	MW	16.5	16.5	16.5	16.5	16.5	16.5	16.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CWL Unit 6	FIRM CAPACITY	MW	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5
CWL Unit 7	FIRM CAPACITY	MW	22.0	22.0	22.0	22.0	22.0	22.0	22.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CWL Unit 8	FIRM CAPACITY	MW	35.0	35.0	35.0	35.0	35.0	35.0	35.0	35.0	35.0	35.0	35.0	35.0	35.0	35.0	35.0	35.0	35.0	35.0	35.0	35.0
Distributed Generation	FIRM CAPACITY	MW	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0
Iatan 2	FIRM CAPACITY	MW	0.0	0.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0
Market Purchase	FIRM CAPACITY	MW	0.0	0.6	0.0	36.4	42.1	0.0	0.0	17.7	22.9	21.0	26.2	32.5	30.2	36.5	39.5	47.0	54.5	62.0	61.9	69.9
Nearman Creek	FIRM CAPACITY	MW	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0
Prairie State Energy Campus	FIRM CAPACITY	MW	0.0	0.0	0.0	0.0	0.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0
Sikeston	FIRM CAPACITY	MW	66.0	66.0	66.0	66.0	66.0	66.0	66.0	66.0	66.0	66.0	66.0	66.0	66.0	66.0	66.0	66.0	66.0	66.0	66.0	66.0
Wartsila:2011	FIRM CAPACITY	MW	0.0	0.0	0.0	16.8	16.8	16.8	16.8	16.8	16.8	16.8	16.8	16.8	16.8	16.8	16.8	16.8	16.8	16.8	16.8	16.8
Wartsila:2015	FIRM CAPACITY	MW	0.0	0.0	0.0	0.0	0.0	0.0	0.0	16.8	16.8	16.8	16.8	16.8	16.8	16.8	16.8	16.8	16.8	16.8	16.8	16.8
	SUBTOTAL CAPACITY	**MW**	252.0	252.6	272.0	330.2	335.9	343.8	343.8	339.8	345.0	343.1	348.3	354.6	352.3	358.6	361.6	369.1	376.6	384.1	384.0	392.0
Columbia Energy Center	GENERATION	GWH	25	21	14	9	12	15	15	13	13	10	11	13	12	12	11	12	12	12	11	11
Combined Heat and Power :2011	GENERATION	GWH	0	0	0	25	27	26	26	24	25	24	24	24	23	23	23	23	23	23	23	23
CWL Unit 5	GENERATION	GWH	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CWL Unit 6	GENERATION	GWH	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CWL Unit 7	GENERATION	GWH	27	24	18	14	20	20	20	0	0	0	0	0	0	0	0	0	0	0	0	0
CWL Unit 8	GENERATION	GWH	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Distributed Generation	GENERATION	GWH	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Iatan 2	GENERATION	GWH	0	0	146	147	148	147	147	127	128	117	118	118	105	106	98	98	100	101	88	88
Nearman Creek	GENERATION	GWH	82	64	41	62	89	67	68	47	47	37	39	41	35	35	33	34	35	36	30	30
Prairie State Energy Campus	GENERATION	GWH	0	0	0	0	0	368	368	335	337	330	331	331	313	310	294	295	298	297	270	272
Sikeston	GENERATION	GWH	418	390	318	359	413	380	380	297	302	250	255	259	216	221	203	206	210	213	183	184
Wartsila:2011	GENERATION	GWH	0	0	0	21	27	28	29	15	15	12	13	14	13	13	12	12	13	13	11	12
Wartsila:2015	GENERATION	GWH	0	0	0	0	0	0	0	20	20	16	17	18	16	17	15	16	16	17	15	15
	SUBTOTAL GENERATION	**GWH**	552	499	538	636	735	1,051	1,054	879	888	797	808	818	733	737	690	696	706	713	630	635
Columbia Energy Center	GENERATOR CAPACITY FACTOR	%	4.00%	3.32%	2.18%	1.36%	1.89%	2.39%	2.46%	2.06%	2.04%	1.63%	1.80%	1.99%	1.86%	1.91%	1.81%	1.87%	1.90%	1.97%	1.75%	1.69%
Combined Heat and Power :2011	GENERATOR CAPACITY FACTOR	%				57.16%	60.69%	59.34%	59.72%	55.73%	56.00%	53.99%	54.30%	54.75%	53.17%	53.35%	51.85%	52.27%	52.63%	53.27%	51.42%	52.71%
CWL Unit 6	GENERATOR CAPACITY FACTOR	%	0.16%	0.14%	0.10%	0.06%	0.06%	0.11%	0.11%	0.09%	0.09%	0.08%	0.09%	0.10%	0.10%	0.11%	0.10%	0.10%	0.11%	0.11%	0.10%	0.09%
CWL Unit 7	GENERATOR CAPACITY FACTOR	%	13.78%	12.60%	9.29%	7.51%	10.16%	10.32%	10.52%													
CWL Unit 8	GENERATOR CAPACITY FACTOR	%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Distributed Generation	GENERATOR CAPACITY FACTOR	%	0.10%	0.09%	0.07%	0.04%	0.03%	0.06%	0.06%	0.05%	0.05%	0.05%	0.05%	0.06%	0.06%	0.07%	0.06%	0.06%	0.06%	0.07%	0.06%	0.06%
Iatan 2	GENERATOR CAPACITY FACTOR	%			83.49%	83.82%	84.02%	83.83%	83.83%	72.69%	73.09%	66.72%	67.15%	67.14%	59.79%	60.55%	55.86%	55.83%	56.83%	57.87%	50.02%	50.47%
Nearman Creek	GENERATOR CAPACITY FACTOR	%	46.69%	36.27%	23.47%	35.39%	50.71%	38.16%	38.94%	26.68%	26.76%	21.22%	22.22%	23.37%	19.87%	20.23%	18.86%	19.47%	19.91%	20.43%	17.12%	16.96%
Prairie State Energy Campus	GENERATOR CAPACITY FACTOR	%						84.02%	84.02%	76.56%	76.81%	75.36%	75.58%	75.60%	71.33%	70.69%	67.07%	67.30%	67.77%	67.72%	61.59%	62.01%
Sikeston	GENERATOR CAPACITY FACTOR	%	72.08%	67.42%	55.08%	62.01%	71.32%	65.67%	65.78%	51.33%	52.03%	43.31%	44.07%	44.88%	37.30%	38.24%	35.15%	35.64%	36.16%	36.85%	31.67%	31.90%
Wartsila:2011	GENERATOR CAPACITY FACTOR	%				14.06%	18.07%	19.36%	19.64%	10.46%	10.50%	8.37%	9.02%	9.62%	8.50%	8.78%	8.26%	8.49%	8.63%	8.90%	7.75%	7.90%
Wartsila:2015	GENERATOR CAPACITY FACTOR	%								13.49%	13.65%	10.96%	11.65%	12.31%	10.83%	11.22%	10.51%	10.82%	11.00%	11.36%	9.87%	10.09%
Columbia Energy Center	TOTAL O AND M COST	$000	$5,301	$5,426	$5,548	$5,677	$5,826	$5,978	$6,128	$6,276	$6,432	$6,588	$6,929	$7,105	$7,280	$7,463	$7,648	$7,840	$8,037	$8,239	$8,441	$8,651
Combined Heat and Power :2011	TOTAL O AND M COST	$000	$0	$0	$0	$417	$457	$459	$476	$458	$475	$470	$487	$506	$508	$523	$524	$544	$565	$588	$585	$617
CWL Unit 6	TOTAL O AND M COST	$000	$1,524	$1,547	$1,592	$1,637	$1,686	$1,740	$1,792	$1,845	$1,900	$1,956	$2,016	$2,077	$2,139	$2,204	$2,269	$2,338	$2,408	$2,480	$2,554	$2,630
CWL Unit 7	TOTAL O AND M COST	$000	$2,222	$2,194	$2,083	$2,049	$2,261	$2,337	$2,419	$157	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
CWL Unit 8	TOTAL O AND M COST	$000	$379	$385	$396	$408	$420	$433	$446	$459	$473	$487	$502	$517	$533	$549	$565	$582	$600	$618	$636	$655
Distributed Generation	TOTAL O AND M COST	$000	$13	$12	$10	$5	$4	$10	$10	$9	$9	$8	$10	$11	$12	$13	$13	$13	$14	$15	$14	$13
Iatan 2	TOTAL O AND M COST	$000	$0	$0	$2,882	$2,978	$3,080	$3,160	$3,255	$2,997	$3,106	$2,977	$3,082	$3,174	$3,004	$3,116	$3,026	$3,115	$3,257	$3,392	$3,148	$3,263
Market Purchase	TOTAL O AND M COST	$000	$0	$40	$0	$2,386	$2,842	$0	$0	$1,304	$1,738	$1,641	$2,109	$2,699	$2,583	$3,220	$3,587	$4,394	$5,246	$6,145	$6,327	$7,357
Nearman Creek	TOTAL O AND M COST	$000	$4,689	$4,532	$4,279	$4,871	$5,634	$5,374	$5,620	$5,338	$5,558	$5,530	$5,797	$6,085	$6,155	$6,417	$6,599	$6,898	$7,203	$7,519	$7,609	$7,903
Prairie State Energy Campus	TOTAL O AND M COST	$000	$0	$0	$0	$0	$0	$4,412	$4,545	$4,493	$4,640	$4,734	$4,882	$5,030	$5,061	$5,188	$5,232	$5,396	$5,579	$5,739	$5,697	$5,883
Sikeston	TOTAL O AND M COST	$000	$18,064	$18,236	$17,737	$19,258	$21,121	$21,360	$22,293	$21,525	$22,582	$22,459	$23,572	$24,743	$24,826	$26,081	$26,823	$28,133	$29,528	$30,988	$31,562	$33,073
Wartsila:2011	TOTAL O AND M COST	$000	$0	$0	$0	$329	$393	$422	$438	$318	$328	$305	$324	$344	$335	$350	$351	$366	$380	$396	$385	$400
Wartsila:2015	TOTAL O AND M COST	$000	$0	$0	$0	$0	$0	$0	$0	$362	$376	$345	$366	$388	$375	$393	$392	$409	$425	$445	$428	$445
Columbia Energy Center	FIXED O AND M COSTS	$000	$5,257	$5,388	$5,523	$5,661	$5,803	$5,948	$6,096	$6,249	$6,405	$6,565	$6,903	$7,076	$7,253	$7,434	$7,620	$7,811	$8,006	$8,206	$8,411	$8,621
CWL Unit 6	FIXED O AND M COSTS	$000	$1,516	$1,540	$1,587	$1,634	$1,683	$1,734	$1,786	$1,839	$1,894	$1,951	$2,010	$2,070	$2,132	$2,196	$2,262	$2,330	$2,400	$2,472	$2,546	$2,622
CWL Unit 7	FIXED O AND M COSTS	$000	$1,516	$1,540	$1,587	$1,634	$1,683	$1,734	$1,786	$156	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
CWL Unit 8	FIXED O AND M COSTS	$000	$379	$385	$396	$408	$420	$433	$446	$459	$473	$487	$502	$517	$533	$549	$565	$582	$600	$618	$636	$655

Columbia Water Light Department
Integrated Resource Planning
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Description	Data Item	Units	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027
Iatan 2	FIXED O AND M COSTS	$000	$0	$0	$586	$604	$622	$640	$660	$680	$700	$721	$742	$765	$788	$812	$836	$861	$887	$913	$941	$969
Market Purchase	FIXED O AND M COSTS	$000	$0	$40	$0	$2,386	$2,842	$0	$0	$1,304	$1,738	$1,641	$2,109	$2,699	$2,583	$3,220	$3,587	$4,394	$5,246	$6,145	$6,327	$7,357
Nearman Creek	FIXED O AND M COSTS	$000	$3,218	$3,347	$3,481	$3,620	$3,765	$3,916	$4,072	$4,235	$4,405	$4,581	$4,764	$4,955	$5,153	$5,359	$5,573	$5,796	$6,028	$6,269	$6,520	$6,781
Prairie State Energy Campus	FIXED O AND M COSTS	$000	$0	$0	$0	$0	$0	$2,417	$2,490	$2,565	$2,641	$2,721	$2,801	$2,885	$2,972	$3,061	$3,153	$3,246	$3,344	$3,444	$3,548	$3,654
Sikeston	FIXED O AND M COSTS	$000	$10,933	$11,480	$12,054	$12,656	$13,289	$13,953	$14,651	$15,384	$16,154	$16,962	$17,810	$18,700	$19,637	$20,619	$21,650	$22,731	$23,868	$25,061	$26,316	$27,631
Wartsila:2011	FIXED O AND M COSTS	$000	$0	$0	$0	$146	$151	$155	$160	$165	$170	$175	$180	$185	$191	$197	$203	$209	$215	$221	$228	$235
Wartsila:2015	FIXED O AND M COSTS	$000	$0	$0	$0	$0	$0	$0	$0	$165	$170	$175	$180	$185	$191	$197	$203	$209	$215	$221	$228	$235
	TOTAL FIXED OM COST	**$000**	$22,819	$23,721	$25,213	$28,749	$30,258	$30,930	$32,147	$33,201	$34,750	$35,979	$38,002	$40,038	$41,433	$43,642	$45,651	$48,168	$50,807	$53,571	$55,701	$58,761
Columbia Energy Center	VARIABLE O AND M COSTS	$/MWH	$1.74	$1.79	$1.83	$1.88	$1.93	$1.97	$2.02	$2.07	$2.13	$2.18	$2.23	$2.29	$2.35	$2.40	$2.47	$2.53	$2.59	$2.65	$2.72	$2.79
Combined Heat and Power :2011	VARIABLE O AND M COSTS	$/MWH	$0.00	$0.00	$0.00	$16.67	$17.16	$17.67	$18.20	$18.75	$19.31	$19.89	$20.49	$21.10	$21.74	$22.39	$23.06	$23.75	$24.47	$25.20	$25.96	$26.74
CWL Unit 6	VARIABLE O AND M COSTS	$/MWH	$43.67	$44.39	$45.73	$47.07	$48.48	$49.95	$51.46	$53.02	$54.64	$56.28	$58.01	$59.75	$61.53	$63.38	$65.29	$67.28	$69.28	$71.36	$73.49	$75.69
CWL Unit 7	VARIABLE O AND M COSTS	$/MWH	$26.52	$26.94	$27.74	$28.66	$29.43	$30.32	$31.23	$31.74	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
CWL Unit 8	VARIABLE O AND M COSTS	$/MWH	$0.94	$0.95	$0.98	$1.02	$1.04	$1.07	$1.11	$1.14	$1.18	$1.21	$1.25	$1.29	$1.32	$1.36	$1.41	$1.45	$1.49	$1.54	$1.58	$1.63
Distributed Generation	VARIABLE O AND M COSTS	$/MWH	$192.95	$196.27	$202.14	$207.53	$214.19	$220.77	$227.46	$234.22	$241.40	$248.66	$256.34	$264.01	$271.86	$280.04	$288.51	$297.30	$306.15	$315.31	$324.71	$334.47
Iatan 2	VARIABLE O AND M COSTS	$/MWH	$0.00	$0.00	$15.70	$16.17	$16.65	$17.16	$17.67	$18.19	$18.74	$19.30	$19.88	$20.48	$21.09	$21.72	$22.37	$23.04	$23.74	$24.45	$25.18	$25.94
Nearman Creek	VARIABLE O AND M COSTS	$/MWH	$17.93	$18.65	$19.39	$20.17	$20.98	$21.81	$22.69	$23.59	$24.54	$25.52	$26.54	$27.60	$28.71	$29.85	$31.05	$32.29	$33.58	$34.93	$36.32	$37.78
Prairie State Energy Campus	VARIABLE O AND M COSTS	$/MWH	$0.00	$0.00	$0.00	$0.00	$0.00	$5.42	$5.58	$5.75	$5.92	$6.10	$6.29	$6.48	$6.67	$6.87	$7.08	$7.29	$7.51	$7.74	$7.97	$8.21
Sikeston	VARIABLE O AND M COSTS	$/MWH	$17.06	$17.33	$17.85	$18.41	$18.94	$19.51	$20.09	$20.69	$21.31	$21.95	$22.61	$23.29	$23.99	$24.71	$25.45	$26.22	$27.00	$27.81	$28.65	$29.51
Wartsila:2011	VARIABLE O AND M COSTS	$/MWH	$0.00	$0.00	$0.00	$8.84	$9.08	$9.35	$9.63	$9.93	$10.23	$10.54	$10.86	$11.19	$11.52	$11.86	$12.22	$12.59	$12.97	$13.36	$13.76	$14.17
Wartsila:2015	VARIABLE O AND M COSTS	$/MWH	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$9.93	$10.23	$10.54	$10.86	$11.18	$11.52	$11.86	$12.22	$12.59	$12.97	$13.36	$13.76	$14.17
Columbia Energy Center	VARIABLE O AND M COSTS	$000	$44	$37	$25	$16	$23	$30	$31	$27	$27	$22	$25	$29	$28	$29	$28	$30	$31	$33	$30	$30
Combined Heat and Power :2011	VARIABLE O AND M COSTS	$000	$0	$0	$0	$417	$457	$459	$476	$458	$475	$470	$487	$506	$508	$523	$524	$544	$566	$588	$585	$617
CWL Unit 6	VARIABLE O AND M COSTS	$000	$8	$7	$5	$3	$3	$6	$6	$5	$6	$5	$6	$7	$7	$7	$7	$8	$8	$9	$8	$8
CWL Unit 7	VARIABLE O AND M COSTS	$000	$706	$654	$497	$415	$578	$603	$633	$1	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
CWL Unit 8	VARIABLE O AND M COSTS	$000	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Distributed Generation	VARIABLE O AND M COSTS	$000	$13	$12	$10	$5	$4	$10	$10	$9	$9	$8	$10	$11	$12	$13	$13	$13	$14	$15	$14	$13
Iatan 2	VARIABLE O AND M COSTS	$000	$0	$0	$2,296	$2,375	$2,458	$2,520	$2,595	$2,317	$2,406	$2,256	$2,339	$2,409	$2,215	$2,304	$2,189	$2,254	$2,370	$2,479	$2,207	$2,293
Nearman Creek	VARIABLE O AND M COSTS	$000	$1,471	$1,185	$798	$1,250	$1,869	$1,459	$1,548	$1,103	$1,154	$949	$1,033	$1,130	$1,002	$1,058	$1,026	$1,101	$1,175	$1,250	$1,090	$1,122
Prairie State Energy Campus	VARIABLE O AND M COSTS	$000	$0	$0	$0	$0	$0	$1,995	$2,055	$1,928	$1,999	$2,014	$2,081	$2,144	$2,090	$2,127	$2,079	$2,149	$2,236	$2,295	$2,149	$2,229
Sikeston	VARIABLE O AND M COSTS	$000	$7,131	$6,756	$5,683	$6,601	$7,832	$7,407	$7,641	$6,141	$6,428	$5,497	$5,762	$6,043	$5,188	$5,463	$5,173	$5,402	$5,660	$5,926	$5,246	$5,442
Wartsila:2011	VARIABLE O AND M COSTS	$000	$0	$0	$0	$183	$242	$266	$278	$153	$158	$130	$144	$158	$144	$153	$149	$157	$165	$175	$157	$165
Wartsila:2015	VARIABLE O AND M COSTS	$000	$0	$0	$0	$0	$0	$0	$0	$197	$206	$170	$186	$203	$184	$196	$189	$201	$210	$223	$200	$210
	TOTAL VAR OM COST	**$000**	$9,373	$8,652	$9,314	$11,266	$13,466	$14,754	$15,275	$12,338	$12,868	$11,521	$12,074	$12,640	$11,378	$11,874	$11,377	$11,860	$12,435	$12,993	$11,685	$12,130
Columbia Energy Center	TOTAL FUEL COST	$000	$3,471	$2,915	$1,933	$1,221	$1,794	$2,241	$2,366	$2,060	$2,147	$1,726	$1,895	$2,080	$1,914	$1,973	$1,892	$1,956	$2,020	$2,105	$1,903	$1,884
Combined Heat and Power :2011	TOTAL FUEL COST	$000	$0	$0	$0	$1,563	$1,729	$1,669	$1,728	$1,699	$1,791	$1,750	$1,754	$1,760	$1,696	$1,702	$1,674	$1,693	$1,725	$1,756	$1,725	$1,809
CWL Unit 6	TOTAL FUEL COST	$000	$34	$30	$22	$13	$13	$25	$25	$22	$23	$20	$23	$26	$25	$26	$26	$26	$27	$28	$26	$25
CWL Unit 7	TOTAL FUEL COST	$000	$1,488	$1,394	$1,057	$878	$1,224	$1,275	$1,337	$2	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
CWL Unit 8	TOTAL FUEL COST	$000	$191	$163	$109	$65	$83	$131	$137	$120	$127	$106	$120	$133	$129	$134	$129	$133	$137	$142	$132	$127
Distributed Generation	TOTAL FUEL COST	$000	$13	$12	$10	$5	$4	$10	$10	$9	$9	$8	$10	$12	$12	$14	$14	$14	$15	$16	$15	$15
Prairie State Energy Campus	TOTAL FUEL COST	$000	$0	$0	$0	$0	$0	$3,165	$3,254	$3,048	$3,152	$3,170	$3,268	$3,361	$3,269	$3,321	$3,240	$3,341	$3,468	$3,553	$3,322	$3,438
Wartsila:2011	TOTAL FUEL COST	$000	$0	$0	$0	$1,988	$2,699	$2,866	$2,992	$1,664	$1,754	$1,406	$1,508	$1,601	$1,393	$1,442	$1,369	$1,413	$1,456	$1,510	$1,337	$1,396
Wartsila:2015	TOTAL FUEL COST	$000	$0	$0	$0	$0	$0	$0	$0	$2,146	$2,283	$1,841	$1,951	$2,052	$1,778	$1,845	$1,745	$1,804	$1,857	$1,931	$1,706	$1,784
	TOTAL REC FUEL COST	**$000**	$5,197	$4,514	$3,130	$5,734	$7,546	$11,382	$11,849	$10,768	$11,286	$10,026	$10,530	$11,024	$10,217	$10,458	$10,089	$10,381	$10,706	$11,042	$10,167	$10,478
AmerenUE PPA	MAXIMUM TRANSACTION CAPACITY	MW	60	65	70	70	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bluegrass Ridge	MAXIMUM TRANSACTION CAPACITY	MW	6.3	6.3	6.3	6.3	6.3	6.3	6.3	6.3	6.3	6.3	6.3	6.3	6.3	6.3	6.3	6.3	6.3	6.3	6.3	6.3
Landfill Gas	MAXIMUM TRANSACTION CAPACITY	MW	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2
RPS Landfill Gas	MAXIMUM TRANSACTION CAPACITY	MW	0	0	0	0	0	7	7.5	8	8.5	9	9.5	10	10.5	11	11.5	12	12.5	13	13.5	13.5
RPS Wind	MAXIMUM TRANSACTION CAPACITY	MW	0	0	0	0	0	0	0	0	0	5	5	5	5	5	35	35	35	35	35	35
Wind:2015	MAXIMUM TRANSACTION CAPACITY	MW	0	0	0	0	0	0	0	50	50	50	50	50	50	50	50	50	50	50	50	50
Wind:2017	MAXIMUM TRANSACTION CAPACITY	MW	0	0	0	0	0	0	0	0	0	50	50	50	50	50	50	50	50	50	50	50
Wind:2020	MAXIMUM TRANSACTION CAPACITY	MW	0	0	0	0	0	0	0	0	0	0	0	0	50	50	50	50	50	50	50	50
Wind:2026	MAXIMUM TRANSACTION CAPACITY	MW	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	50	50
AmerenUE PPA	FIRM CAPACITY	MW	60.0	65.0	70.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Bluegrass Ridge	FIRM CAPACITY	MW	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9
Landfill Gas	FIRM CAPACITY	MW	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2
RPS Landfill Gas	FIRM CAPACITY	MW	0.0	0.0	0.0	0.0	0.0	7.0	7.5	8.0	8.5	9.0	9.5	10.0	10.5	11.0	11.5	12.0	12.5	13.0	13.5	13.5
RPS Wind	FIRM CAPACITY	MW	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.8	0.8	0.8	0.8	0.8	5.3	5.3	5.3	5.3	5.3	5.3
Wind:2015	FIRM CAPACITY	MW	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5
Wind:2017	FIRM CAPACITY	MW	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5
Wind:2020	FIRM CAPACITY	MW	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5
Wind:2026	FIRM CAPACITY	MW	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.5	7.5

Columbia Water Light Department
Integrated Resource Planning
Project 46806

Description	Data Item	Units	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027
	SUBTOT FIRM PURCHASE CAP	**MW**	66.1	71.1	76.1	6.1	6.1	13.1	13.6	21.6	22.1	30.9	31.4	31.9	39.9	40.4	45.4	45.9	46.4	46.9	54.9	54.9
	TOTAL FIRM CAPACITY	**MW**	318.1	323.8	348.1	336.3	342.0	356.9	357.4	361.4	367.1	374.0	379.7	386.5	392.2	399.0	407.0	415.0	423.0	431.0	438.9	446.9
AmerenUE PPA	TRANSACTION ENERGY TAKEN	GWH	308	551	595	254	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bluegrass Ridge	TRANSACTION ENERGY TAKEN	GWH	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18
Landfill Gas	TRANSACTION ENERGY TAKEN	GWH	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42
RPS Landfill Gas	TRANSACTION ENERGY TAKEN	GWH	0	0	0	0	0	55	59	63	67	71	75	79	83	87	91	95	99	103	107	111
RPS Wind	TRANSACTION ENERGY TAKEN	GWH	0	0	0	0	0	0	0	0	0	14	14	14	14	14	100	100	100	100	100	100
Wind:2015	TRANSACTION ENERGY TAKEN	GWH	0	0	0	0	0	0	0	142	143	142	142	142	143	142	142	142	143	142	142	142
Wind:2017	TRANSACTION ENERGY TAKEN	GWH	0	0	0	0	0	0	0	0	0	142	142	142	143	142	142	142	143	142	142	142
Wind:2020	TRANSACTION ENERGY TAKEN	GWH	0	0	0	0	0	0	0	0	0	0	0	0	143	142	142	142	143	142	142	142
Wind:2026	TRANSACTION ENERGY TAKEN	GWH	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	142	142
	SUBTOTAL TRANS ENERGY	**GWH**	368	611	655	314	60	116	119	266	270	430	434	438	586	588	678	682	688	690	836	840
	TOTAL ENERGY	**GWH**	1,219	1,243	1,265	1,291	1,317	1,339	1,361	1,387	1,413	1,436	1,458	1,484	1,511	1,533	1,567	1,597	1,632	1,658	1,703	1,731
AmerenUE PPA	TRANSACTION CAPACITY FACTOR	%	100.00%	100.00%	100.00%	100.00%																
Bluegrass Ridge	TRANSACTION CAPACITY FACTOR	%	32.52%	32.50%	32.50%	32.50%	32.52%	32.50%	32.50%	32.50%	32.52%	32.50%	32.50%	32.50%	32.52%	32.50%	32.50%	32.50%	32.52%	32.50%	32.50%	32.50%
Landfill Gas	TRANSACTION CAPACITY FACTOR	%	92.23%	92.49%	92.49%	92.49%	92.23%	92.49%	92.49%	92.49%	92.23%	92.49%	92.49%	92.49%	92.23%	92.49%	92.49%	92.49%	92.23%	92.49%	92.49%	92.49%
RPS Landfill Gas	TRANSACTION CAPACITY FACTOR	%						90.46%	90.46%	90.46%	90.21%	90.46%	90.46%	90.46%	90.21%	90.46%	90.46%	90.46%	90.21%	90.46%	90.46%	93.81%
RPS Wind	TRANSACTION CAPACITY FACTOR	%										32.50%	32.50%	32.50%	32.52%	32.50%	32.50%	32.50%	32.52%	32.50%	32.50%	32.50%
Wind:2015	TRANSACTION CAPACITY FACTOR	%								32.50%	32.52%	32.50%	32.50%	32.50%	32.52%	32.50%	32.50%	32.50%	32.52%	32.50%	32.50%	32.50%
Wind:2017	TRANSACTION CAPACITY FACTOR	%										32.50%	32.50%	32.50%	32.52%	32.50%	32.50%	32.50%	32.52%	32.50%	32.50%	32.50%
Wind:2020	TRANSACTION CAPACITY FACTOR	%													32.52%	32.50%	32.50%	32.50%	32.52%	32.50%	32.50%	32.50%
Wind:2026	TRANSACTION CAPACITY FACTOR	%																			32.50%	32.50%
AmerenUE PPA	TOTAL TRANSACTION COST	$000	$15,565	$28,052	$30,799	$13,236	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Bluegrass Ridge	TOTAL TRANSACTION COST	$000	$1,234	$1,229	$1,229	$1,229	$1,234	$1,229	$1,229	$1,229	$1,234	$1,229	$1,229	$1,229	$1,234	$1,229	$1,229	$1,229	$1,234	$1,229	$1,229	$1,229
Landfill Gas	TOTAL TRANSACTION COST	$000	$2,443	$2,443	$2,443	$2,443	$2,443	$2,443	$2,443	$2,443	$2,443	$2,443	$2,443	$2,443	$2,443	$2,443	$2,443	$2,443	$2,443	$2,443	$2,443	$2,443
RPS Landfill Gas	TOTAL TRANSACTION COST	$000	$0	$0	$0	$0	$0	$3,328	$3,566	$3,804	$4,041	$4,279	$4,517	$4,754	$4,992	$5,230	$5,468	$5,705	$5,943	$6,181	$6,418	$6,656
RPS Wind	TOTAL TRANSACTION COST	$000	$0	$0	$0	$0	$0	$0	$0	$0	$0	$1,355	$1,355	$1,355	$1,359	$1,355	$9,485	$9,485	$9,516	$9,485	$9,485	$9,485
Wind:2015	TOTAL TRANSACTION COST	$000	$0	$0	$0	$0	$0	$0	$0	$11,999	$12,041	$11,999	$11,999	$11,999	$12,041	$11,999	$11,999	$11,999	$12,041	$11,999	$11,999	$11,999
Wind:2017	TOTAL TRANSACTION COST	$000	$0	$0	$0	$0	$0	$0	$0	$0	$0	$11,999	$11,999	$11,999	$12,041	$11,999	$11,999	$11,999	$12,041	$11,999	$11,999	$11,999
Wind:2020	TOTAL TRANSACTION COST	$000	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$12,041	$11,999	$11,999	$11,999	$12,041	$11,999	$11,999	$11,999
Wind:2026	TOTAL TRANSACTION COST	$000	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$11,999	$11,999
AmerenUE PPA	TRANSACTION ENERGY COST	$000	$15,208	$27,339	$29,857	$12,798	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Bluegrass Ridge	TRANSACTION ENERGY COST	$000	$1,234	$1,229	$1,229	$1,229	$1,234	$1,229	$1,229	$1,229	$1,234	$1,229	$1,229	$1,229	$1,234	$1,229	$1,229	$1,229	$1,234	$1,229	$1,229	$1,229
Landfill Gas	TRANSACTION ENERGY COST	$000	$2,443	$2,443	$2,443	$2,443	$2,443	$2,443	$2,443	$2,443	$2,443	$2,443	$2,443	$2,443	$2,443	$2,443	$2,443	$2,443	$2,443	$2,443	$2,443	$2,443
RPS Landfill Gas	TRANSACTION ENERGY COST	$000	$0	$0	$0	$0	$0	$3,328	$3,566	$3,804	$4,041	$4,279	$4,517	$4,754	$4,992	$5,230	$5,468	$5,705	$5,943	$6,181	$6,418	$6,656
RPS Wind	TRANSACTION ENERGY COST	$000	$0	$0	$0	$0	$0	$0	$0	$0	$0	$1,273	$1,273	$1,273	$1,277	$1,273	$8,911	$8,911	$8,942	$8,911	$8,911	$8,911
Wind:2015	TRANSACTION ENERGY COST	$000	$0	$0	$0	$0	$0	$0	$0	$11,999	$12,041	$11,999	$11,999	$11,999	$12,041	$11,999	$11,999	$11,999	$12,041	$11,999	$11,999	$11,999
Wind:2017	TRANSACTION ENERGY COST	$000	$0	$0	$0	$0	$0	$0	$0	$0	$0	$11,999	$11,999	$11,999	$12,041	$11,999	$11,999	$11,999	$12,041	$11,999	$11,999	$11,999
Wind:2020	TRANSACTION ENERGY COST	$000	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$12,041	$11,999	$11,999	$11,999	$12,041	$11,999	$11,999	$11,999
Wind:2026	TRANSACTION ENERGY COST	$000	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$11,999	$11,999
	TOTAL PURCH EN COST	**$000**	$18,885	$31,012	$33,530	$16,471	$3,677	$7,001	$7,239	$19,476	$19,759	$33,224	$33,461	$33,699	$46,069	$46,174	$54,050	$54,288	$54,684	$54,763	$67,000	$67,238
AmerenUE PPA	TRANSACTION CAPACITY COST	$000	$357	$713	$942	$438	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
RPS Wind	TRANSACTION CAPACITY COST	$000	$0	$0	$0	$0	$0	$0	$0	$0	$0	$82	$82	$82	$82	$82	$574	$574	$574	$574	$574	$574
	TOTAL PURCH CAP COST	**$000**	$357	$713	$942	$438	$0	$0	$0	$0	$0	$82	$82	$82	$82	$82	$574	$574	$574	$574	$574	$574
	TOTAL FIXED COSTS	**$000**	$23,176	$24,434	$26,156	$29,187	$30,258	$30,930	$32,147	$33,201	$34,750	$36,061	$38,084	$40,120	$41,515	$43,724	$46,225	$48,742	$51,381	$54,145	$56,275	$59,335
AmerenUE PPA (Theoretical)	CO2	TONS	2,424	4,337	4,681	1,996	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Columbia Energy Center	CO2	TONS	19,222	15,925	10,463	6,512	9,055	11,473	11,764	9,858	9,790	7,820	8,624	9,517	8,916	9,148	8,685	8,941	9,140	9,440	8,386	8,105
Combined Heat and Power :2011	CO2	TONS	0	0	0	8,124	8,649	8,434	8,489	7,921	7,982	7,674	7,718	7,782	7,578	7,583	7,370	7,429	7,501	7,571	7,308	7,491
CWL Unit 6	CO2	TONS	189	164	119	67	64	127	127	106	107	91	105	118	118	124	119	121	123	126	117	108
CWL Unit 7	CO2	TONS	42,425	38,669	28,510	23,052	31,261	31,671	32,304	42	0	0	0	0	0	0	0	0	0	0	0	0
CWL Unit 8	CO2	TONS	1,249	1,046	685	403	501	780	794	671	679	558	633	710	697	717	686	704	718	741	673	632
Iatan 2	CO2	TONS	0	0	145,438	145,956	146,667	145,975	145,962	126,907	127,910	116,729	117,586	117,558	105,002	105,990	97,808	97,755	99,780	101,300	87,627	88,417
Nearman Creek	CO2	TONS	93,320	72,310	46,794	70,543	101,369	76,074	77,621	53,181	53,491	42,310	44,295	46,583	39,724	40,333	37,587	38,808	39,802	40,730	34,130	33,800
Prairie State Energy Campus	CO2	TONS	0	0	0	0	0	373,598	373,598	342,852	345,251	339,190	339,086	339,111	324,218	320,048	304,965	306,097	308,700	307,392	281,457	283,641
Sikeston	CO2	TONS	448,447	418,326	341,745	384,741	443,724	407,433	408,108	318,484	323,691	268,710	273,446	278,440	232,076	237,262	218,110	221,109	224,938	228,655	196,487	197,910
Wartsila:2011	CO2	TONS	0	0	0	11,175	14,404	15,387	15,613	8,317	8,366	6,657	7,170	7,649	6,774	6,983	6,567	6,752	6,882	7,076	6,160	6,282

Columbia Water Light Department
Integrated Resource Planning
Project 46806

Description	Data Item	Units	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027
Wartsila:2015	CO2	TONS	0	0	0	0	0	0	0	10,720	10,881	8,710	9,261	9,788	8,635	8,918	8,357	8,601	8,765	9,030	7,845	8,017
	TOTAL CO2	**TONS**	607,277	550,777	578,436	652,568	755,695	1,070,950	1,074,377	879,057	888,148	798,448	807,923	817,254	733,738	737,106	690,255	696,317	706,349	712,062	630,191	634,403
CWL Unit 7	Hg	LBS	3.510	3.199	2.359	1.907	2.586	2.620	2.672	0.003	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
CWL Unit 8	Hg	LBS	0.152	0.128	0.084	0.049	0.060	0.096	0.097	0.082	0.083	0.069	0.078	0.088	0.086	0.089	0.085	0.087	0.089	0.092	0.084	0.078
Iatan 2	Hg	LBS	0.000	0.000	0.060	0.060	0.061	0.060	0.060	0.052	0.053	0.048	0.048	0.048	0.043	0.044	0.040	0.040	0.041	0.042	0.036	0.036
Nearman Creek	Hg	LBS	3.030	2.348	1.519	2.290	3.291	2.470	2.520	1.727	1.737	1.374	1.438	1.512	1.290	1.310	1.220	1.260	1.292	1.322	1.108	1.097
Prairie State Energy Campus	Hg	LBS	0.000	0.000	0.000	0.000	0.000	6.965	6.965	6.346	6.385	6.247	6.265	6.267	5.929	5.860	5.560	5.579	5.633	5.614	5.105	5.141
Sikeston	Hg	LBS	18.103	16.887	13.796	15.531	17.912	16.447	16.474	12.857	13.067	10.847	11.038	11.240	9.368	9.578	8.805	8.926	9.080	9.230	7.932	7.989
	TOTAL Hg	**LBS**	24.795	22.561	17.818	19.838	23.911	28.658	28.790	21.068	21.325	18.585	18.868	19.156	16.717	16.880	15.711	15.892	16.136	16.300	14.265	14.342
Columbia Energy Center	NOx	TONS	6	5	3	2	3	4	4	3	3	3	3	3	3	3	3	3	3	3	3	3
Combined Heat and Power :2011	NOx	TONS	0	0	0	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
CWL Unit 6	NOx	TONS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CWL Unit 7	NOx	TONS	109	100	73	59	81	82	83	0	0	0	0	0	0	0	0	0	0	0	0	0
CWL Unit 8	NOx	TONS	5	4	3	2	2	3	3	3	3	2	2	3	3	3	3	3	3	3	3	2
Iatan 2	NOx	TONS	0	0	54	54	54	54	54	47	47	43	43	43	39	39	36	36	37	37	32	33
Nearman Creek	NOx	TONS	195	151	98	147	212	159	162	111	112	88	92	97	83	84	78	81	83	85	71	71
Prairie State Energy Campus	NOx	TONS	0	0	0	0	0	121	121	110	111	109	109	109	103	102	97	97	98	98	89	89
Sikeston	NOx	TONS	461	430	352	396	456	419	420	328	333	276	281	286	239	244	224	227	231	235	202	204
Wartsila:2011	NOx	TONS	0	0	0	2	2	2	2	1	1	1	1	1	1	1	1	1	1	1	1	1
Wartsila:2015	NOx	TONS	0	0	0	0	0	0	0	2	2	1	1	2	1	1	1	1	1	1	1	1
	TOTAL NOx	**TONS**	777	690	583	662	811	845	850	605	612	524	534	545	472	478	444	450	458	464	403	404
CWL Unit 7	SO2	TONS	295	269	198	160	218	220	225	0	0	0	0	0	0	0	0	0	0	0	0	0
CWL Unit 8	SO2	TONS	17	14	10	6	7	11	11	9	9	8	9	10	10	10	10	10	10	10	9	9
Iatan 2	SO2	TONS	0	0	61	61	61	61	61	53	53	48	49	49	43	44	41	40	41	42	36	37
Nearman Creek	SO2	TONS	351	272	176	265	381	286	292	200	201	159	167	175	149	152	141	146	150	153	128	127
Prairie State Energy Campus	SO2	TONS	0	0	0	0	0	315	315	287	289	282	283	283	268	265	251	252	255	254	231	232
Sikeston	SO2	TONS	1,276	1,190	972	1,094	1,262	1,159	1,161	906	921	764	778	792	660	675	620	629	640	650	559	563
Wartsila:2011	SO2	TONS	0	0	0	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Wartsila:2015	SO2	TONS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	TOTAL SO2	**TONS**	1,939	1,746	1,417	1,587	1,930	2,053	2,065	1,456	1,474	1,263	1,286	1,310	1,131	1,146	1,064	1,078	1,096	1,110	964	969
NOx	SYSTEM EFFLUENT EXPENSE	$000	$0	$1,272	$1,108	$1,302	$1,710	$2,005	$2,197	$1,703	$1,814	$1,689	$1,875	$2,081	$1,961	$1,812	$1,536	$1,421	$1,320	$1,221	$966	$885
CO2	SYSTEM EFFLUENT EXPENSE	$000	$0	$0	$0	$0	$0	$0	$0	$19,106	$19,960	$17,704	$18,964	$20,278	$18,425	$20,012	$19,354	$20,649	$22,161	$23,570	$21,935	$23,864
SO2	SYSTEM EFFLUENT EXPENSE	$000	-$2,111	-$2,884	-$1,223	-$1,319	-$913	-$795	-$840	-$395	-$374	-$948	-$967	-$979	-$1,654	-$1,744	-$2,215	-$2,347	-$2,467	-$2,610	-$3,628	-$3,917
Hg	SYSTEM EFFLUENT EXPENSE	$000	$0	$0	$174	$202	$254	$342	$374	$298	$317	$301	$332	$367	$349	$384	$389	$428	$473	$521	$496	$543
	TOTAL GASSES	**$000**	-$2,111	-$1,612	$58	$185	$1,051	$1,551	$1,731	$20,711	$21,717	$18,747	$20,204	$21,747	$19,081	$20,464	$19,064	$20,152	$21,486	$22,701	$19,770	$21,375
	TOTAL VARIABLE COST	**$000**	$49,550	$51,123	$50,925	$55,070	$60,731	$46,848	$49,771	$81,711	$86,132	$90,577	$94,410	$98,907	$103,989	$107,913	$113,435	$117,777	$122,749	$127,291	$133,076	$138,245
	PeakLoad	(MW)	278.0	284.0	289.0	295.0	300.0	306.0	311.0	317.0	322.0	328.0	333.0	339.0	344.0	350.0	357.0	364.0	371.0	378.0	385.0	392.0
	Reserves	(MW)	38.92	39.76	40.46	41.3	42	42.84	43.54	44.38	45.08	45.92	46.62	47.46	48.16	49	49.98	50.96	51.94	52.92	53.9	54.88
	TotalCapacityResponsibility	(MW)	316.9	323.8	329.5	336.3	342.0	348.8	354.5	361.4	367.1	373.9	379.6	386.5	392.2	399.0	407.0	415.0	422.9	430.9	438.9	446.9
(Wind 15% Firm)	TotalFirmResources	(MW)	318.1	323.8	348.1	336.3	342.0	356.9	357.4	361.4	367.1	374.0	379.7	386.5	392.2	399.0	407.0	415.0	423.0	431.0	438.9	446.9
	ReserveSurplus(Deficit)	(MW)	1.2	0.0	18.7	0.0	0.0	8.1	2.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	ReserveMargin	(%)	14.44%	14.01%	20.47%	14.01%	14.01%	16.65%	14.93%	14.01%	14.01%	14.01%	14.01%	14.01%	14.01%	14.01%	14.01%	14.01%	14.01%	14.01%	14.01%	14.01%
New Capacity Investment	CHP	$000	$0	$0	$0	$1,247	$1,247	$1,247	$1,247	$1,247	$1,247	$1,247	$1,247	$1,247	$1,247	$0	$0	$0	$0	$0	$0	$0
	Wart1 DebtService	$000	$0	$0	$0	$1,624	$1,624	$1,624	$1,624	$1,624	$1,624	$1,624	$1,624	$1,624	$1,624	$1,624	$1,624	$1,624	$1,624	$1,624	$1,624	$1,624
	Wart2 DebtService	$000	$0	$0	$0	$0	$0	$0	$0	$1,828	$1,828	$1,828	$1,828	$1,828	$1,828	$1,828	$1,828	$1,828	$1,828	$1,828	$1,828	$1,828
	Total Fixed Costs	($000)	$23,176	$24,434	$26,156	$29,187	$30,258	$30,930	$32,147	$33,201	$34,750	$36,061	$38,084	$40,120	$41,515	$43,724	$46,225	$48,742	$51,381	$54,145	$56,275	$59,335
	Total Variable Costs	($000)	$44,353	$46,609	$47,795	$49,336	$53,185	$35,467	$37,922	$70,943	$74,846	$80,551	$83,881	$87,884	$93,772	$97,455	$103,346	$107,397	$112,044	$116,249	$122,909	$127,767
	Total Fuel Costs	($000)	$5,197	$4,514	$3,130	$5,734	$7,546	$11,382	$11,849	$10,768	$11,286	$10,026	$10,530	$11,024	$10,217	$10,458	$10,089	$10,381	$10,706	$11,042	$10,167	$10,478
	Total Investment Costs	($000)	$0	$0	$0	$2,871	$2,871	$2,871	$2,871	$4,698	$4,698	$4,698	$4,698	$4,698	$4,698	$3,451	$3,451	$3,451	$3,451	$3,451	$3,451	$3,451
	Total Costs	($000)	$72,726	$75,556	$77,080	$87,128	$93,860	$80,649	$84,789	$119,611	$125,581	$131,336	$137,192	$143,726	$150,202	$155,089	$163,111	$169,970	$177,582	$184,886	$192,803	$201,031

20-Year NPV @ 5.5% ($000): $1,419,511

Columbia Water Light Department
Integrated Resource Planning
Project 46806

Description	Data Item	Units	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027
Columbia	ENERGY REQUIREMENTS	GWH	1,221	1,238	1,254	1,274	1,294	1,311	1,327	1,347	1,367	1,383	1,399	1,426	1,452	1,474	1,505	1,535	1,570	1,597	1,627	1,658
Columbia	PEAK DEMAND	MW	278.0	282.1	285.3	289.4	292.5	296.7	299.8	304.0	307.1	311.2	314.4	320.4	325.4	331.4	338.4	345.4	352.4	359.4	366.4	373.4
	MARKET PURCHASE ENERGY	GWH	299	128	67	329	498	151	160	230	237	190	195	206	174	189	182	201	219	236	219	237
THEORETICAL CO2	MARKET PURCHASE ENERGY	TONS	149,550	64,228	33,291	164,563	249,004	75,564	80,144	115,048	118,535	95,006	97,378	103,109	87,184	94,386	90,879	100,561	109,637	117,945	109,449	118,578
	COST OF MARKET PURCHASE ENERGY	$000	$18,203	$8,268	$4,484	$20,502	$33,173	$10,398	$11,397	$17,328	$18,719	$15,239	$16,081	$17,611	$15,498	$16,970	$16,966	$19,147	$21,419	$23,654	$22,511	$24,850
Columbia Energy Center	FIRM CAPACITY	MW	72.0	72.0	72.0	72.0	72.0	72.0	72.0	72.0	72.0	72.0	72.0	72.0	72.0	72.0	72.0	72.0	72.0	72.0	72.0	72.0
Combined Heat and Power :2011	FIRM CAPACITY	MW	0.0	0.0	0.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
CWL Unit 5	FIRM CAPACITY	MW	16.5	16.5	16.5	16.5	16.5	16.5	16.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CWL Unit 6	FIRM CAPACITY	MW	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5
CWL Unit 7	FIRM CAPACITY	MW	22.0	22.0	22.0	22.0	22.0	22.0	22.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CWL Unit 8	FIRM CAPACITY	MW	35.0	35.0	35.0	35.0	35.0	35.0	35.0	35.0	35.0	35.0	35.0	35.0	35.0	35.0	35.0	35.0	35.0	35.0	35.0	35.0
Distributed Generation	FIRM CAPACITY	MW	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0
Iatan 2	FIRM CAPACITY	MW	0.0	0.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0
Market Purchase	FIRM CAPACITY	MW	0.0	0.0	0.0	16.3	19.0	0.0	0.0	5.0	8.1	4.1	7.2	13.5	11.2	17.5	20.5	28.0	35.5	43.0	42.9	50.9
Nearman Creek	FIRM CAPACITY	MW	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0
Prairie State Energy Campus	FIRM CAPACITY	MW	0.0	0.0	0.0	0.0	0.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0
Sikeston	FIRM CAPACITY	MW	66.0	66.0	66.0	66.0	66.0	66.0	66.0	66.0	66.0	66.0	66.0	66.0	66.0	66.0	66.0	66.0	66.0	66.0	66.0	66.0
Wartsila:2011	FIRM CAPACITY	MW	0.0	0.0	0.0	16.8	16.8	16.8	16.8	16.8	16.8	16.8	16.8	16.8	16.8	16.8	16.8	16.8	16.8	16.8	16.8	16.8
	SUBTOTAL CAPACITY	**MW**	252.0	252.0	272.0	310.1	312.8	343.8	343.8	310.3	313.4	309.4	312.5	318.8	316.5	322.8	325.8	333.3	340.8	348.3	348.2	356.2
Columbia Energy Center	GENERATION	GWH	25	21	13	8	12	14	15	20	21	16	17	18	16	16	15	16	16	17	14	14
Combined Heat and Power :2011	GENERATION	GWH	0	0	0	25	27	26	26	24	24	23	23	23	23	23	22	22	22	23	22	22
CWL Unit 5	GENERATION	GWH	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CWL Unit 6	GENERATION	GWH	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CWL Unit 7	GENERATION	GWH	27	24	17	14	20	19	20	0	0	0	0	0	0	0	0	0	0	0	0	0
CWL Unit 8	GENERATION	GWH	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Distributed Generation	GENERATION	GWH	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Iatan 2	GENERATION	GWH	0	0	146	147	148	147	147	127	128	115	115	116	102	103	95	95	97	98	85	86
Nearman Creek	GENERATION	GWH	82	63	40	61	89	64	65	39	40	31	32	34	29	30	28	29	29	30	25	25
Prairie State Energy Campus	GENERATION	GWH	0	0	0	0	0	368	368	335	337	328	329	329	308	305	288	289	292	292	263	265
Sikeston	GENERATION	GWH	418	389	314	355	413	377	377	286	289	234	238	243	200	205	188	191	195	199	170	172
Wartsila:2011	GENERATION	GWH	0	0	0	20	27	28	28	19	19	15	15	16	14	15	14	14	14	15	13	13
	SUBTOTAL GENERATION	**GWH**	553	498	532	631	736	1,044	1,047	851	860	763	770	781	693	698	651	657	668	675	593	599
Columbia Energy Center	GENERATORE CAPACITY FACTOR	%	4.00%	3.29%	2.11%	1.33%	1.88%	2.29%	2.35%	3.20%	3.26%	2.50%	2.62%	2.85%	2.48%	2.61%	2.44%	2.51%	2.55%	2.63%	2.28%	2.25%
Combined Heat and Power :2011	GENERATORE CAPACITY FACTOR	%				56.96%	60.69%	58.81%	59.18%	54.32%	54.46%	52.55%	52.76%	53.23%	51.42%	51.73%	50.33%	50.56%	50.79%	51.63%	49.92%	51.06%
CWL Unit 6	GENERATORE CAPACITY FACTOR	%	0.16%	0.14%	0.10%	0.06%	0.06%	0.11%	0.11%	0.15%	0.16%	0.13%	0.14%	0.15%	0.14%	0.15%	0.14%	0.14%	0.14%	0.15%	0.13%	0.13%
CWL Unit 7	GENERATORE CAPACITY FACTOR	%	13.78%	12.53%	9.05%	7.35%	10.16%	9.96%	10.15%													
CWL Unit 8	GENERATORE CAPACITY FACTOR	%	0.42%	0.35%	0.23%	0.13%	0.17%	0.25%	0.26%	0.37%	0.39%	0.31%	0.32%	0.36%	0.32%	0.34%	0.32%	0.33%	0.33%	0.34%	0.30%	0.29%
Distributed Generation	GENERATORE CAPACITY FACTOR	%	0.10%	0.09%	0.07%	0.04%	0.03%	0.06%	0.06%	0.09%	0.10%	0.08%	0.08%	0.09%	0.08%	0.09%	0.09%	0.09%	0.09%	0.09%	0.08%	0.08%
Iatan 2	GENERATORE CAPACITY FACTOR	%			83.43%	83.79%	84.02%	83.83%	83.83%	72.34%	72.76%	65.63%	65.88%	66.15%	58.28%	58.90%	53.97%	54.04%	55.11%	56.13%	48.24%	48.90%
Nearman Creek	GENERATORE CAPACITY FACTOR	%	46.69%	35.83%	22.74%	34.79%	50.71%	36.67%	37.29%	22.45%	22.87%	17.65%	18.17%	19.22%	16.30%	16.84%	15.91%	16.49%	16.78%	17.16%	14.20%	14.38%
Prairie State Energy Campus	GENERATORE CAPACITY FACTOR	%						84.02%	84.02%	76.51%	76.78%	74.96%	75.18%	75.22%	70.15%	69.72%	65.72%	65.95%	66.54%	66.78%	60.05%	60.49%
Sikeston	GENERATORE CAPACITY FACTOR	%	72.08%	67.28%	54.38%	61.44%	71.32%	65.16%	65.26%	49.47%	49.93%	40.53%	41.12%	42.08%	34.54%	35.49%	32.52%	33.12%	33.69%	34.42%	29.46%	29.75%
Wartsila:2011	GENERATORE CAPACITY FACTOR	%				13.84%	18.07%	18.82%	19.11%	12.64%	12.84%	9.98%	10.39%	11.12%	9.52%	9.98%	9.32%	9.52%	9.66%	9.98%	8.57%	8.99%
Columbia Energy Center	TOTAL O AND M COST	$000	$5,301	$5,426	$5,548	$5,677	$5,826	$5,976	$6,126	$6,291	$6,449	$6,600	$6,940	$7,117	$7,290	$7,474	$7,658	$7,850	$8,048	$8,250	$8,450	$8,661
Combined Heat and Power :2011	TOTAL O AND M COST	$000	$0	$0	$0	$416	$457	$455	$472	$446	$462	$458	$473	$492	$491	$507	$508	$526	$546	$570	$568	$598
CWL Unit 6	TOTAL O AND M COST	$000	$1,524	$1,547	$1,592	$1,637	$1,686	$1,740	$1,792	$1,848	$1,904	$1,959	$2,019	$2,080	$2,141	$2,206	$2,272	$2,340	$2,411	$2,483	$2,557	$2,633
CWL Unit 7	TOTAL O AND M COST	$000	$2,222	$2,191	$2,070	$2,040	$2,261	$2,316	$2,396	$158	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
CWL Unit 8	TOTAL O AND M COST	$000	$379	$385	$396	$408	$420	$433	$446	$460	$474	$488	$502	$518	$533	$549	$565	$582	$600	$618	$636	$655
Distributed Generation	TOTAL O AND M COST	$000	$13	$12	$10	$6	$4	$10	$10	$15	$17	$14	$15	$17	$16	$18	$17	$18	$19	$20	$19	$18
Iatan 2	TOTAL O AND M COST	$000	$0	$0	$2,881	$2,978	$3,080	$3,160	$3,255	$2,985	$3,095	$2,940	$3,037	$3,138	$2,948	$3,053	$2,952	$3,043	$3,185	$3,318	$3,070	$3,192
Market Purchase	TOTAL O AND M COST	$000	$0	$0	$0	$1,071	$1,286	$0	$0	$372	$617	$320	$578	$1,122	$959	$1,546	$1,863	$2,618	$3,417	$4,261	$4,387	$5,358
Nearman Creek	TOTAL O AND M COST	$000	$4,689	$4,518	$4,254	$4,850	$5,634	$5,317	$5,555	$5,163	$5,390	$5,370	$5,609	$5,884	$5,975	$6,240	$6,439	$6,729	$7,018	$7,319	$7,423	$7,732
Prairie State Energy Campus	TOTAL O AND M COST	$000	$0	$0	$0	$0	$0	$4,412	$4,545	$4,492	$4,639	$4,724	$4,872	$5,019	$5,027	$5,159	$5,190	$5,353	$5,539	$5,707	$5,644	$5,828
Sikeston	TOTAL O AND M COST	$000	$18,064	$18,221	$17,665	$19,197	$21,121	$21,303	$22,233	$21,303	$22,323	$22,107	$23,187	$24,367	$24,442	$25,689	$26,435	$27,752	$29,143	$30,597	$31,197	$32,706
Wartsila:2011	TOTAL O AND M COST	$000	$0	$0	$0	$326	$393	$414	$431	$349	$363	$330	$346	$368	$353	$371	$370	$385	$400	$418	$402	$422
Columbia Energy Center	FIXED O AND M COSTS	$000	$5,257	$5,388	$5,523	$5,661	$5,803	$5,948	$6,096	$6,249	$6,405	$6,565	$6,903	$7,076	$7,253	$7,434	$7,620	$7,811	$8,006	$8,206	$8,411	$8,621
CWL Unit 6	FIXED O AND M COSTS	$000	$1,516	$1,540	$1,587	$1,634	$1,683	$1,734	$1,786	$1,839	$1,894	$1,951	$2,010	$2,070	$2,132	$2,196	$2,262	$2,330	$2,400	$2,472	$2,546	$2,622
CWL Unit 7	FIXED O AND M COSTS	$000	$1,516	$1,540	$1,587	$1,634	$1,683	$1,734	$1,786	$156	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
CWL Unit 8	FIXED O AND M COSTS	$000	$378	$384	$396	$408	$420	$432	$445	$459	$472	$487	$501	$516	$532	$548	$564	$581	$598	$616	$635	$654

Columbia Water Light Department
Integrated Resource Planning
Project 46806

Description	Data Item	Units	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027
Iatan 2	FIXED O AND M COSTS	$000	$0	$0	$586	$604	$622	$640	$660	$680	$700	$721	$742	$765	$788	$812	$836	$861	$887	$913	$942	$969
Market Purchase	FIXED O AND M COSTS	$000	$0	$0	$0	$1,071	$1,286	$0	$0	$372	$617	$320	$578	$1,122	$959	$1,546	$1,863	$2,618	$3,417	$4,261	$4,387	$5,358
Nearman Creek	FIXED O AND M COSTS	$000	$3,218	$3,347	$3,481	$3,620	$3,765	$3,916	$4,072	$4,235	$4,405	$4,581	$4,764	$4,955	$5,153	$5,359	$5,573	$5,796	$6,028	$6,269	$6,520	$6,781
Prairie State Energy Campus	FIXED O AND M COSTS	$000	$0	$0	$0	$0	$0	$2,417	$2,490	$2,565	$2,641	$2,720	$2,802	$2,885	$2,972	$3,061	$3,152	$3,247	$3,343	$3,444	$3,548	$3,654
Sikeston	FIXED O AND M COSTS	$000	$10,933	$11,480	$12,054	$12,656	$13,289	$13,953	$14,651	$15,384	$16,154	$16,962	$17,810	$18,701	$19,638	$20,619	$21,650	$22,732	$23,868	$25,061	$26,316	$27,631
Wartsila:2011	FIXED O AND M COSTS	$000	$0	$0	$0	$146	$151	$155	$160	$165	$170	$175	$180	$185	$191	$197	$203	$209	$215	$221	$228	$235
	TOTAL FIXED OM COST	**$000**	$22,818	$23,680	$25,213	$27,434	$28,701	$30,930	$32,146	$32,105	$33,459	$34,483	$36,291	$38,274	$39,616	$41,771	$43,724	$46,185	$48,762	$51,464	$53,532	$56,526
Columbia Energy Center	VARIABLE O AND M COSTS	$/MWH	$1.74	$1.79	$1.83	$1.88	$1.93	$1.97	$2.02	$2.07	$2.13	$2.18	$2.23	$2.29	$2.35	$2.40	$2.47	$2.53	$2.59	$2.65	$2.72	$2.79
Combined Heat and Power :2011	VARIABLE O AND M COSTS	$/MWH	$0.00	$0.00	$0.00	$16.67	$17.16	$17.67	$18.20	$18.75	$19.31	$19.89	$20.49	$21.10	$21.74	$22.39	$23.06	$23.75	$24.47	$25.20	$25.96	$26.74
CWL Unit 6	VARIABLE O AND M COSTS	$/MWH	$43.67	$44.39	$45.73	$47.06	$48.48	$49.95	$51.45	$53.01	$54.64	$56.27	$57.96	$59.74	$61.52	$63.37	$65.28	$67.23	$69.26	$71.34	$73.47	$75.68
CWL Unit 7	VARIABLE O AND M COSTS	$/MWH	$26.52	$26.94	$27.74	$28.67	$29.43	$30.32	$31.23	$31.74	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
CWL Unit 8	VARIABLE O AND M COSTS	$/MWH	$0.94	$0.95	$0.98	$1.02	$1.04	$1.07	$1.11	$1.14	$1.18	$1.21	$1.25	$1.29	$1.32	$1.36	$1.41	$1.45	$1.49	$1.54	$1.58	$1.63
Distributed Generation	VARIABLE O AND M COSTS	$/MWH	$192.95	$196.27	$202.14	$207.47	$214.19	$220.77	$227.41	$234.20	$241.44	$248.66	$256.10	$263.95	$271.85	$280.01	$288.47	$297.08	$306.04	$315.20	$324.65	$334.39
Iatan 2	VARIABLE O AND M COSTS	$/MWH	$0.00	$0.00	$15.70	$16.17	$16.65	$17.16	$17.67	$18.19	$18.74	$19.30	$19.88	$20.48	$21.09	$21.72	$22.37	$23.04	$23.74	$24.45	$25.18	$25.94
Nearman Creek	VARIABLE O AND M COSTS	$/MWH	$17.93	$18.65	$19.39	$20.17	$20.98	$21.81	$22.69	$23.59	$24.54	$25.52	$26.54	$27.60	$28.71	$29.85	$31.05	$32.29	$33.58	$34.93	$36.32	$37.78
Prairie State Energy Campus	VARIABLE O AND M COSTS	$/MWH	$0.00	$0.00	$0.00	$0.00	$0.00	$5.42	$5.58	$5.75	$5.92	$6.10	$6.28	$6.48	$6.67	$6.87	$7.08	$7.29	$7.51	$7.74	$7.97	$8.21
Sikeston	VARIABLE O AND M COSTS	$/MWH	$17.06	$17.33	$17.85	$18.41	$18.94	$19.51	$20.09	$20.69	$21.31	$21.95	$22.61	$23.29	$23.99	$24.71	$25.45	$26.21	$27.01	$27.82	$28.65	$29.51
Wartsila:2011	VARIABLE O AND M COSTS	$/MWH	$0.00	$0.00	$0.00	$8.85	$9.08	$9.35	$9.63	$9.93	$10.23	$10.54	$10.85	$11.18	$11.52	$11.86	$12.22	$12.59	$12.97	$13.36	$13.76	$14.17
Columbia Energy Center	VARIABLE O AND M COSTS	$000	$44	$37	$24	$16	$23	$29	$30	$42	$44	$34	$37	$41	$37	$40	$38	$40	$42	$44	$39	$40
Combined Heat and Power :2011	VARIABLE O AND M COSTS	$000	$0	$0	$0	$416	$457	$455	$472	$446	$462	$458	$473	$492	$491	$507	$508	$526	$546	$570	$568	$598
CWL Unit 6	VARIABLE O AND M COSTS	$000	$8	$7	$5	$3	$3	$6	$6	$9	$10	$8	$9	$10	$9	$10	$10	$10	$11	$11	$11	$10
CWL Unit 7	VARIABLE O AND M COSTS	$000	$706	$650	$484	$406	$578	$582	$611	$2	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
CWL Unit 8	VARIABLE O AND M COSTS	$000	$1	$1	$1	$0	$1	$1	$1	$1	$1	$1	$1	$1	$1	$1	$1	$1	$2	$2	$1	$1
Distributed Generation	VARIABLE O AND M COSTS	$000	$13	$12	$10	$6	$4	$10	$10	$15	$17	$14	$15	$17	$16	$18	$17	$18	$19	$20	$19	$18
Iatan 2	VARIABLE O AND M COSTS	$000	$0	$0	$2,295	$2,374	$2,458	$2,520	$2,595	$2,306	$2,395	$2,219	$2,295	$2,373	$2,159	$2,242	$2,116	$2,182	$2,298	$2,404	$2,128	$2,222
Nearman Creek	VARIABLE O AND M COSTS	$000	$1,471	$1,170	$773	$1,229	$1,869	$1,402	$1,482	$928	$986	$789	$845	$929	$822	$881	$866	$933	$990	$1,050	$904	$952
Prairie State Energy Campus	VARIABLE O AND M COSTS	$000	$0	$0	$0	$0	$0	$1,995	$2,055	$1,927	$1,998	$2,003	$2,070	$2,134	$2,055	$2,098	$2,037	$2,106	$2,195	$2,263	$2,096	$2,174
Sikeston	VARIABLE O AND M COSTS	$000	$7,131	$6,742	$5,611	$6,541	$7,832	$7,350	$7,582	$5,918	$6,169	$5,144	$5,376	$5,667	$4,805	$5,070	$4,785	$5,020	$5,275	$5,536	$4,881	$5,075
Wartsila:2011	VARIABLE O AND M COSTS	$000	$0	$0	$0	$180	$242	$259	$271	$185	$194	$155	$166	$183	$162	$174	$168	$176	$185	$196	$174	$187
	TOTAL VAR OM COST	**$000**	$9,374	$8,620	$9,202	$11,171	$13,466	$14,607	$15,114	$11,778	$12,275	$10,826	$11,286	$11,848	$10,557	$11,040	$10,546	$11,013	$11,563	$12,096	$10,820	$11,278
Columbia Energy Center	TOTAL FUEL COST	$000	$3,471	$2,888	$1,868	$1,198	$1,794	$2,144	$2,260	$3,214	$3,440	$2,647	$2,765	$2,996	$2,565	$2,708	$2,557	$2,640	$2,721	$2,824	$2,493	$2,517
Combined Heat and Power :2011	TOTAL FUEL COST	$000	$0	$0	$0	$1,557	$1,729	$1,654	$1,712	$1,656	$1,742	$1,703	$1,705	$1,711	$1,641	$1,650	$1,625	$1,638	$1,666	$1,702	$1,675	$1,752
CWL Unit 6	TOTAL FUEL COST	$000	$34	$30	$22	$13	$13	$24	$25	$37	$41	$33	$35	$39	$34	$37	$35	$36	$37	$38	$35	$34
CWL Unit 7	TOTAL FUEL COST	$000	$1,488	$1,386	$1,029	$860	$1,224	$1,231	$1,289	$3	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
CWL Unit 8	TOTAL FUEL COST	$000	$191	$162	$106	$64	$83	$126	$132	$194	$217	$170	$180	$198	$174	$185	$176	$180	$186	$192	$173	$172
Distributed Generation	TOTAL FUEL COST	$000	$13	$12	$10	$6	$4	$10	$10	$15	$17	$14	$16	$18	$17	$19	$18	$19	$21	$21	$20	$20
Prairie State Energy Campus	TOTAL FUEL COST	$000	$0	$0	$0	$0	$0	$3,165	$3,254	$3,046	$3,151	$3,153	$3,251	$3,344	$3,215	$3,276	$3,174	$3,274	$3,405	$3,504	$3,239	$3,354
Wartsila:2011	TOTAL FUEL COST	$000	$0	$0	$0	$1,956	$2,699	$2,784	$2,908	$2,015	$2,150	$1,677	$1,740	$1,853	$1,563	$1,641	$1,547	$1,587	$1,632	$1,697	$1,482	$1,589
	TOTAL REC FUEL COST	**$000**	$5,197	$4,478	$3,035	$5,653	$7,546	$11,138	$11,589	$10,180	$10,758	$9,399	$9,693	$10,159	$9,208	$9,516	$9,133	$9,375	$9,669	$9,978	$9,117	$9,437
AmerenUE PPA	MAXIMUM TRANSACTION CAPACITY	MW	60	65	70	70	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bluegrass Ridge	MAXIMUM TRANSACTION CAPACITY	MW	6.3	6.3	6.3	6.3	6.3	6.3	6.3	6.3	6.3	6.3	6.3	6.3	6.3	6.3	6.3	6.3	6.3	6.3	6.3	6.3
Landfill Gas	MAXIMUM TRANSACTION CAPACITY	MW	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2
RPS Landfill Gas	MAXIMUM TRANSACTION CAPACITY	MW	0	0	0	0	0	7	7.5	8	8.5	9	9.5	10	10.5	11	11.5	12	12.5	13	13.5	13.5
RPS Wind	MAXIMUM TRANSACTION CAPACITY	MW	0	0	0	0	0	0	0	0	0	5	5	5	5	5	35	35	35	35	35	35
Wind:2015	MAXIMUM TRANSACTION CAPACITY	MW	0	0	0	0	0	0	0	50	50	50	50	50	50	50	50	50	50	50	50	50
Wind:2017	MAXIMUM TRANSACTION CAPACITY	MW	0	0	0	0	0	0	0	0	0	50	50	50	50	50	50	50	50	50	50	50
Wind:2020	MAXIMUM TRANSACTION CAPACITY	MW	0	0	0	0	0	0	0	0	0	0	0	0	50	50	50	50	50	50	50	50
Wind:2026	MAXIMUM TRANSACTION CAPACITY	MW	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	50	50
AmerenUE PPA	FIRM CAPACITY	MW	60.0	65.0	70.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Bluegrass Ridge	FIRM CAPACITY	MW	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9
Landfill Gas	FIRM CAPACITY	MW	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2
RPS Landfill Gas	FIRM CAPACITY	MW	0.0	0.0	0.0	0.0	0.0	7.0	7.5	8.0	8.5	9.0	9.5	10.0	10.5	11.0	11.5	12.0	12.5	13.0	13.5	13.5
RPS Wind	FIRM CAPACITY	MW	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.8	0.8	0.8	0.8	0.8	5.3	5.3	5.3	5.3	5.3	5.3
Wind:2015	FIRM CAPACITY	MW	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5
Wind:2017	FIRM CAPACITY	MW	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5
Wind:2020	FIRM CAPACITY	MW	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5
Wind:2026	FIRM CAPACITY	MW	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.5	7.5

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Description	Data Item	Units	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027
	SUBTOT FIRM PURCHASE CAP	**MW**	66.1	71.1	76.1	6.1	6.1	13.1	13.6	21.6	22.1	30.9	31.4	31.9	39.9	40.4	45.4	45.9	46.4	46.9	54.9	54.9
	TOTAL FIRM CAPACITY	**MW**	318.1	323.1	348.1	316.3	319.0	356.9	357.4	332.0	335.6	340.3	343.9	350.7	356.4	363.2	371.2	379.2	387.2	395.2	403.1	411.1
AmerenUE PPA	TRANSACTION ENERGY TAKEN	GWH	308	551	595	254	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bluegrass Ridge	TRANSACTION ENERGY TAKEN	GWH	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18
Landfill Gas	TRANSACTION ENERGY TAKEN	GWH	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42
RPS Landfill Gas	TRANSACTION ENERGY TAKEN	GWH	0	0	0	0	0	55	59	63	67	71	75	79	83	87	91	95	99	103	107	111
RPS Wind	TRANSACTION ENERGY TAKEN	GWH	0	0	0	0	0	0	0	0	0	14	14	14	14	14	100	100	100	100	100	100
Wind:2015	TRANSACTION ENERGY TAKEN	GWH	0	0	0	0	0	0	0	142	143	142	142	142	143	142	142	142	143	142	142	142
Wind:2017	TRANSACTION ENERGY TAKEN	GWH	0	0	0	0	0	0	0	0	0	142	142	142	143	142	142	142	143	142	142	142
Wind:2020	TRANSACTION ENERGY TAKEN	GWH	0	0	0	0	0	0	0	0	0	0	0	0	143	142	142	142	143	142	142	142
Wind:2026	TRANSACTION ENERGY TAKEN	GWH	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	142	142
	SUBTOTAL TRANS ENERGY	**GWH**	368	611	655	314	60	116	119	266	270	430	434	438	586	588	678	682	688	690	836	840
	TOTAL ENERGY	**GWH**	1,221	1,238	1,254	1,274	1,294	1,311	1,327	1,347	1,367	1,383	1,399	1,426	1,453	1,476	1,510	1,540	1,575	1,601	1,648	1,676
AmerenUE PPA	TRANSACTION CAPACITY FACTOR	%	100.00%	100.00%	100.00%	100.00%																
Bluegrass Ridge	TRANSACTION CAPACITY FACTOR	%	32.52%	32.50%	32.50%	32.50%	32.52%	32.50%	32.50%	32.50%	32.52%	32.50%	32.50%	32.50%	32.52%	32.50%	32.50%	32.50%	32.52%	32.50%	32.50%	32.50%
Landfill Gas	TRANSACTION CAPACITY FACTOR	%	92.23%	92.49%	92.49%	92.49%	92.23%	92.49%	92.49%	92.49%	92.23%	92.49%	92.49%	92.49%	92.23%	92.49%	92.49%	92.49%	92.23%	92.49%	92.49%	92.49%
RPS Landfill Gas	TRANSACTION CAPACITY FACTOR	%						90.46%	90.46%	90.46%	90.21%	90.46%	90.46%	90.46%	90.21%	90.46%	90.46%	90.46%	90.21%	90.46%	90.46%	93.81%
RPS Wind	TRANSACTION CAPACITY FACTOR	%										32.50%	32.50%	32.50%	32.52%	32.50%	32.50%	32.50%	32.52%	32.50%	32.50%	32.50%
Wind:2015	TRANSACTION CAPACITY FACTOR	%								32.50%	32.52%	32.50%	32.50%	32.50%	32.52%	32.50%	32.50%	32.50%	32.52%	32.50%	32.50%	32.50%
Wind:2017	TRANSACTION CAPACITY FACTOR	%										32.50%	32.50%	32.50%	32.52%	32.50%	32.50%	32.50%	32.52%	32.50%	32.50%	32.50%
Wind:2020	TRANSACTION CAPACITY FACTOR	%													32.52%	32.50%	32.50%	32.50%	32.52%	32.50%	32.50%	32.50%
Wind:2026	TRANSACTION CAPACITY FACTOR	%																			32.50%	32.50%
AmerenUE PPA	TOTAL TRANSACTION COST	$000	$15,565	$28,052	$30,799	$13,236	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Bluegrass Ridge	TOTAL TRANSACTION COST	$000	$1,234	$1,229	$1,229	$1,229	$1,234	$1,229	$1,229	$1,229	$1,234	$1,229	$1,229	$1,229	$1,234	$1,229	$1,229	$1,229	$1,234	$1,229	$1,229	$1,229
Landfill Gas	TOTAL TRANSACTION COST	$000	$2,443	$2,443	$2,443	$2,443	$2,443	$2,443	$2,443	$2,443	$2,443	$2,443	$2,443	$2,443	$2,443	$2,443	$2,443	$2,443	$2,443	$2,443	$2,443	$2,443
RPS Landfill Gas	TOTAL TRANSACTION COST	$000	$0	$0	$0	$0	$0	$3,328	$3,566	$3,804	$4,041	$4,279	$4,517	$4,754	$4,992	$5,230	$5,468	$5,705	$5,943	$6,181	$6,418	$6,656
RPS Wind	TOTAL TRANSACTION COST	$000	$0	$0	$0	$0	$0	$0	$0	$0	$1,355	$1,355	$1,355	$1,359	$1,355	$9,485	$9,485	$9,516	$9,485	$9,485	$9,485
Wind:2015	TOTAL TRANSACTION COST	$000	$0	$0	$0	$0	$0	$0	$0	$11,999	$12,041	$11,999	$11,999	$11,999	$12,041	$11,999	$11,999	$11,999	$12,041	$11,999	$11,999	$11,999
Wind:2017	TOTAL TRANSACTION COST	$000	$0	$0	$0	$0	$0	$0	$0	$0	$0	$11,999	$11,999	$11,999	$12,041	$11,999	$11,999	$11,999	$12,041	$11,999	$11,999	$11,999
Wind:2020	TOTAL TRANSACTION COST	$000	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$12,041	$11,999	$11,999	$11,999	$12,041	$11,999	$11,999	$11,999
Wind:2026	TOTAL TRANSACTION COST	$000	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$11,999	$11,999
AmerenUE PPA	TRANSACTION ENERGY COST	$000	$15,208	$27,339	$29,857	$12,798	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Bluegrass Ridge	TRANSACTION ENERGY COST	$000	$1,234	$1,229	$1,229	$1,229	$1,234	$1,229	$1,229	$1,229	$1,234	$1,229	$1,229	$1,229	$1,234	$1,229	$1,229	$1,229	$1,234	$1,229	$1,229	$1,229
Landfill Gas	TRANSACTION ENERGY COST	$000	$2,443	$2,443	$2,443	$2,443	$2,443	$2,443	$2,443	$2,443	$2,443	$2,443	$2,443	$2,443	$2,443	$2,443	$2,443	$2,443	$2,443	$2,443	$2,443	$2,443
RPS Landfill Gas	TRANSACTION ENERGY COST	$000	$0	$0	$0	$0	$0	$3,328	$3,566	$3,804	$4,041	$4,279	$4,517	$4,754	$4,992	$5,230	$5,468	$5,705	$5,943	$6,181	$6,418	$6,656
RPS Wind	TRANSACTION ENERGY COST	$000	$0	$0	$0	$0	$0	$0	$0	$0	$0	$1,273	$1,273	$1,273	$1,277	$1,273	$8,911	$8,911	$8,942	$8,911	$8,911	$8,911
Wind:2015	TRANSACTION ENERGY COST	$000	$0	$0	$0	$0	$0	$0	$0	$11,999	$12,041	$11,999	$11,999	$11,999	$12,041	$11,999	$11,999	$11,999	$12,041	$11,999	$11,999	$11,999
Wind:2017	TRANSACTION ENERGY COST	$000	$0	$0	$0	$0	$0	$0	$0	$0	$0	$11,999	$11,999	$11,999	$12,041	$11,999	$11,999	$11,999	$12,041	$11,999	$11,999	$11,999
Wind:2020	TRANSACTION ENERGY COST	$000	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$12,041	$11,999	$11,999	$11,999	$12,041	$11,999	$11,999	$11,999
Wind:2026	TRANSACTION ENERGY COST	$000	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$11,999	$11,999
	TOTAL PURCH EN COST	**$000**	$18,885	$31,012	$33,530	$16,471	$3,677	$7,001	$7,239	$19,476	$19,759	$33,224	$33,461	$33,699	$46,069	$46,174	$54,050	$54,288	$54,684	$54,763	$67,000	$67,238
AmerenUE PPA	TRANSACTION CAPACITY COST	$000	$357	$713	$942	$438	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
RPS Wind	TRANSACTION CAPACITY COST	$000	$0	$0	$0	$0	$0	$0	$0	$0	$0	$82	$82	$82	$82	$82	$574	$574	$574	$574	$574	$574
	TOTAL PURCH CAP COST	**$000**	$357	$713	$942	$438	$0	$0	$0	$0	$0	$82	$82	$82	$82	$82	$574	$574	$574	$574	$574	$574
	TOTAL FIXED COSTS	**$000**	$23,175	$24,393	$26,155	$27,872	$28,701	$30,930	$32,146	$32,105	$33,459	$34,565	$36,373	$38,356	$39,698	$41,853	$44,297	$46,759	$49,336	$52,038	$54,106	$57,100
AmerenUE PPA (Theoretical)	CO2	TONS	2,424	4,337	4,681	1,996	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Columbia Energy Center	CO2	TONS	19,222	15,783	10,121	6,394	9,054	10,990	11,255	15,306	15,642	11,965	12,541	13,651	11,900	12,506	11,691	12,016	12,259	12,610	10,945	10,779
Combined Heat and Power :2011	CO2	TONS	0	0	0	8,096	8,649	8,359	8,411	7,720	7,762	7,469	7,499	7,566	7,328	7,352	7,154	7,186	7,239	7,338	7,096	7,257
CWL Unit 6	CO2	TONS	189	164	118	68	64	123	124	177	190	150	160	177	158	170	160	163	168	169	152	146
CWL Unit 7	CO2	TONS	42,425	38,452	27,764	22,574	31,257	30,583	31,148	82	0	0	0	0	0	0	0	0	0	0	0	0
CWL Unit 8	CO2	TONS	1,066	889	575	342	421	646	660	930	992	774	823	908	812	862	808	826	844	862	764	743
Iatan 2	CO2	TONS	0	0	145,238	145,861	146,664	145,938	145,923	125,925	127,003	114,249	114,686	115,149	101,738	102,534	93,953	94,070	96,189	97,705	83,974	85,129

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Description	Data Item	Units	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027
Nearman Creek	CO2	TONS	93,320	71,415	45,334	69,358	101,355	73,108	74,342	44,760	45,705	35,180	36,212	38,309	32,580	33,568	31,724	32,879	33,551	34,198	28,303	28,668
Prairie State Energy Campus	CO2	TONS	0	0	0	0	0	373,598	373,598	340,225	342,352	333,298	334,294	334,489	312,765	310,035	292,216	293,258	296,672	296,945	267,033	268,966
Sikeston	CO2	TONS	448,447	417,446	337,426	381,175	443,725	404,302	404,923	306,924	310,629	251,482	255,151	261,088	214,914	220,186	201,766	205,501	209,602	213,563	182,807	184,554
Wartsila:2011	CO2	TONS	0	0	0	11,000	14,403	14,962	15,187	10,044	10,237	7,935	8,259	8,840	7,591	7,935	7,410	7,568	7,702	7,936	6,812	7,143
	TOTAL CO2	**TONS**	607,094	548,484	571,258	646,863	755,591	1,062,609	1,065,570	852,093	860,512	762,502	769,625	780,177	689,786	695,149	646,881	653,468	664,225	671,327	587,884	593,385
CWL Unit 7	Hg	LBS	3.510	3.181	2.297	1.868	2.586	2.530	2.577	0.007	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
CWL Unit 8	Hg	LBS	0.152	0.127	0.082	0.049	0.060	0.092	0.094	0.133	0.141	0.110	0.117	0.130	0.116	0.123	0.115	0.118	0.120	0.123	0.109	0.106
Iatan 2	Hg	LBS	0.000	0.000	0.060	0.060	0.061	0.060	0.060	0.052	0.053	0.047	0.048	0.048	0.042	0.043	0.039	0.039	0.040	0.041	0.035	0.035
Nearman Creek	Hg	LBS	3.030	2.319	1.472	2.252	3.291	2.374	2.414	1.453	1.484	1.142	1.176	1.244	1.058	1.090	1.030	1.068	1.089	1.110	0.919	0.931
Prairie State Energy Campus	Hg	LBS	0.000	0.000	0.000	0.000	0.000	6.965	6.965	6.343	6.382	6.214	6.232	6.236	5.831	5.780	5.448	5.467	5.531	5.536	4.978	5.014
Sikeston	Hg	LBS	18.103	16.851	13.621	15.387	17.912	16.321	16.346	12.390	12.539	10.152	10.300	10.540	8.676	8.888	8.145	8.296	8.461	8.621	7.380	7.450
	TOTAL Hg	**LBS**	24.795	22.478	17.532	19.616	23.910	28.342	28.456	20.378	20.600	17.666	17.873	18.196	15.722	15.924	14.777	14.987	15.242	15.431	13.420	13.536
Columbia Energy Center	NOx	TONS	6	5	3	2	3	4	4	5	5	4	4	4	4	4	4	4	4	4	4	4
CWL Unit 6	NOx	TONS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CWL Unit 7	NOx	TONS	109	99	72	58	81	79	80	0	0	0	0	0	0	0	0	0	0	0	0	0
CWL Unit 8	NOx	TONS	5	4	3	2	2	3	3	4	4	3	4	4	4	4	4	4	4	4	3	3
Iatan 2	NOx	TONS	0	0	54	54	54	54	54	47	47	42	42	43	38	38	35	35	36	36	31	32
Nearman Creek	NOx	TONS	195	149	95	145	212	153	155	93	95	73	76	80	68	70	66	69	70	71	59	60
Prairie State Energy Campus	NOx	TONS	0	0	0	0	0	121	121	110	111	108	108	108	101	100	95	95	96	96	87	87
Sikeston	NOx	TONS	461	429	347	392	456	416	416	316	319	259	262	269	221	226	208	211	216	220	188	190
Wartsila:2011	NOx	TONS	0	0	0	2	2	2	2	2	2	1	1	1	1	1	1	1	1	1	1	1
	TOTAL NOx	**TONS**	777	687	573	655	810	832	836	577	584	491	498	510	437	445	412	419	427	433	373	377
CWL Unit 7	SO2	TONS	295	268	193	157	218	213	217	1	0	0	0	0	0	0	0	0	0	0	0	0
CWL Unit 8	SO2	TONS	17	14	9	6	7	10	11	15	16	13	13	15	13	14	13	13	14	14	12	12
Iatan 2	SO2	TONS	0	0	61	61	61	61	61	52	53	48	48	48	42	43	39	39	40	41	35	35
Nearman Creek	SO2	TONS	351	269	171	261	381	275	280	168	172	132	136	144	123	126	119	124	126	129	106	108
Prairie State Energy Campus	SO2	TONS	0	0	0	0	0	315	315	287	288	281	282	282	264	261	246	247	250	250	225	227
Sikeston	SO2	TONS	1,276	1,187	960	1,084	1,262	1,150	1,152	873	884	715	726	743	611	626	574	585	596	608	520	525
Wartsila:2011	SO2	TONS	0	0	0	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
	TOTAL SO2	**TONS**	1,939	1,738	1,393	1,569	1,930	2,025	2,035	1,397	1,413	1,189	1,205	1,232	1,053	1,071	992	1,008	1,026	1,041	899	907
NOx	SYSTEM EFFLUENT EXPENSE	$000	$0	$1,265	$1,090	$1,287	$1,710	$1,975	$2,162	$1,625	$1,732	$1,585	$1,749	$1,948	$1,817	$1,686	$1,427	$1,324	$1,231	$1,140	$896	$826
CO2	SYSTEM EFFLUENT EXPENSE	$000	$0	$0	$0	$0	$0	$0	$0	$18,297	$19,106	$16,560	$17,708	$19,026	$16,897	$18,509	$17,754	$19,021	$20,512	$21,927	$20,179	$22,110
SO2	SYSTEM EFFLUENT EXPENSE	$000	-$2,111	-$2,891	-$1,250	-$1,346	-$913	-$848	-$901	-$528	-$517	-$1,136	-$1,192	-$1,216	-$1,911	-$2,014	-$2,495	-$2,642	-$2,788	-$2,954	-$3,982	-$4,278
Hg	SYSTEM EFFLUENT EXPENSE	$000	$0	$0	$171	$200	$254	$338	$369	$288	$307	$286	$315	$349	$328	$362	$366	$404	$447	$493	$467	$513
	TOTAL GASSES	**$000**	-$2,111	-$1,625	$10	$141	$1,051	$1,465	$1,630	$19,683	$20,629	$17,295	$18,581	$20,107	$17,131	$18,544	$17,052	$18,107	$19,401	$20,605	$17,560	$19,169
	TOTAL VARIABLE COST	**$000**	$49,548	$50,752	$50,261	$53,939	$58,913	$44,609	$46,970	$78,444	$82,140	$85,983	$89,103	$93,424	$98,463	$102,244	$107,746	$111,929	$116,736	$121,096	$127,007	$131,973
	PeakLoad	(MW)	278.0	282.1	285.3	289.4	292.5	296.7	299.8	304.0	307.1	311.2	314.4	320.4	325.4	331.4	338.4	345.4	352.4	359.4	366.4	373.4
	Reserves	(MW)	38.9	39.5	39.9	40.5	41.0	41.5	42.0	42.6	43.0	43.6	44.0	44.9	45.6	46.4	47.4	48.4	49.3	50.3	51.3	52.3
	Peak Adjust for DSM Load Mgmt Capacity	(MW)	9.3	10.8	12.2	13.7	14.5	14.5	14.5	14.5	14.5	14.5	14.5	14.5	14.5	14.5	14.5	14.5	14.5	14.5	14.5	14.5
	TotalCapacityResponsibility	(MW)	307.6	310.8	313.0	316.2	319.0	323.7	327.3	332.0	335.6	340.3	343.9	350.7	356.4	363.3	371.2	379.2	387.2	395.2	403.2	411.1
(Wind 15% Firm)	TotalFirmResources	(MW)	318.1	323.1	348.1	316.3	319.0	356.9	357.4	332.0	335.6	340.3	343.9	350.7	356.4	363.2	371.2	379.2	387.2	395.2	403.1	411.1
	ReserveSurplus(Deficit)	(MW)	10.5	12.3	35.1	0.0	(0.0)	33.2	30.2	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)
	ReserveMargin	(%)	17.79%	18.36%	26.32%	14.02%	13.99%	25.20%	24.06%	14.00%	14.00%	14.00%	14.00%	14.00%	14.00%	14.00%	14.00%	14.00%	14.00%	14.00%	14.00%	14.00%
New Capacity Investment	CHP	$000	$0	$0	$0	$1,247	$1,247	$1,247	$1,247	$1,247	$1,247	$1,247	$1,247	$1,247	$1,247	$0	$0	$0	$0	$0	$0	$0
	Wart1 DebtService	$000	$0	$0	$0	$1,624	$1,624	$1,624	$1,624	$1,624	$1,624	$1,624	$1,624	$1,624	$1,624	$1,624	$1,624	$1,624	$1,624	$1,624	$1,624	$1,624
	Total Fixed Costs	($000)	$23,175	$24,393	$26,155	$27,872	$28,701	$30,930	$32,146	$32,105	$33,459	$34,565	$36,373	$38,356	$39,698	$41,853	$44,297	$46,759	$49,336	$52,038	$54,106	$57,100
	Total Variable Costs	($000)	$44,351	$46,274	$47,226	$48,285	$51,368	$33,471	$35,380	$68,264	$71,382	$76,584	$79,411	$83,265	$89,255	$92,728	$98,614	$102,554	$107,067	$111,118	$117,890	$122,536
	Total Fuel Costs	($000)	$5,197	$4,478	$3,035	$5,653	$7,546	$11,138	$11,589	$10,180	$10,758	$9,399	$9,693	$10,159	$9,208	$9,516	$9,133	$9,375	$9,669	$9,978	$9,117	$9,437
	Total Investment Costs	($000)	$0	$0	$0	$2,871	$2,871	$2,871	$2,871	$2,871	$2,871	$2,871	$2,871	$2,871	$2,871	$1,624	$1,624	$1,624	$1,624	$1,624	$1,624	$1,624
	Total Costs	($000)	$72,723	$75,146	$76,416	$84,681	$90,485	$78,409	$81,987	$113,419	$118,469	$123,418	$128,347	$134,651	$141,032	$145,721	$153,667	$160,311	$167,695	$174,758	$182,736	$190,697

20-Year NPV @ 5.5% ($000): $1,369,104

APPENDIX H

STUDY DATA DISK

For a copy of the Study Data Disk, please contact Columbia Water and Light