

VOLUME 4:
SUPPLY-SIDE RESOURCE
ANALYSIS
KANSAS CITY POWER & LIGHT
COMPANY (KCP&L)
INTEGRATED RESOURCE PLAN
4 CSR 240-22.040
CASE NO. EO-2012-0323
APRIL, 2012



TABLE OF CONTENTS

SECTION 1: SUPPLY-SIDE RESOURCE.....	1
1.1 NEW PLANT RESOURCE OPTIONS.....	2
1.1.1 TECHNOLOGY CATEGORIES.....	2
1.1.2 TECHNOLOGY DEVELOPMENT STATUS.....	2
1.2 LIFE EXTENSION & EMISSION CONTROL ENHANCEMENT OPTIONS	5
1.3 CAPACITY & ENERGY MARKET OPTIONS.....	5
1.4 PLANT EFFICIENCY IMPROVEMENTS	6
1.5 EXCLUDED TECHNOLOGIES.....	7
SECTION 2: SUPPLY-SIDE ANALYSIS	10
2.1 SUPPLY-SIDE RESOURCE COST RANKINGS.....	10
2.2 SUPPLY-SIDE RESOURCE PROBABLE ENVIRONMENTAL COSTS.....	20
2.2.1 AIR EMISSION IMPACTS	20
2.2.2 WATER EMISSION IMPACTS	23
2.2.3 WASTE MATERIAL IMPACTS.....	25
2.3 PRELIMINARY SUPPLY-SIDE CANDIDATE RESOURCE OPTIONS	26
2.3.1 POTENTIAL SUPPLY-SIDE RESOURCE OPTION TABLE	27
2.3.2 ELIMINATION OF POTENTIAL SUPPLY-SIDE RESOURCE OPTIONS.....	31
SECTION 3: INTERCONNECTION AND TRANSMISSION REQUIREMENTS.....	36
3.1 INTERCONNECTION AND TRANSMISSION CONSTRAINTS ANALYSIS.....	36
3.2 NEW SUPPLY-SIDE RESOURCES OUTPUT LIMITATIONS.....	38
SECTION 4: SUPPLY-SIDE CANDIDATE RESOURCE OPTIONS	39
4.1 IDENTIFICATION PROCESS FOR POTENTIAL SUPPLY-SIDE RESOURCE OPTIONS	40
4.1.1 NEW PLANT RESOURCE OPTIONS	40
4.1.2 BIOMASS & CONVERSION OPTION	42
4.1.3 ENVIRONMENTAL RETROFIT & LIFE EXTENSION OPTIONS.....	43
4.2 ELIMINATION OF PRELIMINARY SUPPLY-SIDE RESOURCES DUE TO INTERCONNECTION OR TRANSMISSION	56
4.3 INTERCONNECTION COST FOR SUPPLY-SIDE RESOURCE OPTIONS	56
SECTION 5: SUPPLY-SIDE UNCERTAIN FACTORS	58
5.1 FUEL FORECASTS.....	58
5.1.1 COAL FORECAST	58

5.1.2	NATURAL GAS FORECAST.....	59
5.1.3	FUEL OIL FORECAST	59
5.1.4	URANIUM FORECAST	60
5.2	NEW FACILITY CAPITAL COSTS, EXISTING FACILITIES CAPITAL EXPENDITURES	63
5.2.1	TECHNOLOGIES WITH 'HIGH' CAPITAL COST ABOVE 115%.....	63
5.2.2	TECHNOLOGIES WITH 'LOW' CAPITAL COSTS BELOW 90%.....	64
5.3	NEW FACILITY AND EXISTING FACILITY FIXED AND VARIABLE O&M.....	65
5.4	EMISSION ALLOWANCE FORECASTS	67
5.5	LEASED OR RENTED FACILITIES FIXED CHARGES.....	70
5.6	INTERCONNECTION OR TRANSMISSION COSTS FOR SUPPLY-SIDE CANDIDATES	70

TABLE OF TABLES

Table 1: Generating Technology Categories.....	3
Table 2: Technology Development Status **Highly Confidential**	4
Table 3: Summary of RFP Responses **Highly Confidential**	6
Table 4: Technologies Excluded From Pre-Screening	8
Table 5: Technology Net Capacities **Highly Confidential**	13
Table 6: Technology Capacity Factors **Highly Confidential**	14
Table 7: Technology Capital Costs (\$/kW) **Highly Confidential**	15
Table 8: Technology Fixed O&M Costs (\$/kW/Yr) **Highly Confidential**	16
Table 9: Technology Variable O&M Costs (\$/MWh) **Highly Confidential**	17
Table 10: Technology Primary Fuels **Highly Confidential**	18
Table 11: Technology Emission Rates **Highly Confidential**	19
Table 12: Probable Environmental Cost ** Highly Confidential **	28
Table 13: Technology Ranking by Nominal Utility Cost **Highly Confidential** ..	29
Table 14: Technology Ranking by Nominal Probable Environmental Cost **Highly Confidential**	30
Table 15: Candidate Resource Options	40
Table 16: Montrose Station Biomass Assumptions **Highly Confidential**	42
Table 17: AQC Capital Costs Montrose Unit 1 **Highly Confidential**	44
Table 18: AQC Capital Costs Montrose Unit 2 **Highly Confidential**	44
Table 19: AQC Capital Costs Montrose Unit 3 **Highly Confidential**	45
Table 20: AQC O&M Impacts Montrose Unit 1 **Highly Confidential**	45
Table 21: AQC O&M Impacts Montrose Unit 2 **Highly Confidential**	46
Table 22: AQC O&M Impacts Montrose Unit 3 **Highly Confidential**	47
Table 23: Montrose Unit 1 LAMP Capital Plan Years 2017 - 2031 (\$000's) ** Highly Confidential **	49
Table 24: Montrose Unit 2 LAMP Capital Plan Years 2017 - 2031 (\$000's) ** Highly Confidential **	50
Table 25: Montrose Unit 3 LAMP Capital Plan Years 2017 - 2031 (\$000's) ** Highly Confidential **	51
Table 26: Hawthorne 5 LAMP Capital Plan Years 2017 - 2024 (\$000's) ** Highly Confidential **	52
Table 27: Hawthorne Unit 5 LAMP Capital Plan Years 2025 - 2031 (\$000's) ** Highly Confidential **	53
Table 28: KCP&L SHARE LaCygne Station LAMP Capital Plan Years 2017 - 2031 (\$000's) ** Highly Confidential **	54
Table 29: KCP&L SHARE Iatan Station LAMP Capital Plan Years 2017 - 2031 (\$000's) ** Highly Confidential **	55

Table 30: Transmission Interconnection Projection **Highly Confidential**	57
Table 31: Fuel Price Forecasts – Coal, Natural Gas, Fuel Oil **Highly Confidential **	61
Table 32: Fuel Price Forecast – Nuclear ** Highly Confidential **	62
Table 33: Source Forecasts for Coal, Natural Gas, and Fuel Oil	62
Table 34: Technology Capital Cost Ranges	64
Table 35: Capital Cost Estimates Utilized in Integrated Resource Analysis **Highly Confidential**	64
Table 36: Fixed O&M Estimates Utilized In Integrated Resource Analysis ** Highly Confidential **	65
Table 37: Variable O&M Estimates Utilized in Integrated Resource Analysis ** Highly Confidential **	65
Table 38: SO ₂ Price Forecast ** Highly Confidential **	67
Table 39: NO _x Annual Price Forecast ** Highly Confidential **	68
Table 40: NO _x Seasonal Price Forecast ** Highly Confidential **	68
Table 41: CO ₂ Price Forecast ** Highly Confidential **	69
Table 42: Source Forecasts for Emission Allowances.....	69

TABLE OF APPENDICES

Appendix 4A: Segra Study – Montrose Environmental Retrofits

Appendix 4B: Air Quality Control Equipment Costs – Montrose Units 1-3

Appendix 4C: Request For Proposal – Acquisition of Power Supply Capacity and Related Energy - August 3, 2011

Appendix 4D: Fuel Forecasting Methodology

Appendix 4E: Environmental Laws & Regulations

Appendix 4F: Technology Data for Integrated Resource Analysis

INDEX OF RULES COMPLIANCE

22.040 Supply-Side Resource Analysis

(1).....	1
(2).....	10
(2) (A).....	10
(2) (B).....	20
(2) (B) 4.....	27
(2) (C) 1.....	27
(2) (C) 2.....	31
(3).....	36
(3) (A).....	36
(3) (B).....	38
(4).....	40
(4) (A).....	40
(4) (B).....	56
(4) (C).....	56
(5).....	58
(5) (A).....	58
(5) (B).....	63
(5) (C).....	65
(5) (D).....	67
(5) (E).....	70
(5) (F).....	70

VOLUME 4: SUPPLY-SIDE RESOURCE ANALYSIS

PURPOSE: This rule establishes minimum standards for the scope and level of detail required in supply-side resource analysis.

SECTION 1: SUPPLY-SIDE RESOURCE

(1) The utility shall evaluate all existing supply-side resources and identify a variety of potential supply-side resource options which the utility can reasonably expect to use, develop, implement, or acquire, and, for purposes of integrated resource planning, all such supply-side resources shall be considered as potential supply-side resource options. These potential supply-side resource options include full or partial ownership of new plants using existing generation technologies; full or partial ownership of new plants using new generation technologies, including technologies expected to become commercially available within the twenty (20)-year planning horizon; renewable energy resources on the utility-side of the meter, including a wide variety of renewable generation technologies; technologies for distributed generation; life extension and refurbishment at existing generating plants; enhancement of the emission controls at existing or new generating plants; purchased power from bi-lateral transactions and from organized capacity and energy markets; generating plant efficiency improvements which reduce the utility's own use of energy; and upgrading of the transmission and distribution systems to reduce power and energy losses. The utility shall collect generic cost and performance information sufficient to fairly analyze and compare each of these potential supply-side resource options, including at least those attributes needed to assess capital cost, fixed and variable operation and maintenance costs, probable environmental costs, and operating characteristics.

22.040 (1)

1.1 NEW PLANT RESOURCE OPTIONS

1.1.1 TECHNOLOGY CATEGORIES

The evaluation of potential supply-side resource options began with the identification of forty-one existing or new technology alternatives. The information for these potential supply-side technologies was gathered primarily from the December 2010 Electric Power Research Institute Technical Assessment Guide (EPRI-TAG)®. The supply-side technologies were broken down into the following categories:

- Base load technologies
- Intermediate load technologies
- Peaking load technologies
- Renewable technologies

1.1.2 TECHNOLOGY DEVELOPMENT STATUS

For each technology, the development status was also considered and identified as either mature, commercial, demonstration, pilot, or developmental. Following is a brief description of these different technology stages:

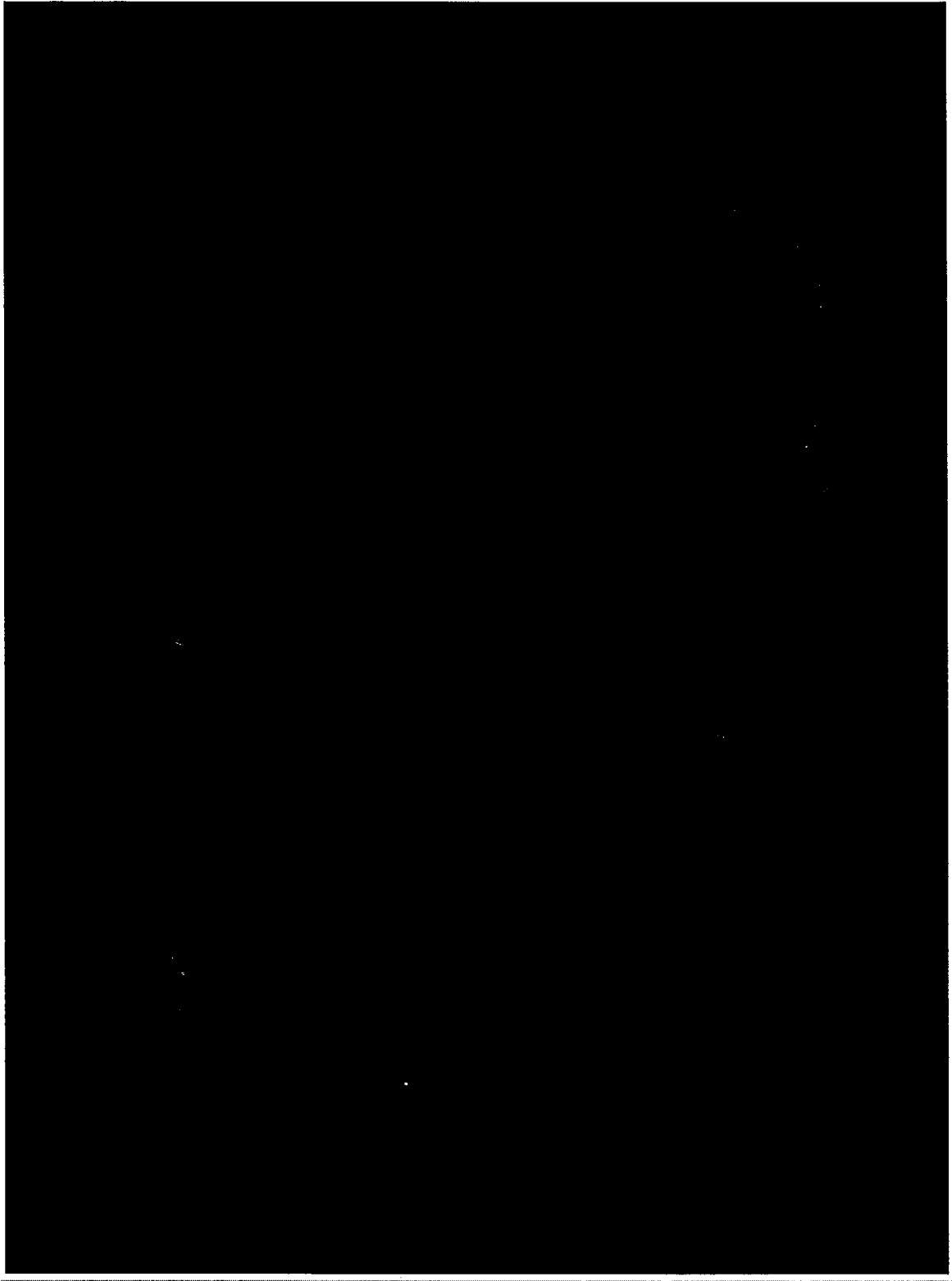
- Mature technologies are proven and well established in the electric power generation industry.
- Commercial technologies are in operation, but efforts to optimize the heat rate and reduce the O&M costs are still on-going.
- Demonstration technologies have designs that are quite advanced, but very few plants exist with actual operating experience.
- Developmental technologies are still emerging.

These technologies and their current development status are shown below in Table 1 and Table 2.

Table 1: Generating Technology Categories

BASE LOAD		
Pulverized Coal & FBC	Integrated Gasification Combined Cycle	Nuclear
SCPC PRB WFGD	IGCC PRB	Nuclear - U.S. EPR
SCPC PRB w/CO2 Capture	IGCC PRB CO2 Capture	Nuclear - G.E. ABWR
SCPC III #6 WFGD		Nuclear - Westinghouse AP1000
SCPC III #6 w/CO2 Capture		
FBC PRB		
FBC PRB w/CO2 Capture		
INTERMEDIATE LOAD		
Combined Cycle	Fuel Cells	Energy Storage
CC w/ GE 7FA.03	Fuel Cell - Molten Carbonate	Compressed Air Energy Storage System
CC w/ GE 7FA.05	Fuel Cell - Solid Oxide	NaS Batteries
	Fuel Cell - PEM	ZnBr Batteries
		Lead-Acid Batteries
		Li-ion Batteries
		Vanadium Redox Batteries
		Flywheel Energy Storage
		Zn Air Batteries
		Fe/Cr Batteries
PEAKING LOAD		
Combustion Turbines	Small Scale Alternatives	
CT LM6000	Internal Combustion Engine - Oil	
CT LMS100	Internal Combustion Engine - Natural Gas/Spark	
CT GE 7EA	Small Scale CT - Natural Gas	
CT GE 7FA.03	Small Scale CT - Oil	
CT GE 7FA.05		
RENEWABLES		
Solar	Wind, Biomass	Waste to Energy
Solar Thermal - Parabolic Trough	Wind	Landfill Gas
Solar Thermal - Power Tower	Biomass BFB Boiler	
Solar Central PV Thin-Film		
Solar PV Residential		

Table 2: Technology Development Status **Highly Confidential**



1.2 LIFE EXTENSION & EMISSION CONTROL ENHANCEMENT OPTIONS

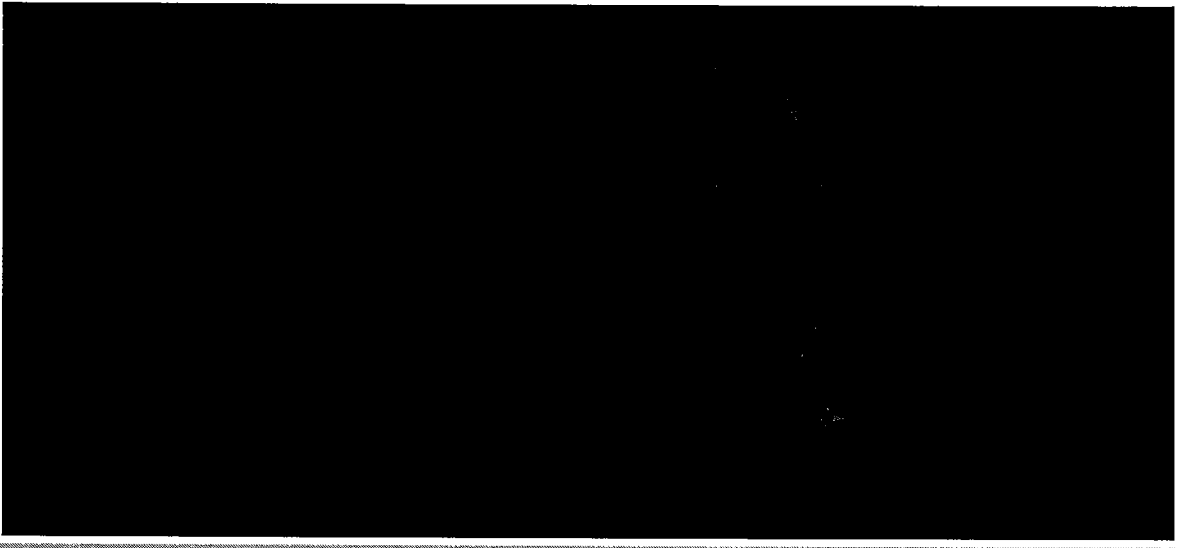
In addition to the potential new supply-side resource options identified above, KCP&L evaluated the life extension and refurbishment of existing generating units, along with the enhancement of the existing emission controls. To evaluate the life extension, an internal review of the long-term plant equipment needs was developed by using the Life Assessment and Management Program (LAMP). To evaluate the potential enhancement of emission controls, the services of the local engineering firm Segra were retained to perform a multi-pollutant emissions control study for the coal-fired units including Montrose Units 1, 2, and 3. The original Segra study for the Montrose Units was completed in November, 2010, and can be found in Appendix 4A. An update to some of the Air Quality Control (AQC) projects for Montrose Units 1, 2, and 3 was provided by Segra in February, 2012, and those updated AQC cost tables can be found in Appendix 4B. The options of retrofitting Montrose Units 1, 2, and 3 were passed on to the integrated resource analysis, with both the LAMP costs and external Segra AQC costs included in the analysis. Detailed discussion of the LAMP process and the Segra Environmental Retrofit Studies can be found in Section 4.1.3.

1.3 CAPACITY & ENERGY MARKET OPTIONS

To identify short-term and long-term market alternatives for the acquisition of capacity and related energy from existing or proposed supply-side facilities, KCP&L considered responses to the Request for Proposal (RFP) issued on August 3, 2011. A copy of the RFP has been provided in Appendix 4C. The responses to the RFP included 5-year, 10-year and 20-year purchased power contracts from existing or proposed generating stations, along with turnkey projects and potential ownership of an existing power plant. The proposal terms and conditions, along with any potential transmission issues, were considered and the Dogwood Energy, LLC, partial ownership alternative was passed on to the integrated resource analysis. See Table 3 below for a listing of the counterparties that responded to the RFP, along with the agreement type (PPA

or ownership), the timing (ownership) or duration (PPA), and the capacity amount offered. A summary of the RFP bids and the cost analysis has been provided in the workpapers.

Table 3: Summary of RFP Responses **Highly Confidential**



1.4 PLANT EFFICIENCY IMPROVEMENTS

As part of an overall CO₂ reduction strategy, KCP&L has completed or is currently executing several capital projects that were recommended as part of a Black & Veatch Plant Efficiency Improvement Assessment. This assessment was done by Black & Veatch back in 2008, and indicated eighteen additional capital projects that should be undertaken to improve the fleet plant efficiency.

Following are the projects that have been completed to date:

- Improved monitoring software has been rolled out for Hawthorn Unit 5, Hawthorn Unit 6&9, Iatan Units 1 & 2, LaCygne Units 1 &2, and Montrose Units 1, 2, and 3.
- Yearly Cycle Isolation and Valve Improvement projects have been rolled out at each major coal unit.

HC

- Performance Engineer positions were created and staffed at each major coal unit.

KCP&L is in the next phase of the recommended Plant Efficiency Improvements, which is primarily the introduction of Combustion and Sootblowing Optimization on the major coal units. Currently, Combustion and Sootblowing Optimization projects are being completed at Hawthorn Unit 5 and LaCygne Units 1 & 2. Combustion Optimization only is being done on latan Unit 1.

1.5 EXCLUDED TECHNOLOGIES

During the process of identifying potential supply-side alternatives, there were also certain resource alternatives excluded from the pre-screening exercise on the basis of not being viable candidate resource options. The reasons these resource alternatives could not be reasonably developed or implemented by KCP&L include lack of technology maturity, lack of suitability for this geographic region, and environmental concerns. The resources that were not considered in the pre-screening exercise and the reason for their exclusion is listed in Table 4 below:

