VOLUME 4:

SUPPLY-SIDE RESOURCE ANALYSIS

KCP&L GREATER MISSOURI OPERATIONS COMPANY (GMO)

INTEGRATED RESOURCE PLAN

CASE NO. EE-2009-0237

4 CSR 240-22.040

** PUBLIC **

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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 ANALYSIS

(1) The analysis of supply-side resources shall begin with the identification of a variety of potential supply-side resource options which the utility can reasonably expect to develop and implement solely through its own resources or for which it will be a major participant. These options include new plants using existing generation technologies; new plants using new generation technologies; life extension and refurbishment at existing generating plants; enhancement of the emission controls at existing or new generating plants; purchased power from utility sources, cogenerators or independent power producers; 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 for each of these potential resource options which shall include at least the following attributes where applicable:

Evaluation of potential resource alternatives began with the identification of forty-nine technologies as possible supply-side additions using existing or new generation technologies. The information for these potential supply-side technologies was gathered from multiple sources, including the EPRI Technical Assessment Guide (TAG)®, EPRI Renewable Energy TAG (TAG-RE)®, bids received in response to recent Request For Proposals (RFP), data provided by consultants, externally published reports, and in-house expertise. In addition to considering new supply-side additions, other resource options considered: A RFP response which offered either 100% ownership or a partial undivided interest in an existing combined cycle facility. Also considered was an option to convert Sibley Units 1 and 2 to 10% biomass usage. The supply-side technologies were broken down into the following categories:

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

These technologies are shown in Table 1 below:

Table 1: Generating Technology Categories

	Base Load	
Pulverized Coal & FBC	**Integrated Gasification Combined Cycle**	**Nuclear**
SCPC IL. No. 6	IGCC CoP Egas	U.S. EPR
SCPC CO_2 Capture ILL No. 6	IGCC CoP Egas CO_2 Capture	G.E. ABWR
SCPC PRB		G.E. ESBWR
USCPC PRB		Westinghouse AP1000
USCPC CO_2 Capture PRB		ACR-1000
Fluidized Bed Combustion (FBC) PRB		
Fluidized Bed Comb (FBC) IL No. 6		
	Intermediate Load	
Combined Cycle	**Energy Storage and Fuel Cells**	
CT/CC	Compressed Air Energy Storage	
CT/CC w/90% CO_2	Fuel Cell - Molten Carbonate	
	Fuel Cell - Solid Oxide	
	Fuel Cell - PEM	
	NaS Batteries	
	Peaking Load	
Combustion Turbines	**Small Scale Alternatives**	
CT Heavy Duty	Internal Combustion Engine - Oil	
CT Conventional	Internal Combustion Engine - Natural Gas/Spark	
CT Siemens 501D5A	Wartsila Reciprocating Engines	
CT GE 7EA	Small Scale CT - Natural Gas	
CT LMS100	Small Scale CT - Oil	
CT LM6000		
	Renewables	
Solar	**Wind, Biomass & Hydro**	**Waste to Energy**
Solar Thermal - Parabolic Trough	Wind	Landfill Gas
Solar Thermal - Dish/Stirling Engine	Biomass Stoker Boiler	Digester - Dairy
Solar Thermal - Tower	Biomass CFB Boiler	Poultry Litter
Central Solar PV Flat Plate Thin Film		Cattle Feedlot
Central Solar PV Tracking (Single Axis)		MSW - Gasification
Central Solar PV Tracking (Two Axis)		MSW - Plasma Arc
Solar PV Residential - Utility Owned		MSW - Incinerator

In addition to identification of potential new and existing generation technologies, other supply-side resources options were studied. Life extension and refurbishment at existing generation plants information is provided in Section 4:, efficiency improvements at existing generation plants are included in Section 4:, emission controls at existing generation plants have been developed and provided in Section 8.2.1, purchase power options have been explored and results provided in Section 5:, and distribution upgrade studies are provided in Section 7:.

It should be noted that in identifying potential supply-side alternatives, there were also certain resource alternatives excluded from the pre-screening exercise as candidate resource options. These resource alternatives were eliminated due to their lack of suitability for this geographic region, lack of technological maturity, or other disadvantages. The resources that were not considered in the pre-screening exercise and the exclusion reason(s) are listed in below:

Table 2: Technology Excluded From Pre-Screening

Technology	Reason(s) for Exclusion
Central Station Geothermal	Region lacks adequate geologic resources
Pumped Storage	Region lacks adequate geographic features High developmental costs
Hydrokinetic (Run of River)	Experimental/Unproven technology Environmental concerns
Small Modular Nuclear Power Reactors	Experimental Nature (on-going research funded by U.S. Congress)

Progress in the 'experimental' hydrokinetic (run of river) and small modular nuclear power technologies will be tracked going forward, and they will be considered as potential future supply-side technology options if they advance beyond the experimental stage. The hydrokinetic technology is designed to channel and convert small waves from the river into electricity by the rotation of a turbine from the river flow. Potential issues beyond the economic feasibility include rivers being full of debris and sentiment, turbine depths of at least nine feet to avoid collisions with boats, and environmental concerns as it pertains to wildlife that have to be addressed.

A discussion regarding the portion of the rule that refers to upgrading the transmission system is attached as Appendix 4G

(A) Fuel type and feasible variations in fuel type or quality;

Fuel types considered in the IRP analysis included traditional fossil fuels, uranium, and energy sources for renewable technologies. The traditional fossil fuels considered included PRB Coal, Illinois No.6 Coal, Natural Gas, and No.2 Fuel Oil. These fossil fuel price forecasts, along with the uranium forecast, were "locked-down" early in the IRP process in order to allow sufficient time for model building and testing prior to the Integrated Analysis. It should be noted that sensitivity of the resource plans to high and low fuel prices was then tested as part of the Integrated Analysis to see what effect, if any, that uncertainty would have on the preferred resource plan. The key uncertain factors impacting resource planning are discussed in further detail in Volume 6, Integrated Analysis. The primary energy sources for the renewable technologies included wind, solar, water, wood, landfill gas, animal waste and municipal solid waste (MSW). The ability of a technology to utilize different fuels, its fuel flexibility, is also addressed for each of the supply-side technology options. The assumed fuel type and the feasible variations in fuel type for each technology are shown in Table 3 below:

Table 3: Fuel Type and Feasibility Variations ** Highly Confidential **

Technology	Primary Fuel	Fuel Flexibility
Pulverized Coal & FBC	[redacted]	[redacted]
SCPC IL. No. 6	[redacted]	[redacted]
SCPC CO_2 Capture IL No. 6	[redacted]	[redacted]
SCPC PRB	[redacted]	[redacted]
USCPC	[redacted]	[redacted]
USCPC CO_2 Capture	[redacted]	[redacted]
Fluidized Bed Combustion (FBC)	[redacted]	[redacted]
Integrated Gasification Combined Cycle	[redacted]	[redacted]
IGCC CoP Egas	[redacted]	[redacted]
IGCC CoP Egas CO_2 Capture	[redacted]	[redacted]
Nuclear	[redacted]	[redacted]
Nuclear - U.S. EPR	[redacted]	[redacted]
Nuclear - G.E. ABWR	[redacted]	[redacted]
Nuclear - G.E. ESBWR	[redacted]	[redacted]
Nuclear - Westinghouse AP1000	[redacted]	[redacted]
Nuclear - ACR-1000	[redacted]	[redacted]
Combined Cycle	[redacted]	[redacted]
CT/CC	[redacted]	[redacted]
CT/CC w/90% CO_2	[redacted]	[redacted]
Energy Storage and Fuel Cells	[redacted]	[redacted]
Compressed Air Energy Storage System	[redacted]	[redacted]
Fuel Cell - Molten Carbonate	[redacted]	[redacted]
Fuel Cell - Solid Oxide	[redacted]	[redacted]
Fuel Cell - PEM	[redacted]	[redacted]
NaS Batteries	[redacted]	[redacted]
Combustion Turbines	[redacted]	[redacted]
CT Heavy Duty	[redacted]	[redacted]
CT Conventional	[redacted]	[redacted]
CT Siemens 501D5A	[redacted]	[redacted]
CT GE 7EA	[redacted]	[redacted]
CT LMS100	[redacted]	[redacted]
CT LMS6000	[redacted]	[redacted]
Small Scale Alternatives	[redacted]	[redacted]
Internal Combustion Engine - Oil	[redacted]	[redacted]
Internal Combustion Engine - Natural Gas/Spark	[redacted]	[redacted]
Wartsila Reciprocating Engines	[redacted]	[redacted]
Small Scale CT - Natural Gas	[redacted]	[redacted]
Small Scale CT - Oil	[redacted]	[redacted]
Solar	[redacted]	[redacted]
Solar Thermal - Parabolic Trough	[redacted]	[redacted]
Solar Thermal - Dish/Stirling Engine	[redacted]	[redacted]
Solar Thermal - Tower	[redacted]	[redacted]
Central Solar PV Flat Plate Thin Film	[redacted]	[redacted]
Central Solar PV Tracking (Single Axis)	[redacted]	[redacted]
Central Solar PV Tracking (Two Axis)	[redacted]	[redacted]
Solar PV Residential - Utility Owned	[redacted]	[redacted]
Wind, Biomass & Hydro	[redacted]	[redacted]
Wind	[redacted]	[redacted]
Biomass Stoker Boiler	[redacted]	[redacted]
Biomass CFB Boiler	[redacted]	[redacted]
Waste to Energy	[redacted]	[redacted]
Landfill Gas	[redacted]	[redacted]
Digester - Dairy	[redacted]	[redacted]
Poultry Litter	[redacted]	[redacted]
Cattle Feedlot	[redacted]	[redacted]
Municipal Solid Waste - Gasification	[redacted]	[redacted]
Municipal Solid Waste - Plasma Arc	[redacted]	[redacted]
Municipal Solid Waste - Incinerator	[redacted]	[redacted]

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1.1 PRACTICAL SIZE RANGE

(B) Practical size range;

Table 4 below provides the total capacity of the generation source rather than a participation level. For baseload coal technologies, sizes were considered that ranged from 500 MW to 750 MW. For the nuclear technologies that are built to capture economies of scale, the sizes considered ranged from 1085 MW to 1600 MW. For the intermediate and peaking technologies, a variety of alternatives are included to develop a representative range of available capacity options and sizes. It should be noted that for the generating resources typically built with high capacities for economies of scale (for example, coal and nuclear), it was assumed that GMO would not be the lead developer but would participate in ownership in these units in blocks of 150 MWs. This participation level was based upon the current ownership in the baseload Iatan-2 unit at 153 MWs. Utilizing a partial ownership assumption avoids eliminating a technology as an alternative for future expansion solely due to its large size in relation to GMO capacity needs.

Table 4: Size Ranges ** Highly Confidential **

Technology	Net Output (MW)
Pulverized Coal & FBC	
SCPC IL. No. 6	[redacted]
SCPC CO_2 Capture IL No. 6	[redacted]
SCPC PRB	[redacted]
USCPC	[redacted]
USCPC CO_2 Capture	[redacted]
Fluidized Bed Combustion (FBC)	[redacted]
Integrated Gasification Combined Cycle	[redacted]
IGCC CoP Egas	[redacted]
IGCC CoP Egas CO_2 Capture	[redacted]
Nuclear	[redacted]
Nuclear - U.S. EPR	[redacted]
Nuclear - G.E. ABWR	[redacted]
Nuclear - G.E. ESBWR	[redacted]
Nuclear - Westinghouse AP1000	[redacted]
Nuclear - ACR-1000	[redacted]
Combined Cycle	[redacted]
CT/CC	[redacted]
CT/CC w/90% CO_2	[redacted]
Energy Storage and Fuel Cells	[redacted]
Compressed Air Energy Storage System	[redacted]
Fuel Cell - Molten Carbonate	[redacted]
Fuel Cell - Solid Oxide	[redacted]
Fuel Cell - PEM	[redacted]
NaS Batteries	[redacted]
Combustion Turbines	[redacted]
CT Heavy Duty	[redacted]
CT Conventional	[redacted]
CT Siemens 501D5A	[redacted]
CT GE 7EA	[redacted]
CT LMS100	[redacted]
CT LMS6000	[redacted]
Small Scale Alternatives	[redacted]
Internal Combustion Engine - Oil	[redacted]
Internal Combustion Engine - Natural Gas/Spark	[redacted]
Wartsila Reciprocating Engines	[redacted]
Small Scale CT - Natural Gas	[redacted]
Small Scale CT - Oil	[redacted]
Solar	[redacted]
Solar Thermal - Parabolic Trough	[redacted]
Solar Thermal - Dish/Stirling Engine	[redacted]
Solar Thermal - Tower	[redacted]
Central Solar PV Flat Plate Thin Film	[redacted]
Central Solar PV Tracking (Single Axis)	[redacted]
Central Solar PV Tracking (Two Axis)	[redacted]
Solar PV Residential - Utility Owned	[redacted]
Wind, Biomass & Hydro	[redacted]
Wind	[redacted]
Biomass Stoker Boiler	[redacted]
Biomass CFB Boiler	[redacted]
Waste to Energy	[redacted]
Landfill Gas	[redacted]
Digester - Dairy	[redacted]
Poultry Litter	[redacted]
Cattle Feedlot	[redacted]
Municipal Solid Waste - Gasification	[redacted]
Municipal Solid Waste - Plasma Arc	[redacted]
Municipal Solid Waste - Incinerator	[redacted]

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1.2 MATURITY OF THE TECHNOLOGY

(C) Maturity of the technology;

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

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

The maturity of each generation technology is shown in Table 5 below:

Table 5: Technology Maturity ** Highly Confidential **

Technology	Maturity
Pulverized Coal & FBC	
SCPC IL. No. 6	[redacted]
SCPC CO_2 Capture IL No. 6	[redacted]
SCPC PRB	[redacted]
USCPC	[redacted]
USCPC CO_2 Capture	[redacted]
Fluidized Bed Combustion (FBC)	[redacted]
Integrated Gasification Combined Cycle	[redacted]
IGCC CoP Egas	[redacted]
IGCC CoP Egas CO_2 Capture	[redacted]
Nuclear	[redacted]
Nuclear - U.S. EPR	[redacted]
Nuclear - G.E. ABWR	[redacted]
Nuclear - G.E. ESBWR	[redacted]
Nuclear - Westinghouse AP1000	[redacted]
Nuclear - ACR-1000	[redacted]
Combined Cycle	[redacted]
CT/CC	[redacted]
CT/CC w/90% CO_2	[redacted]
Energy Storage and Fuel Cells	[redacted]
Compressed Air Energy Storage System	[redacted]
Fuel Cell - Molten Carbonate	[redacted]
Fuel Cell - Solid Oxide	[redacted]
Fuel Cell - PEM	[redacted]
NaS Batteries	[redacted]
Combustion Turbines	[redacted]
CT Heavy Duty	[redacted]
CT Conventional	[redacted]
CT Siemens 501D5A	[redacted]
CT GE 7EA	[redacted]
CT LMS100	[redacted]
CT LMS6000	[redacted]
Small Scale Alternatives	[redacted]
Internal Combustion Engine - Oil	[redacted]
Internal Combustion Engine - Natural Gas/Spark	[redacted]
Wartsila Reciprocating Engines	[redacted]
Small Scale CT - Natural Gas	[redacted]
Small Scale CT - Oil	[redacted]
Solar	[redacted]
Solar Thermal - Parabolic Trough	[redacted]
Solar Thermal - Dish/Stirling Engine	[redacted]
Solar Thermal - Tower	[redacted]
Central Solar PV Flat Plate Thin Film	[redacted]
Central Solar PV Tracking (Single Axis)	[redacted]
Central Solar PV Tracking (Two Axis)	[redacted]
Solar PV Residential - Utility Owned	[redacted]
Wind, Biomass & Hydro	[redacted]
Wind	[redacted]
Biomass Stoker Boiler	[redacted]
Biomass CFB Boiler	[redacted]
Waste to Energy	[redacted]
Landfill Gas	[redacted]
Digester - Dairy	[redacted]
Poultry Litter	[redacted]
Cattle Feedlot	[redacted]
Municipal Solid Waste - Gasification	[redacted]
Municipal Solid Waste - Plasma Arc	[redacted]
Municipal Solid Waste - Incinerator	[redacted]

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1.3 LEAD TIME, DESIGN, CONSTRUCTION, TESTING AND STARTUP

(D) Lead time for permitting, design, construction, testing and startup;

Lead times for the technologies were generally based on EPRI TAG® and EPRI TAG-RE® data. For technologies where GMO had a lead time provided from a self-build estimate, a recent offer(s) from a RFP, or a recently published report or consultant-provided estimate, these sources were utilized in place of the generic EPRI TAG® and EPRI TAG-RE® data. Note that permitting and design time estimates are independent of construction timing. The lead times for each supply-side technology are shown in Table 6 below:

Table 6: Lead Times ** Highly Confidential **

Technology	Permitting and Design (months)	Construction Thru Operation (months)
Pulverized Coal & FBC	[redacted]	[redacted]
SCPC WFGD IL. No. 6 or Pitt. Bit.	[redacted]	[redacted]
SCPC WFGD CO_2 Capture IL No. 6	[redacted]	[redacted]
SCPC WFGD PRB	[redacted]	[redacted]
USCPC	[redacted]	[redacted]
USCPC CO_2 Capture	[redacted]	[redacted]
Fluidized Bed Combustion (FBC)	[redacted]	[redacted]
Integrated Gasification Combined Cycle	[redacted]	[redacted]
IGCC CoP Egas	[redacted]	[redacted]
IGCC CoP Egas CO_2 Capture	[redacted]	[redacted]
Nuclear	[redacted]	[redacted]
Nuclear - U.S. EPR	[redacted]	[redacted]
Nuclear - G.E. ABWR	[redacted]	[redacted]
Nuclear - G.E. ESBWR	[redacted]	[redacted]
Nuclear - Westinghouse AP1000	[redacted]	[redacted]
Nuclear - ACR-1000	[redacted]	[redacted]
Combined Cycle	[redacted]	[redacted]
CT/CC	[redacted]	[redacted]
CT/CC w/90% CO_2	[redacted]	[redacted]
Energy Storage and Fuel Cells	[redacted]	[redacted]
Compressed Air Energy Storage System	[redacted]	[redacted]
Fuel Cell - Molten Carbonate	[redacted]	[redacted]
Fuel Cell - Solid Oxide	[redacted]	[redacted]
Fuel Cell - PEM	[redacted]	[redacted]
NaS Batteries	[redacted]	[redacted]
Combustion Turbines	[redacted]	[redacted]
CT Heavy Duty	[redacted]	[redacted]
CT Conventional	[redacted]	[redacted]
CT Siemens 501D5A	[redacted]	[redacted]
CT GE 7EA	[redacted]	[redacted]
CT LMS 100	[redacted]	[redacted]
CT LMS 6000	[redacted]	[redacted]
Small Scale Alternatives	[redacted]	[redacted]
Internal Combustion Engine - Oil	[redacted]	[redacted]
Internal Combustion Engine - Natural Gas/Spark	[redacted]	[redacted]
Wartsila Reciprocating Engines	[redacted]	[redacted]
Small Scale CT - Natural Gas	[redacted]	[redacted]
Small Scale CT - Oil	[redacted]	[redacted]
Solar	[redacted]	[redacted]
Solar Thermal - Parabolic Trough	[redacted]	[redacted]
Solar Thermal - Dish/Stirling Engine	[redacted]	[redacted]
Solar Thermal - Tower	[redacted]	[redacted]
Central Solar PV Flat Plate Thin Film	[redacted]	[redacted]
Central Solar PV Tracking (Single Axis)	[redacted]	[redacted]
Central Solar PV Tracking (Two Axis)	[redacted]	[redacted]
Solar PV Residential - Utility Owned	[redacted]	[redacted]
Wind, Biomass & Hydro	[redacted]	[redacted]
Wind	[redacted]	[redacted]
Biomass Stoker Boiler	[redacted]	[redacted]
Biomass CFB Boiler	[redacted]	[redacted]
Waste to Energy	[redacted]	[redacted]
Landfill Gas	[redacted]	[redacted]
Digester - Dairy	[redacted]	[redacted]
Poultry Litter	[redacted]	[redacted]
Cattle Feedlot	[redacted]	[redacted]
Municipal Solid Waste - Gasification	[redacted]	[redacted]
Municipal Solid Waste - Plasma Arc	[redacted]	[redacted]
Municipal Solid Waste - Incinerator	[redacted]	[redacted]

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1.4 CAPITAL COST PER KILOWATT

(E) Capital cost per kilowatt;

Capital cost estimates on a dollar per kilowatt basis were collected for all technologies considered as potential supply-side additions. In general, capital costs were gathered from EPRI TAG® or EPRI TAG-RE® for renewable technologies. Capital cost estimates included components for engineering, procurement, and construction (EPC) costs, owner costs, and interest during construction (AFUDC). For technologies where GMO had received a self-build estimate, a recent offer(s) from a RFP, or a recently published report or consultant-provided estimate, these sources were utilized in place of the generic EPRI TAG® and EPRI TAG-RE® data. Instances where sources other than EPRI were utilized include the following technologies:

- The super-critical pulverized coal technology capital cost was based on the most recent Iatan-2 capital cost projection. It is assumed that this on-going construction project provides a better regional cost estimate than the generic EPRI TAG® SCPC technology capital cost estimate.

- Capital cost guidance CO_2 capture was from the November 13, 2008, Congressional Research Service (CRS) Report for Congress. The advantage of the CRS report is that, to the extent possible, the estimates for the costs were taken from actual on-going or planned power projects where the utilities had detailed project cost estimates filed with state public service commissions. Other public sources, including press releases and trade journal articles, were used in the CRS report when commission filings for a project were not available. The CRS report has been attached as Appendix 4A.

- The combined cycle and combustion turbine technology capital cost estimates were based on current estimates received from combined cycle and combustion turbine providers.

- The solar PV options, hydro PPA option, Wartsila reciprocating engines, and an offer to purchase an existing combined cycle facility were all priced based on proposals received in response to recently issued RFPs. Because the offer to purchase an existing combined cycle facility was valid for a limited time only, a generically priced combined cycle option was also included in the prescreening.
- Capital cost estimates for municipal solid waste (MSW) technologies are not specifically addressed in EPRI TAG® or EPRI TAG-RE®; the data was obtained from presentations and additional research performed on companies having experience with MSW technologies.
- Capital cost estimates for animal waste generation technologies were gathered from multiple sources, including a RFP response and research of company presentations and recent projects.

The technology capital cost projections are shown in Table 7 below:

Table 7: Technology Capital Costs ** Highly Confidential **

Technology	Capital Cost ($/kW)
Pulverized Coal & FBC	[redacted]
SCPC IL. No. 6	
SCPC CO_2 Capture IL No. 6	
SCPC PRB	
USCPC	
USCPC CO_2 Capture	
Fluidized Bed Combustion (FBC)	
Integrated Gasification Combined Cycle	
IGCC CoP Egas	
IGCC CoP Egas CO_2 Capture	
Nuclear	
Nuclear - U.S. EPR	
Nuclear - G.E. ABWR	
Nuclear - G.E. ESBWR	
Nuclear - Westinghouse AP1000	
Nuclear - ACR-1000	
Combined Cycle	
CT/CC	
CT/CC w/90% CO_2	
Energy Storage and Fuel Cells	
Compressed Air Energy Storage System	
Fuel Cell - Molten Carbonate	
Fuel Cell - Solid Oxide	
Fuel Cell - PEM	
NaS Batteries	
Combustion Turbines	
CT Heavy Duty	
CT Conventional	
CT Siemens 501D5A	
CT GE 7EA	
CT LMS100	
CT LMS6000	
Small Scale Alternatives	
Internal Combustion Engine - Oil	
Internal Combustion Engine - Natural Gas/Spark	
Wartsila Reciprocating Engines	
Small Scale CT - Natural Gas	
Small Scale CT - Oil	
Solar	
Solar Thermal - Parabolic Trough	
Solar Thermal - Dish/Stirling Engine	
Solar Thermal - Tower	
Central Solar PV Flat Plate Thin Film	
Central Solar PV Tracking (Single Axis)	
Central Solar PV Tracking (Two Axis)	
Solar PV Residential - Utility Owned	
Wind, Biomass & Hydro	
Wind	
Biomass Stoker Boiler	
Biomass CFB Boiler	
Waste to Energy	
Landfill Gas	
Digester - Dairy	
Poultry Litter	
Cattle Feedlot	
Municipal Solid Waste - Gasification	
Municipal Solid Waste - Plasma Arc	
Municipal Solid Waste - Incinerator	

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1.5 ANNUAL FIXED OPERATION AND MAINTENANCE COSTS

(F) Annual Fixed Operation and Maintenance Costs;

Fixed operation and maintenance (O&M) cost estimates were collected for each technology, based primarily on EPRI TAG® or EPRI TAG-RE®. In instances where a better source existed or there was no EPRI TAG® or EPRI-TAG-RE® estimates available, the analysis utilized fixed O&M from existing facilities, self-build estimates, recent offer(s) from a RFP, or a recently published report or consultant-provided estimate. The fixed O&M costs are comprised of operating labor, maintenance costs, and overhead charges for administrative and support labor. These costs are driven primarily by labor rates and the required level of staffing to operate the plant. The annual fixed O&M costs are shown in Table 8 below:

Table 8: Fixed O&M ** Highly Confidential **

Technology	Fixed O&M ($/kW-Yr)
Pulverized Coal & FBC	
SCPC IL. No. 6	[redacted]
SCPC CO_2 Capture IL No. 6	
SCPC PRB	
USCPC	
USCPC CO_2 Capture	
Fluidized Bed Combustion (FBC)	
Integrated Gasification Combined Cycle	
IGCC CoP Egas	
IGCC CoP Egas CO_2 Capture	
Nuclear	
Nuclear - U.S. EPR	
Nuclear - G.E. ABWR	
Nuclear - G.E. ESBWR	
Nuclear - Westinghouse AP1000	
Nuclear - ACR-1000	
Combined Cycle	
CT/CC	
CT/CC w/90% CO_2	
Energy Storage and Fuel Cells	
Compressed Air Energy Storage System	
Fuel Cell - Molten Carbonate	
Fuel Cell - Solid Oxide	
Fuel Cell - PEM	
NaS Batteries	
Combustion Turbines	
CT Heavy Duty	
CT Conventional	
CT Siemens 501D5A	
CT GE 7EA	
CT LMS100	
CT LMS6000	
Small Scale Alternatives	
Internal Combustion Engine - Oil	
Internal Combustion Engine - Natural Gas/Spark	
Wartsila Reciprocating Engines	
Small Scale CT - Natural Gas	
Small Scale CT - Oil	
Solar	
Solar Thermal - Parabolic Trough	
Solar Thermal - Dish/Stirling Engine	
Solar Thermal - Tower	
Central Solar PV Flat Plate Thin Film	
Central Solar PV Tracking (Single Axis)	
Central Solar PV Tracking (Two Axis)	
Solar PV Residential - Utility Owned	
Wind, Biomass & Hydro	
Wind	
Biomass Stoker Boiler	
Biomass CFB Boiler	
Waste to Energy	
Landfill Gas	
Digester - Dairy	
Poultry Litter	
Cattle Feedlot	
Municipal Solid Waste - Gasification	
Municipal Solid Waste - Plasma Arc	
Municipal Solid Waste - Incinerator	

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1.6 ANNUAL VARIABLE OPERATION AND MAINTENANCE COSTS

(G)Annual Variable Operations and Maintenance Costs;

Variable O&M cost estimates were collected for each technology, based primarily on EPRI TAG® or EPRI TAG-RE®. For some technologies or in instances where there was no EPRI TAG® or EPRI TAG-RE® estimates available, the analysis utilized VOM from existing facilities, self-build estimates, recent offer(s) from a RFP, or a recently published report or consultant-provided estimate. The principal components of the variable O&M costs include water, chemicals, and other materials that are consumed in proportion to the energy output. The variable O&M in $/MWh for each technology is listed in Table 9 below:

Table 9: Technology Variable O&M ** Highly Confidential **

Technology	Variable O&M ($/MWh)
Pulverized Coal & FBC	
SCPC IL. No. 6	[redacted]
SCPC CO_2 Capture IL No. 6	[redacted]
SCPC PRB	[redacted]
USCPC	[redacted]
USCPC CO_2 Capture	[redacted]
Fluidized Bed Combustion (FBC)	[redacted]
Integrated Gasification Combined Cycle	[redacted]
IGCC CoP Egas	[redacted]
IGCC CoP Egas CO_2 Capture	[redacted]
Nuclear	[redacted]
Nuclear - U.S. EPR	[redacted]
Nuclear - G.E. ABWR	[redacted]
Nuclear - G.E. ESBWR	[redacted]
Nuclear - Westinghouse AP1000	[redacted]
Nuclear - ACR-1000	[redacted]
Combined Cycle	[redacted]
CT/CC	[redacted]
CT/CC w/90% CO_2	[redacted]
Energy Storage and Fuel Cells	[redacted]
Compressed Air Energy Storage System	[redacted]
Fuel Cell - Molten Carbonate	[redacted]
Fuel Cell - Solid Oxide	[redacted]
Fuel Cell - PEM	[redacted]
NaS Batteries	[redacted]
Combustion Turbines	[redacted]
CT Heavy Duty	[redacted]
CT Conventional	[redacted]
CT Siemens 501D5A	[redacted]
CT GE 7EA	[redacted]
CT LMS100	[redacted]
CT LMS6000	[redacted]
Small Scale Alternatives	[redacted]
Internal Combustion Engine - Oil	[redacted]
Internal Combustion Engine - Natural Gas/Spark	[redacted]
Wartsila Reciprocating Engines	[redacted]
Small Scale CT - Natural Gas	[redacted]
Small Scale CT - Oil	[redacted]
Solar	[redacted]
Solar Thermal - Parabolic Trough	[redacted]
Solar Thermal - Dish/Stirling Engine	[redacted]
Solar Thermal - Tower	[redacted]
Central Solar PV Flat Plate Thin Film	[redacted]
Central Solar PV Tracking (Single Axis)	[redacted]
Central Solar PV Tracking (Two Axis)	[redacted]
Solar PV Residential - Utility Owned	[redacted]
Wind, Biomass & Hydro	[redacted]
Wind	[redacted]
Biomass Stoker Boiler	[redacted]
Biomass CFB Boiler	[redacted]
Waste to Energy	[redacted]
Landfill Gas	[redacted]
Digester - Dairy	[redacted]
Poultry Litter	[redacted]
Cattle Feedlot	[redacted]
Municipal Solid Waste - Gasification	[redacted]
Municipal Solid Waste - Plasma Arc	[redacted]
Municipal Solid Waste - Incinerator	[redacted]

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1.7 SCHEDULED ROUTINE MAINTENANCE OUTAGE REQUIREMENTS

(H) Scheduled Routine Maintenance Outage Requirements;

The assumed routine maintenance outage requirements were categorized for each technology considered as a supply-side option. The refueling cycle requirements of the nuclear technologies control the scheduled routine maintenance outage requirements, so the nuclear technologies are shown below with the appropriate fuel cycle lengths (in months) as opposed to the weeks/year of scheduled maintenance shown for the other technologies. The scheduled routine maintenance outage requirements are shown in Table 10 below:

Table 10: Scheduled Maintenance Outage Requirements ** Highly Confidential **

Technology	Outage Pattern (weeks/yr)
Pulverized Coal & FBC	
SCPC IL. No. 6	[redacted]
SCPC CO_2 Capture IL No. 6	
SCPC PRB	
USCPC	
USCPC CO_2 Capture	
Fluidized Bed Combustion (FBC)	
Integrated Gasification Combined Cycle	
IGCC CoP Egas	
IGCC CoP Egas CO_2 Capture	
Nuclear	
Nuclear - U.S. EPR	
Nuclear - G.E. ABWR	
Nuclear - G.E. ESBWR	
Nuclear - Westinghouse AP1000	
Nuclear - ACR-1000	
Combined Cycle	
CT/CC	
CT/CC w/90% CO_2	
Energy Storage and Fuel Cells	
Compressed Air Energy Storage System	
Fuel Cell - Molten Carbonate	
Fuel Cell - Solid Oxide	
Fuel Cell - PEM	
NaS Batteries	
Combustion Turbines	
CT Heavy Duty	
CT Conventional	
CT Siemens 501D5A	
CT GE 7EA	
CT LMS100	
CT LMS6000	
Small Scale Alternatives	
Internal Combustion Engine - Oil	
Internal Combustion Engine - Natural Gas/Spark	
Wartsila Reciprocating Engines	
Small Scale CT - Natural Gas	
Small Scale CT - Oil	
Solar	
Solar Thermal - Parabolic Trough	
Solar Thermal - Dish/Stirling Engine	
Solar Thermal - Tower	
Central Solar PV Flat Plate Thin Film	
Central Solar PV Tracking (Single Axis)	
Central Solar PV Tracking (Two Axis)	
Solar PV Residential - Utility Owned	
Wind, Biomass & Hydro	
Wind	
Biomass Stoker Boiler	
Biomass CFB Boiler	
Waste to Energy	
Landfill Gas	
Digester - Dairy	
Poultry Litter	
Cattle Feedlot	
Municipal Solid Waste - Gasification	
Municipal Solid Waste - Plasma Arc	
Municipal Solid Waste - Incinerator	

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1.8 EQUIVALENT FORCED OUTAGE RATES

(I) Equivalent Forced-Outage or Full and Partial-Forced-Outage Rates;

The equivalent forced-outage rates (EFOR) were generally gathered for each technology from EPRI TAG® or EPRI TAG-RE® data. For some technologies or in instances where there was no EPRI TAG® or EPRI TAG-RE® estimates available, the analysis gathered the EFOR from existing facilities, self-build estimates, recent offer(s) from a RFP, or a recently published report or consultant-provided estimate. The EFOR for each supply-side alternative is shown in Table 11 below:

Table 11: Forced Outage Rates ** Highly Confidential **

Technology	EFOR(%)
Pulverized Coal & FBC	[redacted]
SCPC IL. No. 6	[redacted]
SCPC CO_2 Capture IL No. 6	[redacted]
SCPC PRB	[redacted]
USCPC	[redacted]
USCPC CO_2 Capture	[redacted]
Fluidized Bed Combustion (FBC)	[redacted]
Integrated Gasification Combined Cycle	[redacted]
IGCC CoP Egas	[redacted]
IGCC CoP Egas CO_2 Capture	[redacted]
Nuclear	[redacted]
Nuclear - U.S. EPR	[redacted]
Nuclear - G.E. ABWR	[redacted]
Nuclear - G.E. ESBWR	[redacted]
Nuclear - Westinghouse AP1000	[redacted]
Nuclear - ACR-1000	[redacted]
Combined Cycle	[redacted]
CT/CC	[redacted]
CT/CC w/90% CO_2	[redacted]
Energy Storage and Fuel Cells	[redacted]
Compressed Air Energy Storage System	[redacted]
Fuel Cell - Molten Carbonate	[redacted]
Fuel Cell - Solid Oxide	[redacted]
Fuel Cell - PEM	[redacted]
NaS Batteries	[redacted]
Combustion Turbines	[redacted]
CT Heavy Duty	[redacted]
CT Conventional	[redacted]
CT Siemens 501D5A	[redacted]
CT GE 7EA	[redacted]
CT LMS100	[redacted]
CT LMS6000	[redacted]
Small Scale Alternatives	[redacted]
Internal Combustion Engine - Oil	[redacted]
Internal Combustion Engine - Natural Gas/Spark	[redacted]
Wartsila Reciprocating Engines	[redacted]
Small Scale CT - Natural Gas	[redacted]
Small Scale CT - Oil	[redacted]
Solar	[redacted]
Solar Thermal - Parabolic Trough	[redacted]
Solar Thermal - Dish/Stirling Engine	[redacted]
Solar Thermal - Tower	[redacted]
Central Solar PV Flat Plate Thin Film	[redacted]
Central Solar PV Tracking (Single Axis)	[redacted]
Central Solar PV Tracking (Two Axis)	[redacted]
Solar PV Residential - Utility Owned	[redacted]
Wind, Biomass & Hydro	[redacted]
Wind	[redacted]
Biomass Stoker Boiler	[redacted]
Biomass CFB Boiler	[redacted]
Waste to Energy	[redacted]
Landfill Gas	[redacted]
Digester - Dairy	[redacted]
Poultry Litter	[redacted]
Cattle Feedlot	[redacted]
Municipal Solid Waste - Gasification	[redacted]
Municipal Solid Waste - Plasma Arc	[redacted]
Municipal Solid Waste - Incinerator	[redacted]

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1.9 OPERATIONAL CHARACTERISTICS

(J) Operational Characteristics and Constraints of Significance in the Screening Process;

Significant operational characteristics and constraints have been identified for technologies that were not passed on to integrated resource planning. These characteristics or constraints are listed in Section 2.3 below.

1.10 ENVIRONMENTAL IMPACTS

(K) Environmental Impacts, including at least the following:

1.10.1 AIR EMISSIONS

1. ***Air emissions including at least the primary acid gases, greenhouse gases, ozone precursors, particulates and air toxics;***

Probable air emission rates were gathered for each of the technology options, and the emission rates provided include nitrogen oxide (NO_x), sulfur dioxide (SO_2), mercury (Hg), carbon dioxide (CO_2), and particulate matter of 10 microns in diameter or smaller (PM_{10}). These data are shown in Table 12 below:

Table 12: Air Emissions ** Highly Confidential **

Technology	NO_x (lbs/mmBtu)	SO_2 (lbs/mmBtu)	Hg (lbs/TBtu)	CO_2 (lbs/mmBtu)	PM_{10} (lbs/mmBtu)
Pulverized Coal & FBC	[redacted]				
SCPC IL. No. 6					
SCPC CO_2 Capture IL No. 6					
SCPC PRB					
USCPC					
USCPC CO_2 Capture					
Fluidized Bed Combustion (FBC)					
Integrated Gasification Combined Cycle					
IGCC CoP Egas					
IGCC CoP Egas CO_2 Capture					
Nuclear					
Nuclear - U.S. EPR					
Nuclear - G.E. ABWR					
Nuclear - G.E. ESBWR					
Nuclear - Westinghouse AP1000					
Nuclear - ACR-1000					
Combined Cycle					
CT/CC					
CT/CC w/90% CO_2					
Energy Storage and Fuel Cells					
Compressed Air Energy Storage System					
Fuel Cell - Molten Carbonate					
Fuel Cell - Solid Oxide					
Fuel Cell - PEM					
NaS Batteries					
Combustion Turbines					
CT Heavy Duty					
CT Conventional					
CT Siemens 501D5A					
CT GE 7EA					
CT LMS100					
CT LMS6000					
Small Scale Alternatives					
Internal Combustion Engine - Oil					
Internal Combustion Engine - Natural Gas/Spark					
Wartsila Reciprocating Engines					
Small Scale CT - Natural Gas					
Small Scale CT - Oil					
Solar					
Solar Thermal - Parabolic Trough					
Solar Thermal - Dish/Stirling Engine					
Solar Thermal - Tower					
Central Solar PV Flat Plate Thin Film					
Central Solar PV Tracking (Single Axis)					
Central Solar PV Tracking (Two Axis)					
Solar PV Residential - Utility Owned					
Wind, Biomass & Hydro					
Wind					
Biomass Stoker Boiler					
Biomass CFB Boiler					
Waste to Energy					
Landfill Gas					
Digester - Dairy					
Poultry Litter					
Cattle Feedlot					
Municipal Solid Waste - Gasification					
Municipal Solid Waste - Plasma Arc					
Municipal Solid Waste - Incinerator					

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1.10.2 WASTE GENERATION

2. Waste generation including at least the primary forms of solid, liquid, radioactive and hazardous wastes;

Solid waste production estimates were developed for each of the potential technologies. In general, the coal-fueled technologies produce large quantities of solid waste in the form of ash and scrubber solids, while the gas or liquid-fueled technologies generate some solid waste as required for raw water treatment but in negligible amounts relative to coal-fired options. The renewable technologies produce little to no waste, with the exception of the MSW technologies. The waste generation in tons per year for each of the supply-side technology options is shown in Table 13 below:

1.10.3 WATER IMPACTS

3. Water impacts including direct usage and at least the primary pollutant discharges, thermal discharges and groundwater effects; and

Since water consumption can vary from plant-to-plant based on unique plant characteristics, a generic range of water consumption has been projected for each technology based on operation at full load. The pollutant discharges, thermal discharges, and groundwater effects could not be adequately addressed due to an inability to identify credible data in regards to raw water quality and wastewater treatment processes. The water consumption in gallons per minute for each of the supply-side technology options is shown in Table 13 below:

Table 13: Waste and Water Consumption ** Highly Confidential **

Technology	Waste (Tons/Year)	Water Consumption (Gal/Min)
Pulverized Coal & FBC	[redacted]	
SCPC IL. No. 6		
SCPC CO_2 Capture IL No. 6		
SCPC PRB		
USCPC		
USCPC CO_2 Capture		
Fluidized Bed Combustion (FBC)		
Integrated Gasification Combined Cycle		
IGCC CoP Egas		
IGCC CoP Egas CO_2 Capture		
Nuclear		
Nuclear - U.S. EPR		
Nuclear - G.E. ABWR		
Nuclear - G.E. ESBWR		
Nuclear - Westinghouse AP1000		
Nuclear - ACR-1000		
Combined Cycle		
CT/CC		
CT/CC w/90% CO_2		
Energy Storage and Fuel Cells		
Compressed Air Energy Storage System		
Fuel Cell - Molten Carbonate		
Fuel Cell - Solid Oxide		
Fuel Cell - PEM		
NaS Batteries		
Combustion Turbines		
CT Heavy Duty		
CT Conventional		
CT Siemens 501D5A		
CT GE 7EA		
CT LMS100		
CT LMS6000		
Small Scale Alternatives		
Internal Combustion Engine - Oil		
Internal Combustion Engine - Natural Gas/Spark		
Wartsila Reciprocating Engines		
Small Scale CT - Natural Gas		
Small Scale CT - Oil		
Solar		
Solar Thermal - Parabolic Trough		
Solar Thermal - Dish/Stirling Engine		
Solar Thermal - Tower		
Central Solar PV Flat Plate Thin Film		
Central Solar PV Tracking (Single Axis)		
Central Solar PV Tracking (Two Axis)		
Solar PV Residential - Utility Owned		
Wind, Biomass & Hydro		
Wind		
Biomass Stoker Boiler		
Biomass CFB Boiler		
Waste to Energy		
Landfill Gas		
Digester - Dairy		
Poultry Litter		
Cattle Feedlot		
Municipal Solid Waste - Gasification		
Municipal Solid Waste - Plasma Arc		
Municipal Solid Waste - Incinerator		
* Nuclear Waste = Low and Intermediate Waste (m^3)		
** Nuclear Water Consumption = Thermal Efficiency (%)		

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1.10.4 SITING IMPACTS

4. Siting impacts and constraints of sufficient importance to affect the screening process; and

Siting impacts and constraints were identified for technologies that were not passed on to integrated resource planning. These characteristics or constraints are listed in Section 2.3. It was assumed that the required fuel, water, transmission interconnections, and land would be available to enable successful plant siting.

1.11 OTHER CHARACTERISTICS

(L) Other characteristics that may make the technology particularly appropriate as a contingency option under extreme outcomes for the critical uncertain factors identified pursuant to 4 CSR 240-22.070(2).

Under increasing levels of a renewable portfolio standard (RPS) or escalating CO_2 emission costs, compressed air energy storage (CAES) may become an increasingly advantageous generation technology. It can be assumed that as RPS increases or CO_2 emission costs or restrictions increase, wind generation will also increase. Because CAES can be dispatched when wind generation decreases, it can be advantageous to pair wind generation with CAES systems. Also, CAES can provide additional accredited capacity to a utility.

No additional characteristics have been identified for the technologies presreened. The integrated resource planning and risk analysis will address uncertainties that might make certain technology alternatives more appropriate as contingency options under extreme conditions.

SECTION 2: PRELIMINARY SCREENING ANALYSIS

(2) Each of the supply-side resource options referred to in section (1) shall be subjected to a preliminary screening analysis. The purpose of this step is to provide an initial ranking of these options based on their relative annualized utility costs and to eliminate from further consideration those options that have significant disadvantages in terms of utility costs, environmental costs, operational efficiency, risk reduction or planning flexibility, as compared to other available supply-side resource options. All costs shall be expressed in nominal dollars.

GMO performed pre-screening on a nominal utility cost and nominal probable environmental cost basis to select resource options that would be passed through to Integrated Resource Analysis.

2.1 COST RANKINGS

(A) Cost rankings shall be based on estimates of the installed capital costs plus fixed and variable operation and maintenance costs levelized over the useful life of the resource using the utility discount rate. In lieu of levelized cost, the utility may use an economic carrying charge annualization in which the annual dollar amount increases each year at an assumed inflation rate and for which a stream of these amounts over the life of the resource yields the same present value.

Each of the technologies identified in Table 1 above were initially ranked based on their relative annualized utility cost. In addition to those technologies, also included were responses received from RFP's that included a combined cycle total or partial ownership option, a solar PPA offer, and a bi-fuel distributed generation offer. In calculating the average cost per MWh, the following characteristics were considered:

- Unit size and capacity factor, which varied depending on the technology's generating unit duty cycle (baseload, intermediate, or peaking). Renewable technologies were analyzed as a separate group of technologies due to the requirements of the MO RES, and unit sizes and capacity factors varied widely across the renewable technologies.

- Total capital requirement for building the unit, including the plant capital costs, transmission capital costs, owner costs, and interest during construction. A levelized fixed charge rate was applied to these capital requirements to arrive at an annual carrying cost for each technology depending on the expected unit life.

- Fixed O&M and variable O&M costs.

- Any applicable tax credits, including the Production Tax Credit (PTC) and Investment Tax Credit (ITC) available for certain renewable technologies.

- Fuel costs based on a projected long-term average cost per MWh. Further discussion of fuel cost projections is provided in section 8.1 below.

- Environmental costs, including forecasted allowance prices for SO_2, NO_x, and CO_2, applied using the appropriate emission rates for each technology.

2.2 PROBABLE ENVIRONMENTAL COSTS

(B) The probable environmental costs of each supply-side resource option shall be quantified by estimating the cost to the utility to comply with additional environmental laws or regulations that may be imposed at some point within the planning horizon.

Probable environmental actions stemming from potential laws or regulations that may be imposed within the 20-year planning horizon include landfills required to provide dry handling of coal combustion products (CCPs), a coal cleaning process to remove hazardous air pollutants (HAPs), a cap and trade program requiring the use of CO_2 allowances for generation technologies that emit CO_2 , cooling towers required to comply with Clean Water Act (CWA) Sections 316(a) and (b) as well as several other potential actions. Complying with potential environmental regulations have been quantified and applied to the supply-side resource option that is affected by each potential regulation.

2.2.1 ENVIRONMENTAL POLLUTANTS

1. The utility shall identify a list of environmental pollutants for which, in the judgment of utility decision-makers, additional laws or regulations may be imposed at some point within the planning horizon which would result in compliance costs that could have a significant impact on utility rates.

As outlined in the above section, several potential laws and regulations may be imposed at some point within the planning horizon that would result in compliance costs related to various supply-side resource options. An extensive review of these potential future regulating actions has been compiled and is attached as Appendix 4B. Provided in this review is the current status or potential future legislative or regulatory action for:

- Air-related issues including National Ambient Air Quaility Standards (NAAQS), particulate matter, ozone, carbon monoxide, sulfur dioxide, nitrogen oxides, Best Available Retrofit Technology (BART), and lead.
- Water-related issues, the Clean Water Act Section 316(A) and 316(B), zebra mussel infestation, and total maximum daily loads are reviewed.
- Waste material impacts due to polychlorinated biphenyls (PCB's) and coal combustion products (CCP's)

- Potential future regulations regarding carbon dioxide, carbon dioxide sequestration, mandatory greenhouse gas reporting, mercury, hazardous air pollutants, and other issues.

2.2.2 LEVELS OF MITIGATION

2. For each pollutant identified pursuant to paragraph (2)(B)1., the utility shall specify at least two (2) levels of mitigation that are more stringent than existing requirements which are judged to have a nonzero probability of being imposed at some point within the planning horizon.

The Commission granted GMO a waiver under "Order Granting KCP&L-GMO'S Request For Waivers", Case No. EE-2009-0237, dated March 11, 2009. This waiver, referred to as "Waiver Request 9" allows GMO to provide two levels of mitigation for an identified pollutant unless two levels of mitigation are not appropriate for the indentified pollutant. It is assumed that full containment of coal combustion products (CCPs) will be required, hazardous air pollutants (HAPs) will be required to be reduced significantly using a cleaning process, and fish impingement and entrainment as well as thermal discharge mitigation will require cooling towers. Regarding CO_2, three levels of CO_2 allowance costs have been estimated and the level of costs that could be imposed is dependant on what CO_2 restrictions will be imposed in the future.

2.2.3 SUBJECTIVE PROBABILITY

3. For each mitigation level identified pursuant to paragraph (2)(B)2., the utility shall specify a subjective probability that represents utility decision-maker's judgment of the likelihood that additional laws or regulations requiring that level of mitigation will be imposed at some point within the planning horizon. The utility, based on these probabilities, shall calculate an expected mitigation level for each identified pollutant.

The subjective probabilities assigned to comply with additional environmental laws or regulations are listed as follows:

- Landfills required to provide dry handling of CCPs = 100% probability
- A coal cleaning process to remove HAPs = 100% probability
- A cap and trade program requiring the use of CO_2 allowances for generation technologies that emit CO_2 = 100% probability
- Cooling towers required to comply with Clean Water Act (CWA) Sections 316(a) and (b) = 100% probability

2.2.4 JOINT COST OF PROBABLE ENVIRONMENTAL

(4) The probable environmental cost for a supply-side resource shall be estimated as the joint cost of simultaneously achieving the expected level of mitigation for all identified pollutants emitted by the resource. The estimated mitigation costs for an environmental pollutant may include or may be entirely comprised of a tax or surcharge imposed on emissions of that pollutant.

The probable joint environmental cost for each supply-side resource to achieve the expected level of mitigation for the pollutants identified in Section 2.2.3 is shown in Table 14 below:

Table 14: Probable Environmental Cost ** Highly Confidential **

Technology	Prob Envir ($/MWh)
Pulverized Coal & FBC	[redacted]
SCPC IL. No. 6	
SCPC CO_2 Capture IL No. 6	
SCPC PRB	
USCPC	
USCPC CO_2 Capture	
Fluidized Bed Combustion (FBC)	
Integrated Gasification Combined Cycle	
IGCC CoP Egas	
IGCC CoP Egas CO_2 Capture	
Nuclear	
Nuclear - U.S. EPR	
Nuclear - G.E. ABWR	
Nuclear - G.E. ESBWR	
Nuclear - Westinghouse AP1000	
Nuclear - ACR-1000	
Combined Cycle	
CT/CC	
CT/CC w/90% CO_2	
Energy Storage and Fuel Cells	
Compressed Air Energy Storage System	
Fuel Cell - Molten Carbonate	
Fuel Cell - Solid Oxide	
Fuel Cell - PEM	
NaS Batteries	
Combustion Turbines	
CT Heavy Duty	
CT Conventional	
CT Siemens 501D5A	
CT GE 7EA	
CT LMS100	
CT LMS6000	
Small Scale Alternatives	
Internal Combustion Engine - Oil	
Internal Combustion Engine - Natural Gas/Spark	
Reciprocating Engines	
Small Scale CT - Natural Gas	
Small Scale CT - Oil	
Bi-Fuel Distributed Generation Bi-Fuel PPA	
Solar	
Solar Thermal - Parabolic Trough	
Solar Thermal - Dish/Stirling Engine	
Solar Thermal - Tower	
Central Solar PV Flat Plate Thin Film	
Central Solar PV Tracking (Single Axis)	
Central Solar PV Tracking (Two Axis)	
Solar PV Residential - Utility Owned	
Wind, Biomass & Hydro	
Wind	
Biomass Stoker Boiler	
Biomass CFB Boiler	
Waste to Energy	
Landfill Gas	
Digester - Dairy	
Poultry Litter	
Cattle Feedlot	
Municipal Solid Waste - Gasification	
Municipal Solid Waste - Plasma Arc	
Municipal Solid Waste - Incinerator	

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2.3 RANKINGS OF UTILITY AND UTILITY PLUS PROBABLE ENVIRONMENTAL COSTS

(C) The utility shall rank all supply-side resource options identified pursuant to section (1) in terms of both of the following cost estimates: utility costs and utility costs plus probable environmental costs. The utility shall indicate which supply-side options are considered to be candidate resource options for purposes of developing the alternative resource plans required by 4 CSR 240-22.060(3). The utility shall also indicate which options are eliminated from further consideration on the basis of the screening analysis and shall explain the reasons for their elimination.

Each of the supply-side resource options identified were ranked in terms of a 'utility cost' estimate and a 'utility cost plus probable environmental cost' estimate. The utility cost estimate is expressed in dollars per megawatt-hour, and it is comprised of fixed O&M, variable O&M, fuel cost, and a levelized carrying cost applied to the capital costs incurred for the technology installation and the transmission interconnection (if applicable). The results of the 'utility cost' rankings show municipal solid waste, ultra-supercritical coal, supercritical coal, fluidized bed coal, wind, and nuclear technologies as having the least-cost estimates. The utility cost ranking of all supply-side resource options are shown in Table 15 through below Table 17:

Table 15: Technology Ranking By Nominal Utility Cost No.1-20 ** Highly Confidential **

RANK	Technology	Capacity Factor (%)	Nominal Utility Cost ($/MWh)
1	Municipal Solid Waste (MSW) Gasification	[redacted]	[redacted]
2	Municipal Solid Waste (MSW) Incinerator	[redacted]	[redacted]
3	USCPC PRB WFGD	[redacted]	[redacted]
4	SCPC PRB SDA	[redacted]	[redacted]
5	SCPC ILL #6 WFGD	[redacted]	[redacted]
6	Fluidized Bed Combustion	[redacted]	[redacted]
7	Wind	[redacted]	[redacted]
8	Nuclear GE ESBWR	[redacted]	[redacted]
9	Nuclear GE ABWR	[redacted]	[redacted]
10	Nuclear Westinghouse AP1000	[redacted]	[redacted]
11	Nuclear US EPR	[redacted]	[redacted]
12	Fluidized Bed Combustion Ill #6	[redacted]	[redacted]
13	IGCC ILL #6 Cop	[redacted]	[redacted]
14	CAES	[redacted]	[redacted]
15	USCPC PRB WFGD CO2 Cap	[redacted]	[redacted]
16	Nuclear ACR-1000	[redacted]	[redacted]
17	SCPC ILL #6 WFGD CO2 CAP	[redacted]	[redacted]
18	Landfill Gas	[redacted]	[redacted]
19	Combined Cycle Total Ownership Offer	[redacted]	[redacted]
20	Combined Cycle Partial Ownership Offering	[redacted]	[redacted]

It should be noted that MSW technologies have a “tipping fee” which is the fee that trash haulers pay to dump (tip) their loads at dumping sites. This tipping fee is treated as a credit and reduces the estimated overall cost per megawatt-hour by more than 50 percent.

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Table 16: Technology Ranking By Nominal Utility Cost No.21-39 ** Highly Confidential **

RANK	Technology	Capacity Factor (%)	Nominal Utility Cost ($/MWh)
21	NaS Batteries	[redacted]	[redacted]
22	CT/CC	[redacted]	[redacted]
23	IGCC ILL #6 Cop CO2 Cap	[redacted]	[redacted]
24	Poultry Litter	[redacted]	[redacted]
25	Gasifier - Cattle Feedlot	[redacted]	[redacted]
26	Biomass Fluid Bed	[redacted]	[redacted]
27	CT/CC CCS	[redacted]	[redacted]
28	Digester - Dairy Cattle	[redacted]	[redacted]
29	Biomass Stoker	[redacted]	[redacted]
30	Molten Carbonate Fuel Cell	[redacted]	[redacted]
31	Municipal Solid Waste (MSW) Plasma Arc	[redacted]	[redacted]
32	Lock and Dam Hydrological PPA	[redacted]	[redacted]
33	Distributed Generation - Bi-Fuel PPA	[redacted]	[redacted]
34	Central Solar PV Tracking (two Axis)	[redacted]	[redacted]
35	CT Siemens (Sedalia Cost)	[redacted]	[redacted]
36	CT 7EA (Sedalia Cost)	[redacted]	[redacted]
37	Wartsila Reciprocating Engines	[redacted]	[redacted]
38	Solar Thermal-Tower	[redacted]	[redacted]
39	CT LMS100	[redacted]	[redacted]

Table 17: Technology Ranking By Nominal Utility Cost No.40-54 ** Highly Confidential **

RANK	Technology	Capacity Factor (%)	Nominal Utility Cost ($/MWh)
40	CT LM6000	[redacted]	[redacted]
41	Central Solar PV Tracking (single Axis)	[redacted]	[redacted]
42	CT Heavy Duty	[redacted]	[redacted]
43	Solid Oxide Fuel Cells	[redacted]	[redacted]
44	CT Conventional	[redacted]	[redacted]
45	Internal Combustiion Engine - Natural Gas - Spark Ignition	[redacted]	[redacted]
46	Solar - Thin Film PV 4 MW	[redacted]	[redacted]
47	Solar - Thin Film PV 25-Yr PPA	[redacted]	[redacted]
48	Solar Thermal-Dish/Stirling Engine	[redacted]	[redacted]
49	Solar Thermal -Parabolic Trough	[redacted]	[redacted]
50	Proton Exchange Membrane	[redacted]	[redacted]
51	Internal Combustion Engine - Oil	[redacted]	[redacted]
52	Small Scale CT Dual- Fuel Capable - Natural Gas	[redacted]	[redacted]
53	Small Scale CT Dual-Fuel Capable - Oil	[redacted]	[redacted]
54	Solar PV Residential - Utility Owned	[redacted]	[redacted]

HC

Development of these nominal utility costs was completed in an Excel workbook and is included as a working paper to this filing.

For this pre-screening exercise, emphasis was placed on the 'utility cost plus probable environmental cost' rankings in anticipation of legislation being passed to reduce U.S. emissions of CO_2 and other greenhouse gases. The results of the 'utility cost plus probable environmental cost' rankings show municipal solid waste, wind, nuclear and ultra-supercritical coal technologies as having the least-cost estimates. The technology rankings of the supply-side technologies with the inclusion of these estimated probable environmental costs are shown in Table 18 through Table 20 below:

Table 18: Technology Ranking By Nominal Probable Environmental Cost No.1-20 ** Highly Confidential **

RANK	Technology	Capacity Factor (%)	Nominal Probable Environmental Cost ($/MWh)
1	Municipal Solid Waste (MSW) Gasification	[redacted]	[redacted]
2	Wind	[redacted]	[redacted]
3	Nuclear GE ESBWR	[redacted]	[redacted]
4	Nuclear GE ABWR	[redacted]	[redacted]
5	Nuclear Westinghouse AP1000	[redacted]	[redacted]
6	Nuclear US EPR	[redacted]	[redacted]
7	Nuclear ACR-1000	[redacted]	[redacted]
8	USCPC PRB WFGD	[redacted]	[redacted]
9	SCPC PRB SDA	[redacted]	[redacted]
10	CAES	[redacted]	[redacted]
11	Municipal Solid Waste (MSW) Incinerator	[redacted]	[redacted]
12	SCPC ILL #6 WFGD	[redacted]	[redacted]
13	Landfill Gas	[redacted]	[redacted]
14	USCPC PRB WFGD CO2 Cap	[redacted]	[redacted]
15	Fluidized Bed Combustion	[redacted]	[redacted]
16	NaS Batteries	[redacted]	[redacted]
17	SCPC ILL #6 WFGD CO2 CAP	[redacted]	[redacted]
18	IGCC ILL #6 Cop	[redacted]	[redacted]
19	Combined Cycle Full Ownership Offer	[redacted]	[redacted]
20	Combined Cycle Partial Ownership Offer	[redacted]	[redacted]

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Table 19: Technology Ranking By Nominal Probable Environmental Cost No. 21-39 ** Highly Confidential **

RANK	Technology	Capacity Factor (%)	Nominal Probable Environmental Cost ($/MWh)
21	Fluidized Bed Combustion Ill #6	[redacted]	
22	CT/CC		
23	IGCC ILL #6 Cop CO2 Cap		
24	Poultry Litter		
25	Gasifier - Cattle Feedlot		
26	Biomass Fluid Bed		
27	CT/CC CCS		
28	Digester - Dairy Cattle		
29	Biomass Stoker		
30	Lock and Dam Hydrological PPA		
31	Molten Carbonate Fuel Cell		
32	Central Solar PV Tracking (two Axis)		
33	Municipal Solid Waste (MSW) Plasma Arc		
34	Distributed Generation - Bi-Fuel PPA		
35	CT Siemens (Sedalia Cost)		
36	Solar Thermal-Tower		
37	Central Solar PV Tracking (single Axis)		
38	CT 7EA (Sedalia Cost)		
39	Wartsila Reciprocating Engines		

Table 20: Technology Ranking By Nominal Probable Environmental Cost No. 40-54 ** Highly Confidential **

RANK	Technology	Capacity Factor (%)	Nominal Probable Environmental Cost ($/MWh)
40	CT LMS100	[redacted]	
41	CT LM6000		
42	CT Heavy Duty		
43	Solid Oxide Fuel Cells		
44	Solar - Thin Film PV 4 MW		
45	Solar - Thin Film PV 25-Yr PPA		
46	Solar Thermal-Dish/Stirling Engine		
47	CT Conventional		
48	Internal Combustiion Engine - Natural Gas - Spark Ignition		
49	Solar Thermal -Parabolic Trough		
50	Proton Exchange Membrane		
51	Internal Combustion Engine - Oil		
52	Small Scale CT Dual- Fuel Capable - Natural Gas		
53	Small Scale CT Dual-Fuel Capable - Oil		
54	Solar PV Residential - Utility Owned		

HC

Development of these nominal probable environmental costs was completed in an Excel workbook and is included as a working paper to this filing.

The supply-side technologies passed on to the integrated resource analysis as candidate resource options including a 10% biomass at Sibley 1&2 option are shown in Table 21 below:

Table 21: Candidate Resource Options

Technology
Super Critical Pulverized Coal
Super Critical Pulverized Coal w/CO_2 Capture
Fluidized Bed Combustion (FBC)
Integrated Gasification Combined Cycle (IGCC)
IGCC w/CO_2 Capture
Nuclear - U.S. EPR
Combined Cycle
Compressed Air Energy Storage
Fuel Cell - Molten Carbonate
Combustion Turbines - 77 MW
Combustion Turbines - 46 MW
Reciprocating Engines
Distributed Generation Bi-Fuel PPA
Central Solar PV Flat Plate Thin Film
Wind
Landfill Gas
Poultry Litter
100% Biomass Circulating Fluidized Bed
10% Biomass at Sibley 1&2

The technology options that were eliminated from further consideration on the basis of the pre-screening analysis, along with the reason for their elimination, are addressed in the discussion below. In general, some low-ranking options that were passed on to integrated resource analysis because the technology was applicable in meeting the Missouri Proposition C Renewable Energy Standard (RES) Requirements or could offer environmental benefits for contingency planning under potential greenhouse gas restriction scenarios. On the other hand, certain high-ranking options were not passed on to integrated resource because the technology was not beyond the stages of development, demonstration, or pilot testing and therefore considered infeasible at this time. .

Technologies that were not passed onto integrated resource analysis with reason(s) why are listed as follows:

- **Ultra Super Critical Pulverized Coal (USCPC) Technologies.** The USCPC technologies are currently listed as 'demonstration' technologies in EPRI TAG®. Therefore the 'mature' Super Critical Pulverized Coal (SCPC) option with Powder River Basin (PRB) coal as the fuel source was selected as the supply-side pulverized coal resource option.

- **Combustion Turbine (CT) Technologies.** There were 6 combustion turbine technologies identified in Table 1 above, and their nominal cost rankings were relatively similar. The CT technologies of CT Heavy Duty, CT Conventional, CT Siemens 501D5A and CT LMS100, were not passed on to the integrated resource analysis process. The CT technologies of the GE 7EA and the LM6000 were passed on to the integrated resource analysis process, and were assumed to be representative of the larger group of CT technologies. The GE 7EA was chosen due to its flexible operating characteristics and familiarity among GMO personnel, while the LM6000 was chosen due to its smaller size and ability to fill smaller capacity needs in any given year.

- **Municipal Solid Waste (MSW) Technologies.** Two of the three MSW technologies, MSW Gasification and MSW Incinerator, ranked high in the pre-screen rankings but have several issues. Gasification and Plasma Arc technologies are 'developmental' technologies and there is limited data to support the capital cost estimates. Although the MSW incineration is a proven commercially available option, there are significant environmental concerns, and it is doubtful an incineration plant could be sighted or permitted. There are also potential issues surrounding the availability and delivery of a sufficient supply of solid waste to fuel the technologies, in order for them to operate in the projected capacity factor range of seventy-five to ninety percent. Regional supplies of MSW also limit the available capacity of this generating resource. Finally, the pre-screening assumes a large revenue stream for 'tipping fee' revenues, which is a payment made for diverting the waste from landfills. The assumed tipping fee revenue of $32 per ton is another unknown that significantly contributes to the high ranking of the MSW technologies. For those reasons, the MSW technologies were not passed onto the second level of pre-screening. However, GMO will continue to monitor MSW technologies for future application.

- **Biomass Stoker Technology.** This technology was not passed onto integrated resource analysis due to the higher cost and lack of any benefits when compared to the 'mature' Biomass Fluidized Bed technology.

- **NaS Batteries Technology.** This technology was not passed onto integrated resource analysis due to its relatively high cost, current development status, and infrequent application. Per the EPRI TAG© December 2008 report 1018497, only two utilities have completed NaS battery deployments. However, GMO will continue to monitor its development for future application as an alternative to meet the requirements of the MO Renewable Energy Standard (MO RES).

- **Solid Oxide and Proton Exchange Membrane Technologies.** These technologies were not passed onto integrated resource analysis due to their higher cost ranking relative to molten carbonate fuel cell technology, which was passed on to the integrated resource analysis process.

- **Solar Thermal Technologies.** The solar thermal technologies – parabolic trough, power tower, and dish/engine – were excluded from integrated resource analysis due to high cost and the geographic region requirements. The highest quality resources for solar thermal within the United States are located in the Southwest (Nevada, Arizona, California, New Mexico), and no solar thermal facilities currently exist in the Midwest. However, to meet the solar requirements of the MO RES, GMO included solar photovoltaic (PV) fixed flat-plate technology in the integrated resource analysis.

- **Solar PV Tracking (One-Axis & Two-Axis) Technologies.** These technologies were not passed onto the second level of pre-screening due to the current development status of solar tracking technologies in comparison to solar PV fixed flat-plate technology. While the cost rankings were better than the fixed flat-plate technology due to higher capacity factors, the two-axis tracking technology is still in the 'pilot' technology testing phase and all of the bids received by GMO to-date for solar facilities have been based upon the solar PV fixed flat-plate technology. GMO will continue to monitor the development of PV tracking technologies for future application and will invite bids that use PV tracking technologies as an alternative to meet the requirements of the Missouri Renewable Energy Standard (RES).

- **Solar PV Residential Technology.** This technology was not passed onto the integrated resource analysis due to it having the highest cost ranking of all the technologies reviewed. GMO will continue to monitor and analyze this technology in terms of the $2/watt rebate per the Missouri RES, as opposed to utility ownership of residential solar systems.

- **Lock and Dam Hydrological Technology.** This technology was not passed onto integrated resource analysis due to its high cost ranking relative to other baseload technologies such as nuclear and coal.

- **Digester Dairy and Cattle Feedlot Technologies.** These technologies were not passed onto the integrated resource analysis due to the higher cost ranking relative to the other animal waste technology, poultry litter, which was passed on to the integrated resource analysis process.

- **CT/CC with 90% CO_2 Capture Technology.** This technology was not passed on to the integrated resource analysis process due to its high cost ranking relative to other carbon capture technologies.

- **Small Scale CT Technologies.** The small scale CT technologies were not passed on to integrated resource analysis process due to the high cost rankings and potential siting and permitting limitations. The small scale CT technologies provided no benefits over the larger scale CT technologies, and with large scale CT technologies having significantly lower costs the large scale CT technologies, the large scale CT technologies were passed on to integrated resource analysis process.

- **Internal Combustion Engine (ICE) Technologies.** These technologies were not passed onto the integrated resource analysis due to their high cost rankings.

SECTION 3: ANALYSIS OF EXISTING AND PLANNED INTERCONNECTED GENERATION RESOURCES

(3) The analysis of supply-side resource options shall include a thorough analysis of existing and planned interconnected generation resources. The analysis can be performed by the individual utility or in the context of a joint planning study with other area utilities. The purpose of this analysis shall be to ensure that the transmission network is capable of reliably supporting the supply resource options under consideration, that the costs of transmission system investments associated with supply-side resources are properly considered and to provide an adequate foundation of basic information for decisions about the following types of supply-side resource alternatives:

The cost of new transmission facilities was included in the prescreen resource alternatives based on Waiver #10 granted by the Commission under "Order Granting KCP&L-GMO'S Request For Waivers", Case No. EE-2009-0237, dated March 11, 2009.

3.1 JOINT PARTICIPATION

(A) Joint participation in generation construction projects;

A discussion of this rule requirement can be found in the attached Appendix 4G.

3.2 CONSTRUCTION OF GENERATION OR TRANSMISSION FACILITIES

(B) Construction of wholly-owned generation or transmission facilities; and

A discussion of this rule requirement can be found in the attached Appendix 4G.

3.3 EXISTING GENERATION OR TRANSMISSION REFURBISHMENT, UPGRADING OR RETROFITTING

(C) Participation in major refurbishment, upgrading or retrofitting of existing generation or transmission resources.

A discussion of this rule requirement can be found in the attached Appendix 4G.

SECTION 4: LIFE EXTENSION AND REFURBISHMENT OF EXISTING PLANTS

(4) The utility shall identify and analyze opportunities for life extension and refurbishment of existing generation plants, taking into account their current condition to the extent that it is significant in the planning process.

The Life Assessment and Management Program (LAMP) was developed in the late 1980's for the purpose of identifying, evaluating, and recommending improvements and special maintenance requirements necessary for continued reliable operation of KCP&L coal-fired generating units. This program has now been expanded to include the GMO coal-fired generating units. Current schedules of identified LAMP projects and costs for Lake Road 4-6 and Sibley Units 1, 2, and 3 are shown in Table 22 through Table 27 below:.

Table 22: Lake Road Unit 4-6 LAMP Capital Plan Years 2011 - 2019 ($000's) ** Highly Confidential **

STATION	Project Name	2011	2012	2013	2014	2015	2016	2017	2018	2019
Lake Road	[redacted]									
Lake Road										
Lake Road										
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Table 23: Lake Road Unit 4-6 LAMP Capital Plan Years 2020 - 2028 ($000's) ** Highly Confidential **

STATION	Project Name	2020	2021	2022	2023	2024	2025	2026	2027	2028	Plant Total
Lake Road	[redacted]										
Lake Road											
Lake Road											
Lake Road											
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Lake Road											

Table 24: Sibley Units 1 and 2 LAMP Capital Plan Years 2014 - 2021 ($000's) ** Highly Confidential **

STATION	Project Name		2014	2015	2016	2017	2018	2019	2020	2021
Sibley	[redacted]									
Sibley										
Sibley										
Sibley										
Sibley										
Sibley										
Sibley										
Sibley										
Sibley										
Sibley										
Sibley										

Table 25: Sibley Units 1 and 2 LAMP Capital Plan Years 2022 - 2028 ($000's) ** Highly Confidential **

STATION	Project Name		2022	2023	2024	2025	2026	2027	2028	Plant Total
Sibley	[redacted]									
Sibley										
Sibley										
Sibley										
Sibley										
Sibley										
Sibley										
Sibley										
Sibley										
Sibley										
Sibley										

Table 26: Sibley Unit 3 LAMP Capital Plan Years 2012 - 2020 ($000's) ** Highly Confidential **

STATION	Project Name	2012	2013	2014	2015	2016	2017	2018	2019	2020
Sibley	[redacted]									
Sibley										
Sibley										
Sibley										
Sibley										
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Table 27: Sibley Unit 3 LAMP Capital Plan Years 2021 - 2028 ($000's) ** Highly Confidential **

STATION	Project Name		2021	2022	2023	2024	2025	2026	2027	2028	Plant Total
Sibley	[redacted]										
Sibley	[redacted]										
Sibley	[redacted]										
Sibley	[redacted]										
Sibley	[redacted]										
Sibley	[redacted]										
Sibley	[redacted]										
Sibley	[redacted]										
Sibley	[redacted]										
Sibley	[redacted]										
Sibley	[redacted]										
Sibley	[redacted]										
Sibley	[redacted]										
Sibley	[redacted]										
Sibley	[redacted]										
	[redacted]										

SECTION 5: LONG-TERM POWER PURCHASES AND SALES OPPORTUNITIES

(5) The utility shall identify and evaluate potential opportunities for new long-term power purchases and sales, both firm and nonfirm, that are likely to be available over all or part of the planning horizon. This evaluation shall be based on an analysis of at least the following attributes of each potential transaction:

To obtain market values for supply side alternatives including potential Power Purchase Agreements (PPAs), GMO issued a Request for Proposal (RFP) on September 18, 2008. While several of the proposals received are not valid for the timeline that GMO projects potential resource needs, the primary value of the RFP was to provide key data points to support the market value of PPAs and turnkey alternatives. The RFP is attached as Appendix 4C.

In addition to the RFP alternatives, a short-term purchase or sale alternative was made available on an annual basis throughout the IRP planning horizon. This alternative was based upon the levelized installed cost of a new CT facility with the associated contract energy priced at market. The calculation of this cost is shown in Table 28 below:

Table 28: Pricing of PPAs for Integrated Analysis ** Highly Confidential **

CT Cost Utilized for PPA Proxy	
Net Capacity (MW)	[redacted]
Capacity Factor	[redacted]
Fixed O&M ($/kW-Yr)	[redacted]
Var O&M ($/MWh)	[redacted]
Technology Cost ($/kW)	[redacted]
Technology Capital	[redacted]
Levelized FCR for construction projects	[redacted]
Annual Technology Carrying Cost	[redacted]
Transmission Cost ($/kW)	[redacted]
Transmission Capital	[redacted]
Transmission FCR	[redacted]
Annual Transmission Carrying Cost	[redacted]
Total Annual Cost	[redacted]
Total Fixed O&M	[redacted]
Total Variable O&M	[redacted]
Total Levelized Fixed Cost Per Year	[redacted]
Installed Cost $/kW	[redacted]

5.1 TYPE OF LONG-TERM PURCHASE OR SALE

(A) Type or nature of the purchase or sale (for example, firm capacity, summer only);

See Table 29 below for a summary of the type or nature of the long-term purchases considered over all or part of the IRP planning horizon.

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Table 29: Type or Nature of Long-Term Purchase ** Highly Confidential **

Type of Long-Term Purchase or Sale	
Counterparty	Type of Purchase/Sale (Firm/Nonfirm and Year-Round/Summer Only)
[redacted]	

5.2 AMOUNT OF POWER

(B) Amount of power to be exchanged;

See Table 30 below for a summary of the amount of power to be exchanged in the long-term purchases considered over all or part of the IRP planning horizon.

Table 30: Amount of Power ** Highly Confidential **

Amount of Power to be Exchanged	
[redacted]	

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5.3 CONTRACT PRICE

(C) Estimated contract price;

See Table 31 below for a summary of the contract pricing for the long-term purchases considered over all or part of the IRP planning horizon.

Table 31: Contract Prices ** Highly Confidential **

Contract Price Estimates				
Counterparty	**Capacity ($/kW-mth)**	**Energy ($$/MWh) or**	**Var O&M ($$/MWh)**	**Start Charge ($$ per Start)**
[redacted]				

5.4 TIMING AND DURATION

(D) Timing and duration of the transaction;

See Table 32 below for a summary of the timing and duration of the long-term purchases considered over all or part of the IRP planning horizon.

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Table 32: Contract Timing & Duration ** Highly Confidential **

Transaction Timing & Duration	
Counterparty	**Contract Timing/Duration**
[redacted]	

5.5 TERMS AND CONDITIONS

(E) Terms and conditions of the transaction, if available;

The PPA responses can be reviewed in the attached Appendix 4F.

5.6 REQUIRED IMPROVEMENTS

(F) Required improvements to the utility's generating system, transmission system, or both, and the associated costs; and

A discussion of this rule requirement can be found in the attached Appendix 4G. It should be noted that no PPA bids were pursued due to a combination of cost and timing issues in comparison to ownership. Therefore, additional costs for required transmission improvements would have only made the PPA proposals less attractive in comparison to ownership.

5.7 CONSTRAINTS ON THE UTILITY SYSTEM

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(G) Constraints on the utility system caused by wheeling arrangements, whether on the utility's own system, or on an interconnected system, or by the terms and conditions of other contracts or interconnection agreements.

A discussion of this rule requirement can be found in the attached Appendix 4G. As noted in Section 5.6 above, no PPA bids were pursued due to cost and timing issues in comparison to ownership. Therefore potential constraints on the utility system would only make a PPA proposal less attractive.

SECTION 6: FUTURE TRANSMISSION FACILITIES

(6) For the utility's preferred resource plan selected pursuant to 4 CSR 240-22.070(7), the utility shall determine if additional future transmission facilities will be required to remedy any new generation-related transmission system inadequacies over the planning horizon. If any such facilities are determined to be required and, in the judgment of utility decision-makers, there is a risk of significant delays or cost increases due to problems in the siting or permitting of any required transmission facilities, this risk shall be analyzed pursuant to the requirements of 4 CSR 240-22.070(2).

A discussion of this rule requirement can be found in the attached Appendix 4G. A determination was made that new sources of generation associated with the preferred resource plan would require new transmission facilities. The cost of new transmission facilities was included in the prescreen resource alternatives based on "Waiver Request 10" granted by the Commission under "Order Granting KCP&L-GMO'S Request For Waivers", Case No. EE-2009-0237, dated March 11, 2009. Transmission cost was derived utilizing recent transmission-related cost data from KCP&L's Osawatomie and GMO's Iatan-2 construction projects The details of the transmission cost calculation is shown in Table 33 below:

Table 33: Transmission Cost Estimate For New Generation ** Highly Confidential**

Transmission Cost Estimate
[redacted]

This transmission cost estimate was applied to each resource alternative with a few exceptions: the wind transmission cost was increased to 1.5 times the estimate, or ** $[redacted] **, due to the often remote locations of wind generation sites, and no transmission cost was applied to distributed generation, fuel cells, small-scale generation sources, or existing facilities offered through PPA's or for sale that already have transmission facilities established.

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SECTION 7: EXISTING TRANSMISSION AND DISTRIBUTION FACILITIES

(7) The utility shall assess the age, condition and efficiency level of existing transmission and distribution facilities, and shall analyze the feasibility and cost-effectiveness of transmission and distribution system loss-reduction measures as a supply-side resource. This provision shall not be construed to require a detailed line-by-line analysis of the transmission and distribution system, but is intended to require the utility to identify and analyze opportunities for efficiency improvements in a manner that is consistent with the analysis of other supply-side resource options.

A discussion of this rule requirement regarding transmission facilities can be found in the attached Appendix 4G.

7.1 TRANSFORMER LOSSES

In 2007, KCP&L analyzed its distribution transformer population base and purchasing practices to determine if lower losses would be a positive economic choice. Department of Energy (DOE) standards TP1, TSL2 and TSL4 loss levels were used as benchmarks for comparison. TP1 is the level of transformer efficiency that was adopted in the 2005 energy bill that utilities must meet or exceed by January 2007 to be in compliance. (TSL4 efficiencies are higher than TSL2, which is higher than TP1). These DOE proposed standards recommend that utilities obtain the TSL2 level by 2010 and the TSL4 level in the indeterminate future. Present EEI recommendations are that utilities change their buying practices to achieve TSL2 levels by 2009, and TSL4 levels by 2013. These dates have been supported by KCP&L.

An analysis of the existing distribution transformers installed on the KCP&L system indicated that;

1. All existing single phase and three phase distribution transformers are in compliance with TP1;

2. Nearly all single phase transformers are at TSL4 levels or higher based on the best total owning cost for KCP&L's system;

3. Currently, 96% of three phase transformers are TSL2 compliant, and;

4. Of those three phase transformers that are TSL2 compliant, 20% are TSL4 compliant, also based on best total owning cost as well.

After KCP&L completed the analysis above the DOE came out with a new efficiency level which will be mandatory beginning in 2010. Once again in analyzing KCP&L's current transformer fleet it was found that the overwhelming majority of KCP&L's single phase transformers are 2010 compliant. A large majority of the existing three phase transformers are compliant as well. The decision was made in 2007 by KCP&L to:

1. Continue to purchase single phase transformers that are 2010 compliant, and;

2. Alter purchasing practices to buy only 2010 compliant three phase transformers.

Expected aggregate results of this purchase decision are savings of 7.4 MW of peak demand after 30 years.

Evaluations indicated it was not economic to replace existing non-compliant transformers (those transformers less efficient than 2010 standards) with 2010 units simply to gain efficiency. Instead of a system-wide program of replacements, non-compliant transformers will be replaced with 2010 compliant transformers when failures occur. A change out program was estimated to cost $62 million and would provide a 36 MW load reduction only across the system peak with annual energy savings of less than 18,000 MWh. Compared to a supply-side alternative, the project would equate to installing a $1,722/kW resource with less than a 6% capacity factor.

Analysis of the GMO transformers utilizing the same analysis basis indicates similar findings for purchasing and installation of 2010 compliant transformers. Expected aggregate results of this purchase decision are savings of 7.1 MW of peak demand after 30 years.

The evaluation indicated that it also was not economic to replace existing non-compliant transformers (those transformers less efficient than 2010 standards) with 2010 units simply to gain efficiency in the GMO areas. A replacement program is estimated to cost $38 million and provide only a 26 MW load reduction and annual energy savings of under 32,000 MWh. The supply side equivalent for this group would be a $1,462/kW resource having less than a 14% capacity factor.

7.2 LINE LOSSES

An additional strategy that also contributes to reduce demand as well as reduced carbon emissions is for utilities to find ways to minimize existing system line losses. Many utilities like KCP&L and GMO are adopting the idea of building "Green Circuits", by the study, demonstration, and application of line loss reduction technologies and measures.

Electrical distribution systems losses typically range from 3% to 7%. Efficiency standards and carbon emission reduction requirements should lead utilities to consider options for addressing these distribution losses. Company material and construction standards are developed to provide both load and economic efficiency to the distribution system. Design processes review both system operating requirements and economics. Improvements in material and changes in system cost factors result in improvements to both standards and the design process.

New or advances in existing technology help achieve reduced line loss including:

Advances in modeling capabilities enable better loss estimation, identification of loss mitigating technologies and verification of improvements

Time stamped metering data provides information on end-use patterns and diversity factors and enables improved quantification of distribution losses

Communications and control capabilities create opportunities to implement precise voltage and var control algorithms to reduce line losses, transformer losses and lower end-use consumption and make automatic reconfiguration or looped operation feasible.

Feeder conductor replacement for the sole purpose of improving efficiency returns a negative 20-year NPV with assumed energy costs of either $0.06/kWh or $0.10/kWh. This means that the cost of achieving decreased line losses exceeds the benefits obtained. Based on this finding, feeder conductor replacement is not an economic alternative to supply-side alternatives. The two examples below summarize these findings. Both Case 1 and Case 2 are projected based on upgrading 1-mile of conductor.

CASE 1: Replace #2 ACSR with 3/0 ACSR ** [redacted] **

Losses (watts per hour) associated with each conductor are 7383 watts for the #2 conductor and 2,652 watts for 3/0. The on-peak loss reduction due to the difference in resistance between the two wire sizes is 4,733 watts. Annual Savings at $0.06/kWh = ** [redacted] ** and at $0.10/kWh = ** [redacted] **. Net present values (NPV) of the upgrade over a 20-year life at different energy values are ** [redacted] ** and ** [redacted] ** respectively.

CASE 2: Replace # 2 ACSR with 477 MCM ** [redacted] **

Apply the same assumptions and calculations as Case 1, except the 477 MCM line has lower losses (489 watts) than the 3/0 conductor and the cost of replacing 1-mile of line is ** [redacted] ** instead of ** [redacted] **. The resulting NPV at $0.06/kWh is ** [redacted] **.

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7.3 TRANSMISSION

GMO has established processes to identify transmission assets with anticipated or demonstrated deficiencies related to age and condition. The replacement of equipment is addressed via the Asset Management process. Information on lines identified for significant maintenance (e.g., replacement of conductor or structures) is provided on an annual basis. Rebuilding or replacement of these lines is considered in annual transmission planning studies with the impact on system losses included in the analyses.

7.3.1 SUBSTATION CONDITION AND EFFICIENCY ASSESSMENT

Substation maintenance is scheduled to maximize reliability and functionality of substation equipment. Diagnostic tests and frequency are carefully selected to obtain meaningful data that can be used to predict and prevent failures. Many tests can be done with the equipment on-line. Infra-red scanning is an example. This is done to detect abnormal heating of equipment and connections that could lead to failure if not repaired. Corrective maintenance is scheduled based largely on diagnostic data, with the intent of restoring equipment to full functionality. Occasionally old equipment is no longer practical to repair and replacement is scheduled. As equipment is replaced and the system is developed, an emphasis is placed on reliability, efficiency and reduction of losses.

7.3.2 DISTRIBUTION SYSTEM CONDITION AND EFFICIENCY ASSESSMENT

GMO assesses the age and condition of its distribution system equipment via inspection, testing and equipment replacement programs, as described below.

Circuits and devices are inspected to protect public and worker safety and to identify conditions that might impact system reliability. This program includes inspection of all sub-transmission and distribution circuits having voltages in the range of 4kV to 34kV, as well as the poles, hardware and equipment on those circuits. Inspections will be planned to comply with MPSC Rule 4 CSR 240-

23.020 – Electrical Corporation Infrastructure Standards. A small number of transformers will be replaced annually due to oil leaks or other visually detectable issues. When transformers are replaced, GMO uses high efficiency transformers. In addition, the inspection program includes annual inspections or diagnostics of all line capacitors. Any banks found to be inoperable are repaired or replaced, thus enabling the proper power factor correction function.

KCP&L has begun installing distribution automation equipment on portions of the GMO distribution system, including, distribution capacitors, 34kV reclosers, communicating faulted circuit indicators, and power quality monitors. These systems are equipped with two-way communications and have intelligent sensors installed that allow for continuous, remote monitoring. These systems enable GMO to monitor the health of the equipment and perform condition-based inspections and maintenance.

7.3.3 MULTIPLE DEVICE INTERRUPTIONS

Devices or laterals experiencing multiple interruptions in a calendar year are designated for an engineering review. Corrective actions might include spot tree trimming, protective device additions, interrupting device coordination reviews, or other remedies.

7.3.4 (URD) CABLE REPLACEMENTS

Individual sections of single phase or three phase direct buried cable are targeted for replacement after two failures in a lifetime.

All or a subset of the cable sections in single phase or three phase direct buried cable laterals (i.e., fuse to normal open or fuse to end-of-circuit), are evaluated for replacement by application of a set of criteria for ranking replacement alternatives. An engineer will study the performance in more detail (as well as the performance of the lateral on the other side of the normal open if looped) in order to make a final determination as to how much cable (if any) will be replaced. This approach is at a more macro level than individual sections and addresses cable replacement at a neighborhood or subdivision level.

These replacements typically result in aluminum cable being replaced with more efficient copper cables.

7.3.5 DISTRIBUTION COMPONENT LIFE-CYCLE ANALYSIS

GMO is currently evaluating a more formal life cycle analysis process. The purpose is to establish credible and defensible asset life cycle estimates, determine future spending requirements for all asset classes, and support efforts to fund the replacement and cost recovery of aging delivery infrastructure. As equipment is replaced and the system is developed, emphasis is placed on reliability, efficiency and reduction of losses. GMO is currently performing a Distribution System Inventory to gather data to be used in studies as part of the life cycle analysis process. Present plans are to continue the Distribution System Inventory across the GMO territory.

7.3.6 CONVERSION OF DUSK-TO-DAWN LIGHTING

GMO standard lighting is high-pressure sodium. Mercury vapor, fluorescent and incandescent lamps are obsolete lighting types and are replaced with the standard high-pressure sodium luminaries as they fail. GMO continually monitors development of more efficient lighting technology for trial applications.

7.3.7 DISTRIBUTION SYSTEM PLANNING

GMO areas assesses system capacity, efficiency and losses via seasonal distribution system planning studies.

7.3.8 ANNUAL DISTRIBUTION SYSTEM LOAD ANALYSIS AND SYSTEM PLANNING PROCESS

GMO records summer and winter peak load conditions (power, power factor, phase balance and voltage levels) at bulk and distribution substations. Power flow analyses are then performed using the distribution substation loads as input data.

An integral part of the distribution system load analysis process is the establishment of equipment ratings and/or loading limits. GMO evaluates transformer and conductor losses as part of the methodology used in establishing distribution equipment standards for subsequent application by distribution system planning engineers. A recent study has been performed to re-evaluate transformer and conductor efficiencies throughout the distribution system.

Computer models of the electric power delivery system are updated to include projected load magnitudes and updated equipment ratings on an annual basis. GMO performs seasonal planning studies for winter and summer peak conditions. Worst-case single-contingency failure scenarios are evaluated for all bulk subtransmission substations, 34kV subtransmission feeders, distribution substations, and distribution feeder circuits. These studies assist in evaluating system limitations requiring upgrades necessary to maintain adequate system capacity and reliability. The evaluation of distribution system losses and maintenance of adequate system voltage levels are included in these analyses.

Planning system upgrades to withstand single-contingency (N-1) outage conditions insures that load levels will remain within circuit capabilities for such events. Under normal conditions (the majority of the time) individual circuit elements operate at lower load levels with correspondingly lower losses.

7.3.9 2008 SYSTEM LOSS STUDY

During 2008, KCP&L and GMO performed an evaluation of its overall electric delivery system losses. Data was used from the 2007 calendar year.

The results of these studies are being utilized in the system planning activities for the combined companies.

7.3.10 TRANSMISSION AND DISTRIBUTION SYSTEM ENGINEERING ANALYSIS

7.3.10.1 Distribution Engineering Modeling System

GMO utilizes SynerGEE modeling for distribution circuit analysis. Representations of the distribution circuits are installed in SynerGEE to perform analysis in order to ensure reliable, safe, and efficient operation of the distribution system. SynerGEE is used to perform the following types of analyses at GMO: Load Estimation, Power Flow, Protective Device Coordination, Fault Current, Phase Balancing, and Capacitor Placement. SynerGEE allows engineers to examine existing (and alternate or proposed circuit) configurations for over/under voltage/current, examine line losses, determine appropriate conductor sizing, and determine the optimal capacitor placement to reduce distribution losses. A separate cable derating program is utilized to analyze cable heating limits in order to maximize cable loading limits.

7.3.10.2 PSS/E System

GMO utilizes Siemens PTI's PSS/E software to evaluate Power Flow, Voltage Flicker and Capacitor Placement within the transmission and subtransmission system. Circuit models are utilized in PSS/E to perform these analyses in order to ensure reliable, safe, and efficient operation of the transmission system. PSS/E allows engineers to examine existing (and alternate or proposed) circuit configurations for over/under voltage/current, line losses, appropriate conductor sizing, and optimal capacitor placement configurations.

7.3.10.3 ASPEN System

GMO utilizes Siemens PSS/E and ASPEN, Inc. software to evaluate Fault Current and Protective Device Coordination within the transmission and subtransmission system. Circuit models are utilized in PSS/E and ASPEN to perform these analyses in order to ensure reliable and safe operation of the transmission system. PSS/E and ASPEN allows engineers to examine existing (and alternate or proposed) circuit configurations for maximum/minimum fault voltage/current and to develop appropriate protective device configurations and settings.

7.3.10.4 SCADA System

SCADA data is used to make system models more precisely reflect real system operation, therefore enabling better planning of the system.

7.3.11 TRANSFORMER REPLACEMENT FOR LOSS REDUCTION

GMO has previously evaluated the replacement of older, less efficient transformers for the specific purpose of loss reduction and found this approach not to be cost effective. Energy cost savings associated with reduced losses are dwarfed by the purchase price and change-out cost associated with transformer replacement.

7.3.12 COMMITMENT TO FUTURE EFFICIENCY INCREASES

GMO recently became a member of the Clinton Global Initiative, an association of eight leading utilities committed to the creation of a national institute for electric efficiency to develop regulatory models and convene supporting conferences in the power sector.

7.4 DISTRIBUTION SYSTEM LOSS EVALUATION

GMO evaluates the feasibility and cost effectiveness of potential system upgrades or expansion projects on an on-going basis.

7.4.1 PROJECT EVALUATION

Potential projects are typically identified by system operating personnel, division engineering staff and distribution system planning engineers.

All projects require an appropriate engineering analysis and review for cost-benefit justification. An internal Economic Value Added (EVA) report is prepared to capture the benefits of the project.

7.4.2 LOSS-EVALUATED TRANSFORMER PURCHASING

GMO purchases distribution transformers on a total cost of ownership basis capitalized over a 30 year life. DOE efficiency regulations have guided this methodology. GMO current purchasing practices result in the lowest full-life total owning cost for distribution, medium and large power transformers.

7.4.3 SYSTEM POWER FACTOR

GMO frequently adds new capacitor bank projects to maintain overall power factor near unity, thereby releasing as much system capacity as practical. Automatic and remote-controlled capacitor banks help to keep the system voltage stable as loads are cycled on and off, while greater system capacity supports the addition of new load on the existing system. By maintaining a power factor near unity, lower current flows through the system resulting in less power lost (I^2R losses) to heating of cables, bus bars, transformers, etc. These devices will run cooler and last longer too.

7.4.4 TYPICAL PROJECTS WHICH AFFECT SYSTEM LOSS REDUCTIONS

GMO frequently introduces projects to increase supply voltage, thereby reducing load current and I^2R losses. Examples include conversions from 4kV to 12kV, and migration toward 161kV-fed distribution substations. GMO are also involved in the EPRI (Electric Power Research Institute) Green Circuit Project that is evaluating system loss reductions.

When engineering staff reviews new customer requests, customer load additions, maintenance needs, or other issues, they typically review the design of the secondary distribution system. Circuit lengths and the number of step-down transformers installed have a significant effect on overall system efficiency.

Reconductoring existing circuits or building new circuits to serve increased system loading have a direct effect on lowering system losses.

Upgrading existing substations or strategically placing new substations to serve areas with increasing load density also act to reduce system losses.

7.4.5 DISTRIBUTED GENERATION PROJECTS (GMO OWNED AND DISPATCHED)

GMO has an interest in distributed generation (DG) to delay necessary distribution system expansion projects. Potential projects are analyzed on a case-by-case basis; however, the scope of potential candidates tends to be small. Furthermore, there is a broad range of additional considerations that do not favor installations, including:

7.4.5.1 System Expansion Projects

System expansion projects usually provide significantly improved benefits that the addition of DG would not provide. As an example, a second distribution feeder or unit at a substation provides contingency backup whereas a DG project does not.

7.4.5.2 Siting Complexities

The siting complexities, including noise and other required permitting take additional time and resources, and may altogether negate a DG project. project.

7.4.5.3 Operational complexities

There are a range of operational complexities, including fuel availability, testing, how to address failures, and new skill sets for employees to master that need to be overcome for DG projects to be successful.

7.4.6 CUSTOMER GENERATION PROJECTS (BEHIND THE METER)

Using customer generation for distribution system reliability is not in the scope of GMO electrical distribution system contribution this IRP filing. However, the following comments are offered for consistency with the preceding information regarding distributed generation:

7.4.6.1 Customer Generation Supplies Power Locally

Customer generation reduces the overall customer demand by supplying power locally - behind the meter. It is not envisioned that customer generators will routinely feed into the GMO distribution system. Customers that do intend to feed into our system will be handled through our net-metering tariffs.

7.4.6.2 Optional Customer Participation

Unless there is an agreement whereby GMO is authorized to dispatch the customer generation, there can be no firm distribution system benefit because GMO could not count on this generation, since participation by the customer is optional.

7.4.6.3 Non-Dispatchable Customer Generation

Because customer generation is non-dispatchable, GMO discounts this generation when performing load analysis and system improvement justifications. This applies to customers with generation who have not taken advantage of GMO peak shaving programs.

SECTION 8: UNCERTAIN FACTOR DEVELOPMENT

(8) Before developing alternative resource plans and performing the integrated resource analysis, the utility shall develop ranges of values and probabilities for several important uncertain factors related to supply resources. These values can also be used to refine or verify information developed pursuant to section (2) of this rule. These cost estimates shall include at least the following elements and shall be based on the indicated methods or sources of information:

8.1 FUEL PRICE FORECASTS

(A) Fuel price forecasts over the planning horizon for the appropriate type and grade of primary fuel and for any alternative fuel that may be practical as a contingency option.

The Commission granted GMO a waiver under "Order Granting KCP&L-GMO'S Request For Waivers", Case No. EE-2009-0237, dated March 11, 2009. The waiver, referred to as "Waiver Request 11", allows GMO to develop statistically averaged price forecasts for fuel commodities based on various sources of price forecast data. The various commodity price forecasts used were obtained from independent consulting firms and/or government agencies that have expert knowledge and experience in forecasting these commodities. Background methodology of the forecasts is provided in Appendix 4D. The results of the statistically averaged fuel price forecasts are shown in Table 34 and Table 35 below. The sources of the forecasts are provided in Table 36 and Table 37 below.

Table 34: Fuel Price Forecast - Natural Gas, Fuel Oil, Coal ** Highly Confidential **

FUEL PRICE FORECAST	CASE	[redacted]
Natural Gas Index Price ($/mmbtu)	MID	[redacted]
Fuel Oil Index Price ($/mmbtu)	MID	[redacted]
Coal Price Delivered ($/mmbtu)	MID	[redacted]
Natural Gas Index Price ($/mmbtu)	LOW	[redacted]
Fuel Oil Index Price ($/mmbtu)	LOW	[redacted]
Coal Price Delivered ($/mmbtu)	LOW	[redacted]
Natural Gas Index Price ($/mmbtu)	HIGH	[redacted]
Fuel Oil Index Price ($/mmbtu)	HIGH	[redacted]
Coal Price Delivered ($/mmbtu)	HIGH	[redacted]

FUEL PRICE FORECAST		2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
Natural Gas Index Price ($/mmbtu)	MID	[redacted]												
Fuel Oil Index Price ($/mmbtu)	MID	[redacted]												
Coal Price Delivered ($/mmbtu)	MID	[redacted]												
Natural Gas Index Price ($/mmbtu)	LOW	[redacted]												
Fuel Oil Index Price ($/mmbtu)	LOW	[redacted]												
Coal Price Delivered ($/mmbtu)	LOW	[redacted]												
Natural Gas Index Price ($/mmbtu)	HIGH	[redacted]												
Fuel Oil Index Price ($/mmbtu)	HIGH	[redacted]												
Coal Price Delivered ($/mmbtu)	HIGH	[redacted]												

Table 35: Fuel Price Forecast – Nuclear ** Highly Confidential **

FUEL PRICE FORECAST	CASE	2009	2010	2011	2012	2013	2014
Nuclear Fuel Cost without disposal fee ($/mmbtu)	MID	[redacted]					
Nuclear Fuel Cost without disposal fee ($/mmbtu)	LOW	[redacted]					
Nuclear Fuel Cost without disposal fee ($/mmbtu)	HIGH	[redacted]					
FUEL PRICE FORECAST	**CASE**	[redacted]					
Nuclear Fuel Cost without disposal fee ($/mmbtu)	MID	[redacted]					
Nuclear Fuel Cost without disposal fee ($/mmbtu)	LOW	[redacted]					
Nuclear Fuel Cost without disposal fee ($/mmbtu)	HIGH	[redacted]					

8.1.1 EXPERTISE OF FORECASTS

1. ***Fuel price forecasts shall be obtained from a consulting firm with specific expertise in detailed fuel supply and price analysis or developed by the utility if it has expert knowledge and experience with the fuel under consideration. Each forecast shall consider at least the following factors as applicable to each fuel under consideration:***

The source forecasts utilized to develop these fuel forecasts are shown in Table 36 and Table 37 below:

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Table 36: Source Forecasts for Coal, Natural Gas, and Fuel Oil

	Fuels		
Forecast Source	Coal	Natural Gas	Fuel Oil
EIA	x	x	x
Energy Ventures	x	x	x
Global Insight		x	x
Hill & Assoc	x		
JD Energy	x		
NYMEX		x	x
PIRA		x	x

Table 37: Source Forecast for Nuclear Fuel

	Nuclear Fuel			
Forecast Source	Mine	Conversion	Enrichment	Fabrication
	U_3O_8	UF_6	SWU	Fuel Rod
Energy Resource International	x	x	x	x

Additional information about each forecaster can be found in Appendix 4D.

For coal, see Appendix 4D, Section 2.1.

For natural gas, see Appendix 4D, Section 3.1.

For fuel oil, see Appendix 4D, Section 4.1.

For uranium, see Appendix 4D, Section 5.1.

8.1.1.1 Present Reserves and Rates

A. Present reserves, discovery rates and usage rates of the fuel and forecasts of future trends of these factors;

For coal, see Appendix 4D, Sections 2.2, 2.3 and 2.4.

For natural gas, Appendix 4D, Sections 3.2, 3.3 and 3.4.

For fuel oil, see Appendix 4D, Sections 4.2, 4.3 and 4.4.

For uranium, see Appendix 4D, Sections 5.2, 5.3 and 5.4.

8.1.1.2 Producer Information

B. Profitability and financial condition of producers;

For coal, see Appendix 4D, Section 2.5.

For natural gas, see Appendix 4D, Section 3.5.

For fuel oil, see Appendix 4D, Section 4.5.

For uranium, see Appendix 4D, Section 5.5.

8.1.1.3 Effects on Producers

C. Potential effect of environmental factors, competition and government regulations on producers, including the potential for changes in severance taxes;

For coal, see Appendix 4D, Section 2.5.

For natural gas, see Appendix 4D, Section 3.5.

For fuel oil, see Appendix 4D, Section 4.5.

For uranium, see Appendix 4D, Section 5.5.

8.1.1.4 Present And Potential Fuel Transportation Options;

(D) Capacity, profitability and expansion potential of present and potential fuel transportation options;

For coal, see Appendix 4D, Section 2.6.

For natural gas, see Appendix 4D, Section 3.6.

For fuel oil, see Appendix 4D, Section 4.6.

For uranium, see Appendix 4D, Section 5.6.

8.1.1.5 Potential Effects On Fuel Transporters

(E) Potential effects of government regulations, competition and environmental legislation on fuel transporters;

For coal, see Appendix 4D, Section 2.7.

For natural gas, see Appendix 4D, Section 3.7.

For fuel oil, see Appendix 4D, Section 4.7.

For uranium, see Appendix 4D, Section 5.7.

8.1.1.6 Potential Effects On Uranium Enrichment and Cleanup

(F) In the case of uranium fuel, potential effects of competition and government regulations on future costs of enrichment services and cleanup of production facilities;

There are no indications at the present time that any regulatory changes are planned, or will be made in the future, that significantly impact competition or cost within enrichment services or cleanup. There exists the potential for US governmental regulation changes that encourage the recycling and re-enrichment of spent nuclear fuel. Such action may reduce the space required for waste storage thereby reducing cleanup needs. However, such activity is not likely to have any material change on competition since the enrichment and manufacturing market is an oligopoly controlled by a very small number of authorized operators, and many of those operators have some degree of direct governmental control, as in the case of Areva, which is 90 percent controlled by the French government.

8.1.1.7 Potential Effects On Fuel Use

(G) Potential for governmental restrictions on the use of the fuel for electricity production.

For coal, see Appendix 4D, Section 3.8.

For natural gas, see Appendix 4D, Section 3.8.

For fuel oil, see Appendix 4D, Section 4.8.

For uranium, see Appendix 4D, Section 5.8.

8.1.2 ACCURACY OF PREVIOUS FORECAST ACCURACY

(2) The utility shall consider the accuracy of previous forecasts as an important criterion in selecting providers of fuel price forecasts.

For coal, see Appendix 4D, Section 2.9.

For natural gas, see Appendix 4D, Section 3.9.

For fuel oil, see Appendix 4DC, Section 4.9.

For uranium, see Appendix 4D, Section 5.9.

8.1.3 CRITICAL UNCERTAIN FACTORS OF PRICE FORECASTS, RANGE OF FORECASTS AND SUBJECTIVE PROBABILITY DISTRIBUTIONS

(3) The provider of each fuel price forecast shall be required to identify the critical uncertain factors that drive the price forecast and to provide a range of forecasts and an associated subjective probability distribution that reflects this uncertainty;

For coal, see Appendix 4D, Section 2.10.

For natural gas, see Appendix 4D, Section 3.10.

For fuel oil, see Appendix 4D, Section 4.10.

For uranium, see Appendix 4D, Section 5.10.

The range of allowance forecasts are shown in Table 34 above. The associated probability distribution that reflects the range of forecasts is Low: 25%, Mid: 50%, High: 25%

8.2 CAPITAL COST OF NEW FACILITIES OR MAJOR UPGRADES, REFURBISHMENT OR REHABILITATION OF EXISTING FACILITIES.

(B) Estimated capital costs including engineering design, construction, testing, startup and certification of new facilities or major upgrades, refurbishment or rehabilitation of existing facilities.

The estimated capital costs for new facilities, environmental retrofitting of existing facilities, and probable environmental factors of existing facilities are shown in Section 8.2.1 below.

8.2.1 CAPITAL COST ESTIMATE DEVELOPMENT

1. ***Capital cost estimates shall either be obtained from a qualified engineering firm actively engaged in the type of work required or***

developed by the utility if it has available other sources of expert engineering information applicable to the type of facility under consideration.

The capital cost estimates for new facilities are shown in Table 38 below and reflect costs that do not include AFUDC because Midas© calculates AFUDC internally. It should be noted that a few of these resource options utilized in integrated resource analysis relied on pricing obtained from recently obtained market-based sources instead of EPRI TAG®.

Table 38: Capital Cost Estimates Utilized In Integrated Resource Analysis
**** Highly Confidential ****

	SCPC	SCPC w/CCS*	Circulating Fluid Bed	IGCC	IGCC w/CCS*	Nuclear	Combined Cycle
	Capital w/o AFUDC ($/kW)						
Low Mid High	[redacted]						
	Combined Cycle - Total Ownership Offer	CT - G.E. 7EA	CT - LM6000	Wind	CAES	Solid Oxide Fuel Cells	Reciprocating Engines
Low Mid High	[redacted]						
	Distributed Generation	Photovoltaic Flat Plate	Animal Waste-Poultry	Landfill Gas	100% Biomass Fluidized Bed	10% Biomass for Existing Unit	
	Capital w/o AFUDC ($/kW)						
Low Mid High	[redacted]						

* CCS = Amine Absorption Capture and Compression - No Pipeline, Transportation or Sequestration Costs Included

Cost estimates were developed for anticipated environmental retrofits for Lake Road 4-6 and Sibley Station. "Option 1" retrofits are assumed to be required by 2015 and would driven by the Clean Air Interstate Rule (CAIR), CAIR replacement due to legislative action, or Best Available Retrofit Technology (BART). Option 1 retrofits include Selective Non-Catalytic Reduction/Compact Selective Catalytic Reduction (SNCR/CSCR) for NO_x control, Spray Dryer Absorber (SDA) for SO_2 control, Pulse-Jet Fabric Filter Baghouse for particulate

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capture, and Activated Carbon Injection (ACI) for mercury control at Lake Road 4-6. Option 1 retrofits are the same for Sibley 1&2 except that a SNCR system is already in place and operating. Sibley 3 has a Selective Catalytic Reduction (SCR) system already in place and operating and a SDA for SO_2 control cannot be utilized on a generating unit of this size. Therefore there isn't an "Option 1" for Sibley 3. The cost estimates for "Option 1" are shown in Table 39 below:

"Option 2" retrofits are assumed to be required by 2023 and would be driven by a second phase of a CAIR replacement program or Best Available Control Technology (BACT) requirements. Option 2 retrofits include SCR for NO_x control, Flue Gas Desulphurization (FGD) for SO_2 control, Pulse-Jet Fabric Filter Baghouse for particulate capture, and Activated Carbon Injection (ACI) for mercury control at Lake Road 4-6 and Sibley 1-2. As noted above, Sibley 3 has a SCR therefore Option 2 retrofits for this unit include Flue Gas Desulphurization (FGD) for SO_2 control, Pulse-Jet Fabric Filter Baghouse for particulate capture, and Activated Carbon Injection (ACI) for mercury control. The cost estimates for "Option 2" are shown in Table 40 below:

Table 39: Cost Estimates for Existing Units using Option 1 Environmental Retrofits ** Highly Confidential **

Option I			
	Lake Road 4-6	**Sibley 1&2**	**Sibley 3**
Capital w/o AFUDC ($/kW)			
Low	[redacted]		
Mid			
High			
Option 1 includes SNCR/CSCR (for LR 4-6 only), Spray Dryer Absorbers, and Activated Carbon Injection			

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Table 40: Cost Estimates for Existing Units using Option 2 Environmental Retrofits ** Highly Confidential **

Option 2			
	Lake Road 4-6	Sibley 1&2	Sibley 3
Capital w/o AFUDC ($/kW)			
Low Mid High	[redacted]		
Option 2 includes SCR (already in use on Sibley-3) Wet Flue Gas Desulphurization, and Activated Carbon Injection			

Cost estimates for expected probable environmental factors expected to affect existing facilities were estimated and are shown in Table 41 below:

Table 41: Probable Environmental Cost Estimates For Existing Facilities ** Highly Confidential **

	[redacted]
CCP Landfill Clean Coal Process	
Total Probable Environmental Cost ($/MWh)	

Note that two other probable environmental factors that have been identified for Lake Road 4-6 and Sibley Station, namely cooling towers and zebra mussel control, have been included in LAMP.

8.2.2 <u>CRITICAL UNCERTAIN FACTORS OF CAPITAL COST ESTIMATE AND SUBJECTIVE PROBABILITY DISTRIBUTION</u>

(2) The provider of the estimate shall be required to identify the critical uncertain factors that may cause the capital cost estimates to change significantly and to provide a range of estimates and an associated subjective probability distribution that reflects this uncertainty;

The ranges of capital cost estimates for new facilities are shown in Table 38 above. The associated probability distribution that reflects the range of forecasts is Low: 25%, Mid: 50%, High: 25%.

8.3 ESTIMATED FIXED AND VARIABLE COSTS

(C) Estimated annual fixed and variable operation and maintenance costs over the planning horizon for new facilities or for existing facilities that are being upgraded, refurbished or rehabilitated.

The estimated annual fixed and variable operation and maintenance costs for new facilities considered in integrated analysis are shown in Table 42 below. Estimated annual fixed and variable operation and maintenance costs estimated for existing facilities due to the potential addition of environmental retrofits are shown in Table 43 and Table 44 below. Further discussion of the FOM and VOM estimates was provided earlier in Sections 1.5 and 1.6.

Table 42: Fixed and Variable Operation and Maintenance Cost Estimates for New Facilities Utilized In Integrated Resource Analysis ** Highly Confidential **

	SCPC	SCPC w/CCS	Circulating Fluid Bed	IGCC	IGCC w/CCS*	Nuclear	Combined Cycle
Fixed O&M ($/kW-yr)							
Low Mid High	[redacted]						
Variable O&M ($/MWh)							
Low Mid High	[redacted]						
	Combined Cycle - Total Ownership Offer	CT - G.E. 7EA	CT - LM6000	Wind	CAES	Solid Oxide Fuel Cells	Reciprocating Engines
Fixed O&M ($/kW-yr)							
Low Mid High	[redacted]						
Variable O&M ($/MWh)							
Low Mid High	[redacted]						
	Distributed Generation	Photovoltaic Flat Plate	Animal Waste-Poultry	Landfill Gas	10% Biomass for Existing Unit	100% Biomass Fluidized Bed	
Fixed O&M ($/kW-yr)							
Low Mid High	[redacted]						
Variable O&M ($/MWh)							
Low Mid High	[redacted]						

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Table 43: Fixed and Variable Operation and Maintenance Cost Estimates for Existing Units using Option 1 Environmental Retrofits ** Highly Confidential **

Option I			
	Lake Road 4-6	**Sibley 1&2**	**Sibley 3**
Fixed O&M Increase ($/kW-yr)			
Low Mid High	[redacted]		
Variable O&M Increase ($/MWh)			
Low Mid High	[redacted]		
Option 1 includes SNCR/CSCR (for LR 4-6 only), Spray Dryer Absorbers, and Activated Carbon Injection			

Table 44: Fixed and Variable Operation and Maintenance Cost Estimates for Existing Units using Option 2 Environmental Retrofits ** Highly Confidential **

Option 2			
	Lake Road 4-6	**Sibley 1&2**	**Sibley 3**
Fixed O&M Increase ($/kW-yr)			
Low Mid High	[redacted]		
Variable O&M Increase ($/MWh)			
Low Mid High	[redacted]		
Option 2 includes SCR (already in use on Sibley-3) Wet Flue Gas Desulphurization, and Activated Carbon Injection			

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8.3.1 FIXED AND VARIABLE COSTS FROM SAME SOURCE AS CAPITAL COST ESTIMATES

(1) Fixed and variable operation and maintenance cost estimates shall be obtained from the same source that provides the capital cost estimates.

The fixed and variable operation and maintenance cost estimates shown in Table 42 were obtained from EPRI TAG® or EPRI TAG-RE® if the capital cost estimate was from EPRI TAG®. If the capital cost was obtained from a market-based source, the fixed and variable operation and maintenance costs were utilized from that same source if the data were available. Otherwise, EPRI TAG® data was used. The fixed and variable operation and maintenance cost estimates shown in Table 43 and Table 44 for the two options of potential environmental retrofits for existing units are based on estimates provided from the vendor that provided the capital cost estimates.

8.3.2 CRITICAL UNCERTAIN FACTORS AFFECTING COST ESTIMATES, RANGE OF ESTIMATES, AND SUBJECTIVE PROBABILITY DISTRIBUTION

(2) The critical uncertain factors that affect these cost estimates shall be identified and a range of estimates shall be provided, together with an associated subjective probability distribution that reflects this uncertainty;

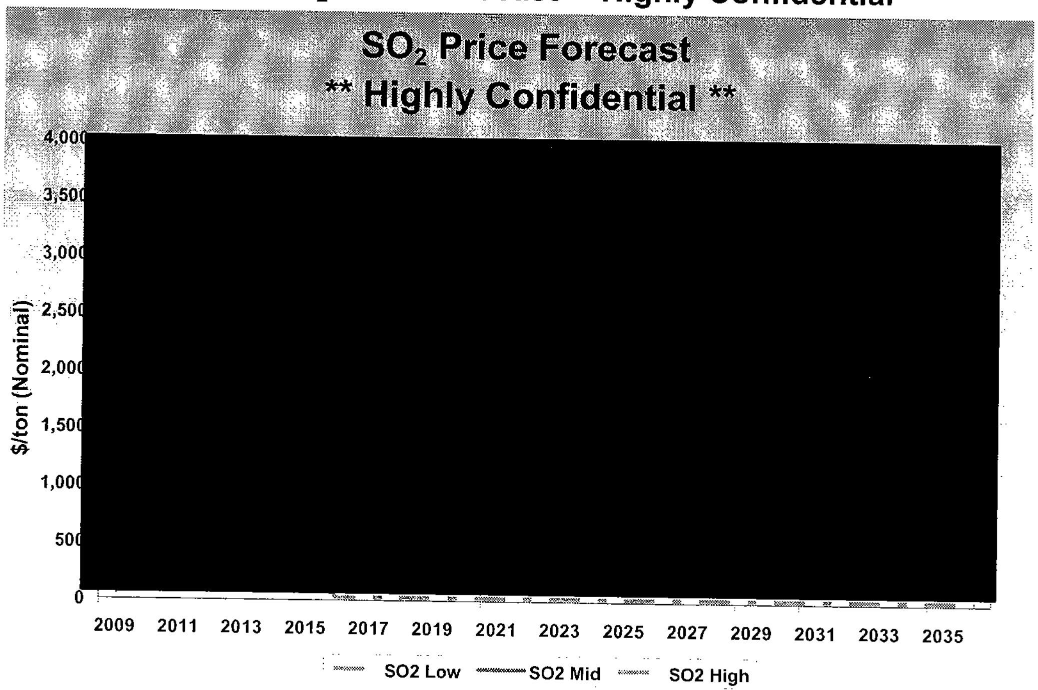
The range of fixed and variable operation and maintenance cost estimates are shown in Table 42, Table 43, and Table 44 above. The associated probability distribution that reflects the range of forecasts is Low: 25%, Mid: 50%, High: 25%

8.4 SULFUR DIOXIDE EMISSION ALLOWANCES FORECASTS

(D) Forecasts of the annual cost or value of sulfur dioxide emission allowances to be used or produced by each generating facility over the planning horizon.

The forecasted cost of sulfur dioxide emission allowances over the planning horizon is shown in Table 45 below:

Table 45: SO_2 Price Forecast ** Highly Confidential **



[redacted]

Also provided in this section are the forecasts for Annual NO_x, Seasonal NO_x, and CO_2 in Table 46, Table 47, and Table 48 below:

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Table 46: NO_x Annual Price Forecast ** Highly Confidential **

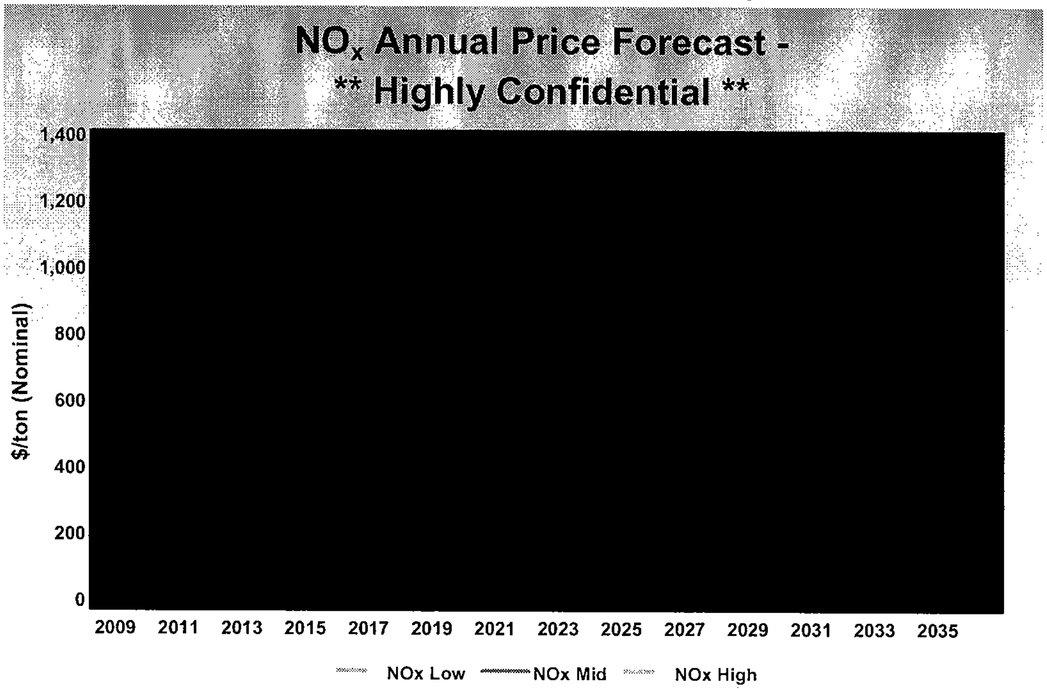

Table 47: NO_x Seasonal Price Forecast ** Highly Confidential **

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Table 48: CO_2 Price Forecast ** Highly Confidential **

8.4.1 <u>SOURCE OF FORECASTS OF THE FUTURE VALUE OF EMISSION ALLOWANCES</u>

1. Forecasts of the future value of emission allowances shall be obtained from a qualified consulting firm or other source with expert knowledge of the factors affecting allowance prices.

The source forecasts utilized to develop the emission allowance forecasts are shown in Table 49 below:

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Table 49: Source Forecasts for Emission Allowances

	Emissions			
Forecast Source	SO_2	Annual NO_x	Seasonal NO_x	CO_2
EIA				x
Energy Ventures	x	x	x	x
EPA	x			
EPRI				x
JD Energy	x	x	x	
Synapse				x
PIRA	x	x	x	x
CRA				x

f

8.4.2 ALLOWANCE CRITICAL UNCERTAIN FACTORS, RANGE OF FORECASTS AND SUBJECTIVE PROBABILITY DISTRIBUTION

2. ***The provider of the forecast shall be required to identify the critical uncertain factors that may cause the value of allowances to change significantly and to provide a range of forecasts and an associated subjective probability distribution that reflects this uncertainty; and***

8.4.2.1 Critical Uncertain Factor: Judicial and Legislative Uncertainty With Respect To Allowance Pricing

The dominant factor driving all current activity and future outlook for the SO_2 market is the uncertainty surrounding Congressional inaction on a four pollutant (4P) bill, and the disarray triggered by decisions handed down by the DC Circuit Court of Appeals regarding CAIR.

Prices for SO_2 allowances were in the low $300 per ton range just prior to the DC Circuit Court of Appeals vacating the CAIR in a decision issued on July 11, 2008. Prices went into a freefall and settled as low as $85 before rebounding to a trading range between $130 and $190 per ton. Immediately following the Court's December 23rd ruling regarding CAIR (discussed below) the price increased from about $148 to $245.

In late September the EPA made a request before the Court for a rehearing. The Court responded October 21st with an order requesting the original petitioners and EPA to reconsider if they really wanted CAIR vacated in its entirety or only in part. The petitioners filed responses with the Court on November 5th. The filings included states that were not party to the original case. The filings were only slightly in favor of the Court issuing a stay.

On December 23, 2008, the Court issued an order remanding CAIR to EPA without vacatur so the EPA may remedy CAIR's flaws in accordance with the July 11, 2008 ruling and denying the petitions for rehearing. The Court indicated, "we are convinced that, notwithstanding the relative flaws of CAIR, allowing CAIR to remain in effect until it is replaced by a rule consistent with our opinion would at least temporarily preserve the environmental values covered by CAIR." As to EPA's timeline on remand, the Court indicated, "Though we do not impose a particular schedule by which EPA must alter CAIR, we remind EPA that we do not intend to grant an indefinite stay of the effectiveness of this court's decision. Our opinion revealed CAIR's fundamental flaws, which EPA must still remedy. Further, we remind the Petitioners that they may bring a mandamus petition to this court in the event that EPA fails to modify CAIR in a manner consistent with our July 11, 2008 opinion."

The primary concern the Court had with CAIR was its inability to address fine particulate and ozone issues. The Court's order will allow CAIR to proceed for a limited period until a revised rule is promulgated by EPA to address the Court's concerns. Ultimately Congress may deal with the Court's concerns, thereby allowing SO_2 and NO_x markets to continue functioning. The eventual Congressional action may replace CAIR with a 4P bill that includes regulation of CO_2 and mercury in addition to SO_2 and NO_x. This belief that CAIR will be extended until a legislative fix can be implemented is the driving force that has kept SO_2 allowance prices in the upper end of the trading range they have occupied since August.

8.4.2.2 Critical Uncertain Factor: Potential Future Changes in Environmental Regulations With Respect To Allowance Pricing

Enactment of increasingly stringent regulatory standards as originally proposed under the Clear Skies Act may reduce the national emission cap to 3 million tons per year by 2015, and additional action could take the cap as low as 2.5 million tons by 2020. If such additional regulations do emerge, they will require additional FGD installations beyond what is currently necessary under the existing Clean Air Interstate Rule (CAIR). Regulations that focus on stricter SO_2 control are expected to push SO_2 prices upward; however, such upward price movement may be short-lived as new controls are installed. On the other hand, new environmental regulations that focus on other pollutants or combine the control of other pollutants with the increased control of SO_2 are expected to drive SO_2 prices down.

The CAVR program aimed at reducing regional haze will force the installation of scrubbers on units that largely burn very low sulfur coals and that would otherwise not require FGDs to comply with SO_2 mandates. The upshot of these developments is that even when there is no pronounced need emanating from the SO_2 market to install FGDs, scrubbers will continue to be constructed for other reasons.

Any GHG legislation will likely have profound impacts on the power industry and the SO_2 markets. The issue of climate change is particularly important to SO_2 markets from the standpoint that any restriction on carbon emissions creates a very strong incentive to replace existing coal-fired units with advanced technologies that scrub for SO_2 and are ready to capture carbon dioxide (CO_2) when that technology is commercially available.

8.4.2.3 Critical Uncertain Factor: Environmental Retrofit Installation With Respect To Allowance Pricing

In spite of the vacatur and subsequent remand of CAIR, and the uncertainty surrounding the eventual judicial and legislative settlement of this issue, there is another factor that still weighs heavily on the market for SO_2 allowances. That issue is the installation of FGD technology by utilities. The majority of FGD retrofits have not been impacted by the court action, because most utilities are bound by state regulatory and legislative requirements, and/or by existing contracts, therefore, construction and retrofits have continued unimpeded. With continued FGD installations, it is not likely that SO_2 allowance prices will return to the lofty levels reached in 2006.

8.4.2.4 Critical Uncertain Factor: Expected Future Regulations

Further detail of expected future environmental regulations is referred to in Section 2.2.1 above and attached as Appendix 4B.

8.4.2.5 Allowance Forecast Probability Distribution

The range of allowance forecasts are shown in Table 45 through Table 48 above. The associated probability distribution that reflects the range of forecasts is Low: 25%, Mid: 50%, High: 25%

8.5 FIXED CHARGES FOR FACILITY IN RATE BASE OR ANNUAL PAYMENT SCHEDULE FOR LEASED OR RENTED FACILITIES.

(5) Annual fixed charges for any facility to be included in rate base or annual payment schedule for leased or rented facilities.

There are no leased or rented facilities included in any of the GMO alternative resource plans or in the rate base, so this rule does not apply to this IRP evaluations.

SECTION 9: REPORTING REQUIREMENTS

(9) Reporting Requirements. To demonstrate compliance with the provisions of this rule, and pursuant to the requirements of 4 CSR 240-22.080, the utility shall furnish at least the following information:

9.1 SUPPLY RESOURCE SUMMARY TABLE

(A) A summary table showing each supply resource identified pursuant to section (1) and the results of the screening analysis, including:

The summary table showing the nominal utility and probable environmental cost rankings is shown in Table 50 below.

9.1.1 RESOURCE OPTION UTILITY AND PROBABLE ENVIRONMENTAL COST RANKING

1. The calculated values of the utility cost and the probable environmental cost for each resource option and the rankings based on these costs;

The summary of utility cost rankings and probable environmental cost rankings is shown in Table 50 below.

Table 50: Technology Ranking By Nominal Utility and Probable Environmental Costs ** Highly Confidential **

RANK	Technology	Nominal Utility Cost ($/MWh)	RANK	Technology	Nominal Probable Environmental Cost ($/MWh)
1	Municipal Solid Waste (MSW) Gasification	[redacted]		Municipal Solid Waste (MSW) Gasification	[redacted]
2	Municipal Solid Waste (MSW) Incinerator			Wind	
3	USCPC PRB WFGD			Nuclear GE ESBWR	
4	SCPC PRB SDA			Nuclear GE ABWR	
5	SCPC ILL #6 WFGD			Nuclear Westinghouse AP1000	
6	Fluidized Bed Combustion			Nuclear US EPR	
7	Wind			Nuclear ACR-1000	
8	Nuclear GE ESBWR			USCPC PRB WFGD	
9	Nuclear GE ABWR			SCPC PRB SDA	
10	Nuclear Westinghouse AP1000			CAES	
11	Nuclear US EPR			Municipal Solid Waste (MSW) Incinerator	
12	Fluidized Bed Combustion Ill #6			SCPC ILL #6 WFGD	
13	IGCC ILL #6 Cop			Landfill Gas	
14	CAES			USCPC PRB WFGD CO2 Cap	
15	USCPC PRB WFGD CO2 Cap			Fluidized Bed Combustion	
16	Nuclear ACR-1000			NaS Batteries	
17	SCPC ILL #6 WFGD CO2 CAP			SCPC ILL #6 WFGD CO2 CAP	
18	Landfill Gas			IGCC ILL #6 Cop	
19	Combined Cycle Total Ownership Offer			Combined Cycle Total Ownership Offer	
20	Combined Cycle Partial Ownership Offer			Combined Cycle Partial Ownership Offer	
21	NaS Batteries			Fluidized Bed Combustion Ill #6	
22	CT/CC			CT/CC	
23	IGCC ILL #6 Cop CO2 Cap			IGCC ILL #6 Cop CO2 Cap	
24	Poultry Litter			Poultry Litter	
25	Gasifier - Cattle Feedlot			Gasifier - Cattle Feedlot	
26	Biomass Fluid Bed			Biomass Fluid Bed	
27	CT/CC CCS			CT/CC CCS	
28	Digester - Dairy Cattle			Digester - Dairy Cattle	
29	Biomass Stoker			Biomass Stoker	
30	Molten Carbonate Fuel Cell			Lock and Dam Hydrological PPA	
31	Municipal Solid Waste (MSW) Plasma Arc			Molten Carbonate Fuel Cell	
32	Lock and Dam Hydrological PPA			Central Solar PV Tracking (two Axis)	
33	Distributed Generation - Bi-Fuel PPA			Municipal Solid Waste (MSW) Plasma Arc	
34	Central Solar PV Tracking (two Axis)			Distributed Generation - Bi-Fuel PPA	
35	CT Siemens (Sedalia Cost)			CT Siemens (Sedalia Cost)	
36	CT 7EA (Sedalia Cost)			Solar Thermal-Tower	
37	Reciprocating Engines			Central Solar PV Tracking (single Axis)	
38	Solar Thermal-Tower			CT 7EA (Sedalia Cost)	
39	CT LMS100			Reciprocating Engines	
40	CT LM6000			CT LMS100	
41	Central Solar PV Tracking (single Axis)			CT LM6000	
42	CT Heavy Duty			CT Heavy Duty	
43	Solid Oxide Fuel Cells			Solid Oxide Fuel Cells	
44	CT Conventional			Solar - Thin Film PV 4 MW	
45	Internal Combustiion Engine - Natural Gas - Spark Igniti			Solar - Thin Film PV 25-Yr PPA	
46	Solar - Thin Film PV 4 MW			Solar Thermal-Dish/Stirling Engine	
47	Solar - Thin Film PV 25-Yr PPA			CT Conventional	
48	Solar Thermal-Dish/Stirling Engine			Internal Combustiion Engine - Natural Gas - Spark Ig	
49	Solar Thermal -Parabolic Trough			Solar Thermal -Parabolic Trough	
50	Proton Exchange Membrane			Proton Exchange Membrane	
51	Internal Combustion Engine - Oil			Internal Combustion Engine - Oil	
52	Small Scale CT Dual- Fuel Capable - Natural Gas			Small Scale CT Dual- Fuel Capable - Natural Gas	
53	Small Scale CT Dual-Fuel Capable - Oil			Small Scale CT Dual-Fuel Capable - Oil	
54	Solar PV Residential - Utility Owned			Solar PV Residential - Utility Owned	

9.1.2 CANDIDATE RESOURCE OPTION IDENTIFICATION

2. Identification of candidate resource options that may be included in alternative resource plans; and

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Based on the rankings of the candidate resource options listed in Section 2.3 above, several resource options were passed on to integrated resource analysis. The resource options are listed in Section 2.3, Table 21 above. The initial rankings were performed generally utilizing EPRI TAG® or EPRI TAG-RE® cost data to ensure generation resource options were evaluated on a consistent cost basis. For the integrated resource analysis, the Congressional Research Service (CRS) Report for Congress provided specific project cost estimates for IGCC and nuclear projects and those cost estimates were therefore utilized. Detailed information for each of the resource options identified can be viewed in Appendix 4E.

9.1.3 SUPPLY-SIDE RESOURCE OPTION REJECTION REASONS

3. An explanation of the reasons why each supply-side resource option rejected as a result of the screening analysis was not included as a candidate resource option;

All resource options that were pre-screened but not selected for use in integrated resource analysis are listed with the exclusion explanation in Section 2.3 above.

9.2 CANDIDATE RESOURCE OPTIONS LIST

(B) A list of the candidate resource options for which the forecasts, estimates and probability distributions described in section (8) have been developed or are scheduled to be developed by the utility's next scheduled compliance filing pursuant to 4 CSR 240-22.080;

The candidate resource options are listed in Section 2.3, Table 21 above.

9.3 UNCERTAINTY ANALYSIS RESULTS

(C) A summary of the results of the uncertainty analysis described in section (8) that has been completed for candidate resource options; and

Fuel price forecasts are listed in Table 34 and Table 35 in Section 8.1 above.

Capital cost estimates for new supply-side generation are provided in Table 38 in Section 8.2.1 above.

Cost estimates for environmental retrofits are listed in Table 39 and Table 40 in Section 8.2.1 above.

Cost estimates for probable environmental of existing units are listed in Table 41 in Section 8.2.1 above.

Fixed and variable O&M cost estimates for new and existing generation are provided in Table 42 through Table 44 in Section 8.3 above.

Emission price forecasts are listed in Table 45 through Table 48 in Section 8.4 above.

9.4 CANDIDATE RESOURCE OPTIONS MITIGATION COST ESTIMATES

(D) A summary of the mitigation cost estimates developed by the utility for the candidate resource options identified pursuant to subsection (2)(C). This summary shall include a description of how the alternative mitigation levels and associated subjective probabilities were determined and shall identify the source of the cost estimates for the expected mitigation level.

For the candidate resource options identified in Section 2.3, the mitigation cost estimates are shown in Table 51 below. Mitigation cost estimates are comprised of two components: the utility costs based upon the averaging of SO_2, NO_x, and $NO_{x\ Seasonal}$ emissions cost estimates and probable environmental costs based upon HAPs control, landfill operation costs, zebra mussel control, and averaging of CO_2 emission cost estimates. Note that the subjective probabilities assigned to the probable environmental components are all 100% because proposed laws, regulations, and likelihood of occurrence (zebra mussel infestation) are considered inevitable.

Table 51: Candidate Resource Options Probable Environmental Costs ** Highly Confidential **

Technology	Prob Envir ($/MWh)
Super Critical Pulverized Coal	[redacted]
Super Critical Pulverized Coal w/CO_2 Capture	[redacted]
Fluidized Bed Combustion (FBC)	[redacted]
Integrated Gasification Combined Cycle (IGCC)	[redacted]
IGCC w/CO_2 Capture	[redacted]
Nuclear - U.S. EPR	[redacted]
Combined Cycle	[redacted]
Compressed Air Energy Storage	[redacted]
Fuel Cell - Molten Carbonate	[redacted]
Combustion Turbines - 77 MW	[redacted]
Combustion Turbines - 46 MW	[redacted]
Reciprocating Engines	[redacted]
Distributed Generation Bi-Fuel PPA	[redacted]
Central Solar PV Flat Plate Thin Film	[redacted]
Wind	[redacted]
Landfill Gas	[redacted]
Poultry Litter	[redacted]
100% Biomass Circulating Fluidized Bed	[redacted]

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