NP

2010-2029 Integrated Resource Plan
for
The Empire District Electric Company

Volume V
Integrated Resource Analysis (4 CSR 240-22.060)
Risk Analysis and Strategy Selection (4 CSR 240-22.070)

September 2010

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S.0 Volume V Summary

S.1 Overview

This volume of Empire's Integrated Resource Plan addresses the requirements of 4 CSR 240-22.060 Integrated Resource Analysis and 4 CSR 240-22.070 Risk Analysis and Strategy Selection. Volumes II, III, and IV present the load forecast assumptions, demand-side resource candidates available for selection in the future, and the supply-side resources that are to be optimized in the capacity expansion modeling. This volume presents the development and analysis of the alternate resource plans considered in the optimized resource selection, the alternate futures evaluated, the results of the optimized resource selection, the identification of critical uncertain factors that impact the performance of alternate plans, the assessment of the risk associated with alternate resource plan, the resulting Preferred Plan and the associated Implementation Plan and Resource Acquisition Strategy.

As of the date of this IRP filing (September 2010), Empire has selected a Preferred Plan that represents the actions that it would take if the conditions that existed at the time of the analysis still existed at the time of the filing. As part of Empire's normal budget cycle, an updated five-year load forecast has been developed. **

**

This periodic IRP analysis, in conjunction with Empire's normal planning process, assists Empire in making decisions concerning the timing and type of system expansion that should ultimately occur. The results of the IRP analysis documented in this report reflect only current and projected conditions as they were known at the time that the results were developed. Empire will re-examine its capacity expansion decisions as the need for additional resources, driven by load growth, and the influence of external factors, primarily environmental, become more evident. **

** The preferred plan, implementation plan, and resource acquisition plan (Plans) presented in this IRP have been approved by a committee of Empire's senior management[1] at the time of this IRP filing (September 2010).

The Plans will be subjected to ongoing evaluation as modeling assumptions change based on evolving business conditions and as environmental laws and regulations become more codified.

[1] The senior management team that approved this IRP consists of Brad Beecher, Executive Vice President and COO – Electric; Greg Knapp, Vice President – Finance and CFO, Kelly Walters, Vice President – Regulatory and General Services; and Harold Colgin, Vice President – Energy Supply. The entire IRP team is listed in Appendix A.

S.2 Objectives

Integrated resource planning for electric utilities has evolved considerably over the past twenty years and can no longer solely be used to identify the least cost resources; such a plan must explicitly consider risks and uncertainties. Empire's objectives in preparing the 2010 IRP reflect its commitment to provide cost-effective, safe, and reliable electric service to its customers and include:

- to provide reliable electricity service while complying with all environmental requirements
- to minimize the cost of providing electric service
- to achieve and/or maintain investment grade ratings on its debt to provide corporate financial stability and minimize financing costs
- to accommodate and manage a broad range of industry uncertainties.

S.3 Base Assumptions

Both DSM and supply-side resources were considered as available resources in this IRP. A number of scenarios were examined in developing the preferred plan. Resource assumptions made for the base case, most of which are common to other cases, except where specified, include:

1) The expiration of the Westar contract for 162 MW.
2) An ownership share of 7.52% (approximately 50 MW) in the coal-fired Plum Point generating unit. The unit met in-service criteria on August 12, 2010.
3) A 50 MW Plum Point PPA (with the option to convert to ownership in 2015).
4) A 12% (approximately 102 MW) ownership share in Iatan 2 (scheduled to begin operation in the fall of 2010).
5) The assumption that five percent of any new wind capacity would count towards the capacity reserve margin.
6) **_____**
7) **_____**
8) **_____**

With these supply-side resource decisions and implementation of the slate of DSM programs, Empire's planning reserve margins appear to be satisfied until **_____**

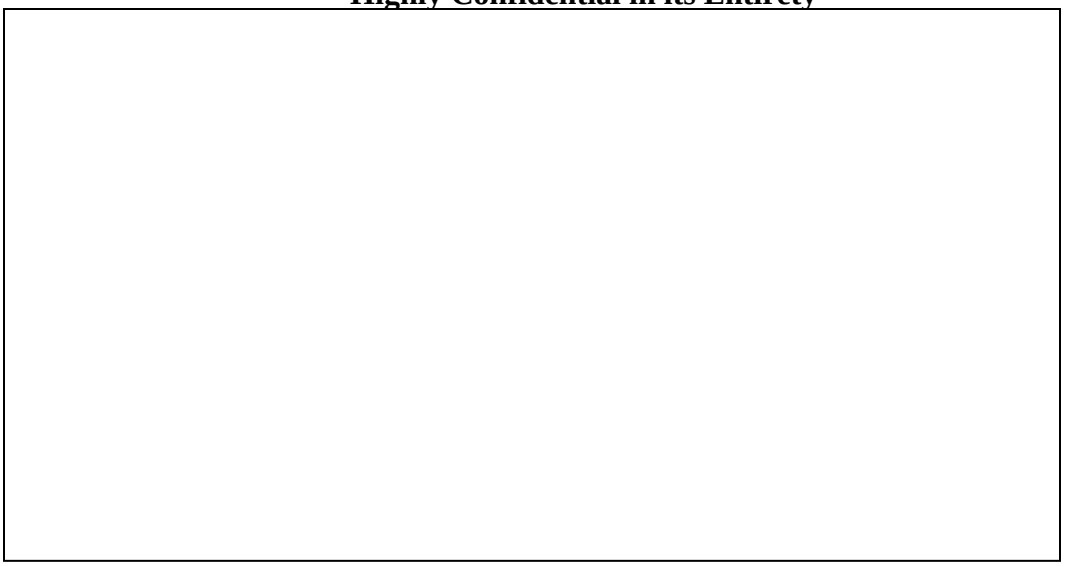
S.4 Alternative Resource Plans

IRP cases were developed and analyzed in this IRP filing for the following 17 sets of future assumptions.

1. Base Assumptions (all resources)
2. Base Assumptions (no future coal)
3. Base Assumptions (no future coal and no DSM)
4. **_____**
5. **_____**
6. **_____**
7. **_____**
8. **_____**
9. No CO_2 tax with correlated market and fuel prices
10. Low CO_2 tax with correlated market and fuel prices
11. High CO_2 tax with correlated market and fuel prices
12. High CO_2 tax with correlated market and fuel prices (no future coal)
13. Base assumptions with high load
14. Base assumptions with low load
15. High fuel and market prices – base CO_2
16. Low fuel and market prices – base CO_2
17. Base assumptions with no future coal option, all DSM programs passing base cost assumptions

Both DSM and supply-side resources were considered as available resources in this IRP. During Phase 1 of the integration and risk analysis (capacity expansion modeling), specific optimized resource plans that resulted in the lowest present value of revenue requirements (PVRR) were developed for each of 17 different scenarios with a capacity expansion model. Each set of resources was developed specifically to perform the best under the assumptions for the possible future dictated by each plan. These cases are not directly comparable since the base assumptions varied significantly between the plans. Figure S-1 shows the PVRR for each plan based on the assumption that the futures that they were developed for would actually occur.

Figure S-1
**** Highly Confidential in its Entirety****

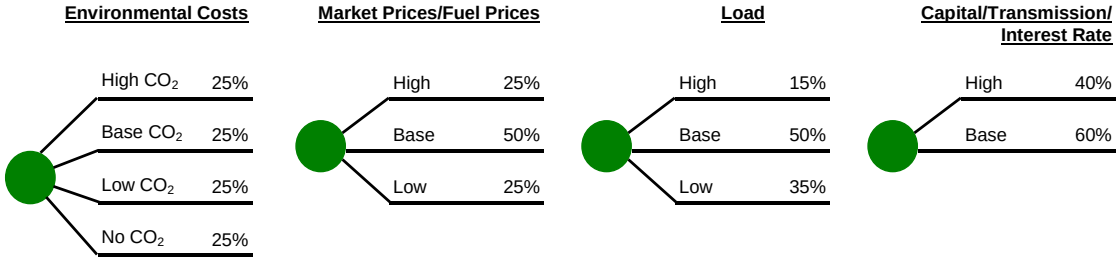


Source: Ventyx

S.5 Uncertainty Analysis and Risk Profiles

Risk profiles were prepared in order to quantify the risks associated with the preferred plan and the other plans. These risk profiles are cumulative probability distributions of the present value of revenue requirements (PVRR) developed across a range of uncertainties that reflect the critical uncertain factors associated with the future. The decision tree (Figure ES-6) developed for the uncertainty analysis examined many uncertain variables for each plan (critical uncertain factors). The uncertainties can be grouped into four main categories: 1) environmental costs, 2) market and fuel prices, 3) load forecast, and 4) capital and transmission costs and interest rates. For environmental costs, the base contains higher costs than the low and no CO_2 cost cases and lower costs than the high case. All environmental costs were correlated to the assumed CO_2 costs. For the market prices/fuel prices and load, the uncertainties reflect a high and low around a base. All high, low and base market and fuel prices were correlated with the corresponding CO_2 costs. For capital and transmission costs and interest rates, only a base and high level were examined. The critical uncertain factors are shown in Figure S-2. The probabilities assigned to each branch were developed by the IRP team in conjunction with Empire's senior management and reflect knowledge of the Empire system and the application of professional judgment.

Figure S-2
Critical Uncertain Factors



(Source: Ventyx)

All of the cases were also analyzed stochastically in a decision tree by subjecting each plan to all of the levels of the critical uncertain factors, creating a 72 endpoint tree for each of the 17 plans. This analysis results in risk profiles for each plan.

The risk profiles for the cases that utilize the base case assumptions (and that can be compared one with the other) are shown on Figure S-3. The risk profile for Plan 4 can be seen to be the left-most curve on the figure and the one with the steepest profile, which translates into the lowest risk. Plan 4 was selected by Empire as the Preferred Plan as described in Section S.6.

Figure S-3
All Base Scenarios – Risk Profiles (2010-2029)
****Highly Confidential in its Entirety****

(Source: Ventyx)

S.6 Preferred Plan

The examination of the seventeen plans led to a set of DSM and supply-side resource additions over the planning horizon that constitute Empire's preferred plan. Figure S-4 describes the highlights in the early years of the Preferred Plan.

Figure S-4
Preferred Plan Highlights for the Early Years of the IRP

- **Proposed Changes to Existing Resources**
  - **
  -
  -
  -
  -
  - **
- **Proposed New Supply-Side Resources**
  - Plum Point coal-fired unit begins operation in 2010
  - Iatan 2 coal-fired unit expected to begin operation in 2010
  - **
- **Proposed New Demand-Side Management**
  - **
  -
  -
  -
  -
  - **

Figure S-5 shows the DSM and supply-side resources in the preferred plan along with the existing resources. Figure S-6 shows only the new supply-side resources added over the planning horizon in the preferred plan. Figure S-7 shows the DSM programs selected in the preferred plan.

Table S-1 details the supply-side and DSM resources that in total constitute the resources in the preferred plan.

The results of the IRP analysis documented in this report reflect only current and projected conditions as they were known at the time that the results were developed.

Empire will re-examine its capacity expansion decisions as the need for additional resources, driven by load growth, and the influence of external factors, primarily environmental, become more evident. **

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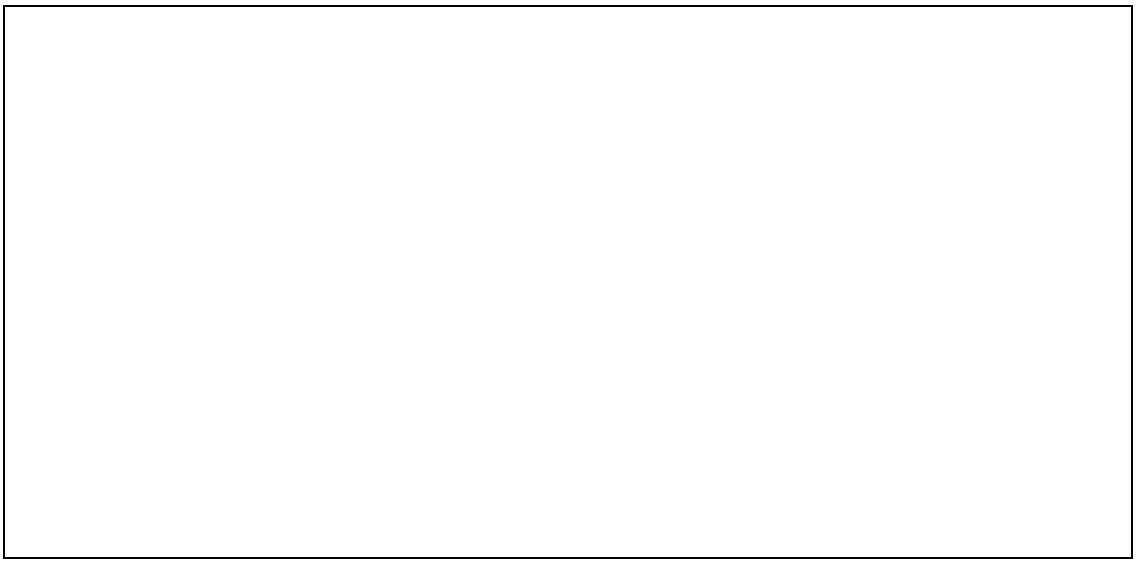
Figure S-5
Existing and Preferred Plan Proposed New Resources
****Highly Confidential in its Entirety****

(Source: Ventyx)

Figure S-6
Proposed New Supply-Side Resources in Preferred Plan
****Highly Confidential in its Entirety****



(Source: Ventyx)

The additional supply-side resources contemplated in the Preferred Plan, as shown in Figures S-6 and Table S-1, include **

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Figure S-7
Preferred Plan – Proposed New Demand-Side Management Programs
****Highly Confidential in its Entirety****

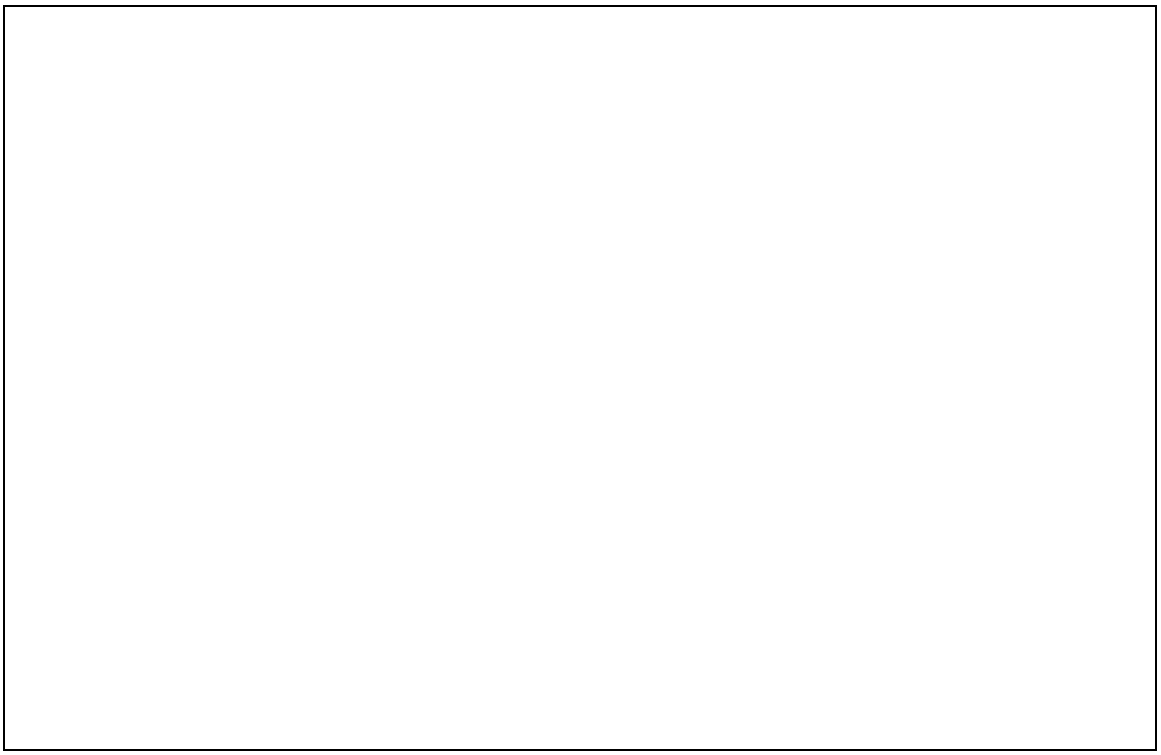

Table S-1 ** Highly Confidential in its Entirety**
Empire's Preferred Plan – Proposed Changes to Existing Resources, New DSM and New Supply-Side Resources

S.7 Implementation Plan

During 2010, the construction of the Plum Point coal-fired generating unit has been completed and the unit met its in-service criteria on August 12, 2010. Empire has a 7.52% (approximately 50 MW) undivided ownership share of the unit plus a 50 MW power purchase agreement (PPA). Iatan 2 is anticipated to enter commercial operation during the fall of 2010. Kansas City Power & Light is the majority owner-operator of the coal-fired Iatan 2 unit; Empire's share of the unit is 12% (approximately 102 MW).

The demand-side management (DSM) programs that have been implemented include:

- Low Income Weatherization
- Low Income – New Homes
- Home Performance with ENERGY STAR®
- Residential High Efficiency Lighting (ENERGY STAR® Change a Light)
- Residential High Efficiency Central Air Conditioning (CAC)
- ENERGY STAR® Homes
- Commercial and Industrial (C&I) Rebate
- Building Operator Certification Program
- Interruptible Service Rider

Evaluation, Measurement & Verification (EM&V) studies for several of these programs have been completed since the 2007 IRP was filed or are currently in process.

As a result of its current resource commitments in conjunction with the analysis results from this IRP, Empire will:

- **
- **
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- **
- **

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- **
- **
- Track and evaluate results of the implementation of DSM programs and keep the Customer Programs Collaborative (CPC) informed as to the results.[2]
- Monitor federal efforts regarding carbon regulations.

Table S-2 outlines the steps that Empire might take to implement the DSM programs selected in the Preferred Plan, **

**

[2] The Customer Programs Collaborative was established as a result of a stipulation and agreement and, in addition to Empire personnel, is comprised of Missouri Public Service Commission (MPSC) staff, Office of Public Counsel, Missouri Department of Natural Resources, and other interested parties. The CPC is charged with making decisions pertaining to the development, implementation, monitoring, and evaluation of Empire's affordability, energy efficiency, and demand response programs.

Table S-2
Implementation Plan Timeline
****Highly Confidential in its Entirety****

Empire will continue to monitor federal legislative and regulatory requirements associated with renewable portfolio standards (RPS) in addition to tracking changes in other environmental regulations. With its current purchases of wind energy from both the Elk River and Meridian Way Wind Farms, Empire meets the percentages of renewable energy now required by the States of Missouri and Kansas for the near-term time period covered in the implementation plan.

S.8 Resource Acquisition Strategy

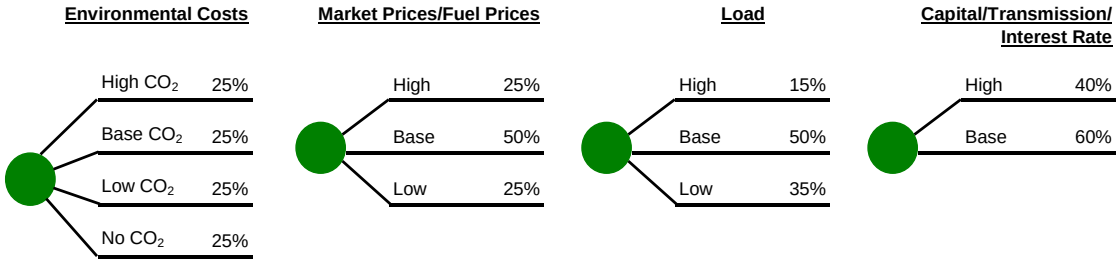
The Empire Resource Acquisition Strategy (RAS), required as part of the filing of this IRP, was formally approved by a committee of senior management at a meeting on August 30, 2010.[3] The Preferred Plan incorporated in this IRP is documented in the Executive Summary Volume and further discussed in Section 4.0 of this Volume. The Implementation Plan is documented in the Executive Summary Volume and further discussed in Section 5.0 of this Volume.

The critical uncertain factors Empire has identified include environmental costs, market prices/fuel prices, load, and capital/transmission/interest costs (See Figure S-8). As part

[3] The senior management team composition was previously documented in this Volume. A listing of the entire IRP team is shown in Appendix A.

of the normal course of business, these factors are monitored very closely by Empire personnel in coordination with senior management.

Figure S-8
Critical Uncertain Factors



Company personnel monitor environmental regulations and requirements to determine what actions need to be undertaken to ensure compliance and to determine the costs associated with that compliance. Among the environmental issues Empire is currently tracking are issues relating to ozone; sulfur dioxide (SO_2); nitrogen dioxide (NO_2); the Clean Air Interstate Rule (CAIR) and its impending replacement rule, the Clean Air Transport Rule (CATR); water; particulate matter, specifically for 2.5 micrometers ($PM_{2.5}$); the Coal Combustion Residuals (CCR) rule relating to ash; mercury and hazardous air pollutants (Hg/HAPS); and carbon dioxide (CO_2). The information gathered is shared through discussions with senior management.

Power prices and fuel prices are regularly monitored by operational personnel. Both operational personnel and senior management are kept abreast of the processes and procedures being implemented in the Southwest Power Pool (SPP) that directly impacts the availability and pricing of power. The price of natural gas is closely monitored. As documented in Volume III, Empire implemented a natural gas risk management policy that has an objective of minimizing the impact of natural gas price volatility. The risk management policy includes monitoring of natural gas prices. The natural gas risk management policy is overseen and positions taken are approved annually by senior management.

Empire's load forecast is revised annually and close attention is paid to the levels of peak demand during the summer and winter months. Scheduled reviews on the load forecast are held with senior management. Each month, Empire prepares a variance report related to the demand and energy forecast and the actual results.

The capital costs associated with generation and transmission projects are monitored by Empire in a variety of ways. A project development team is formed for each major generation project with direct line reporting to a member of senior management. Finance personnel monitor the markets daily to track interest rates, are in frequent contact with the rating agencies, and are kept abreast of planned budgets for new projects. These efforts are coordinated with members of senior management.

Empire's operating structure is organized in such a manner that senior management is both involved in and well-informed as to the key factors that have been identified in this IRP as the critical uncertain factors. Due to the level of communication and information flow within the Company, significant changes in these factors can be addressed immediately with appropriate changes to the Preferred Plan, implementation plan, or any other portion of the IRP prior to the next scheduled IRP filing (2013).

Empire will determine the range of outcomes within which the Preferred Plan is judged to be appropriate in accordance with 4 CSR 240-22.070. **

** Through its monitoring of the critical uncertain factors, Empire may decide that changes to its Preferred Plan are warranted.

Empire's 2010 IRP considers a twenty-year planning horizon. Today, with all of the uncertainties discussed above, the resource planning process is a difficult and complex task. The IRP process, while rigorous, is built on a large set of planning assumptions that are always shifting. The plan is subject to the ongoing need to reevaluate modeling assumptions based on changing business conditions. The plans presented in this IRP are based on the best information available at the time that the analysis was conducted. It is a plan. Requests for proposals, further analysis, and, in some instances, regulator support are needed to turn aspects of the plan into actual projects.

1.0 Introduction

1.1 Background

The Empire District Electric Company (Empire) is an operating public utility engaged in the generation, purchase, transmission, distribution and sale of electricity in parts of Missouri, Kansas, Oklahoma and Arkansas. Empire's service territory includes an area of about 10,000 square miles with a population of over 450,000. The service territory is located principally in southwestern Missouri and also includes smaller areas in southeastern Kansas, northeastern Oklahoma and northwestern Arkansas. The principal activities of these areas include light industry, agriculture and tourism.

Empire's total 2009 retail electric revenues were derived approximately 89.1% from Missouri customers, 5.1% from Kansas customers, 3.0% from Oklahoma customers and 2.8% from Arkansas customers. Empire supplies electric service at retail to 120 incorporated communities and to various unincorporated areas and at wholesale to four municipally owned distribution systems. The largest urban area served is the city of Joplin, Missouri, and its immediate vicinity, with a regional population of approximately 157,000. Empire's system hit a new maximum hourly demand of 1,199 MW on January 8, 2010. The previous maximum demand of 1,173 MW was set on August 15, 2007. Empire's 2009 native customer load was 5,263,206 MWh (net system input or NSI). Empire's electric operating revenues in 2009 were derived as follows: residential 41.6%, commercial 31.4%, industrial 15.2%, wholesale on-system 4.2%, wholesale off-system 3.3% and other 4.3%.

1.2 Objectives

Integrated resource planning for electric utilities has evolved considerably over the past twenty years and can no longer solely be used to identify the least cost resources; such a plan must explicitly consider risks and uncertainties. Empire's objectives in preparing the 2010 IRP reflect its commitment to provide cost-effective, safe, and reliable electric service to its customers and include:

- to provide reliable electricity service while complying with all environmental requirements
- to minimize the cost of providing electric service
- to achieve and/or maintain investment grade ratings on its debt to provide corporate financial stability and minimize financing costs
- to accommodate and manage a broad range of industry uncertainties.

1.3 Regulatory Requirements

1.3.1 4 CSR 240-22.060 Integrated Resource Analysis

PURPOSE: This rule requires the utility to design alternative resource plans to meet the planning objectives identified in 4 CSR 240-22.010(2) and sets minimum standards for the scope and level of detail required in resource plan analysis, and for the logically consistent and economically equivalent analysis of alternative resource plans.

(1) Resource Planning Objectives. The utility shall design alternative resource plans to satisfy at least the objectives and priorities identified in 4 CSR 240-22.010(2). The utility may identify additional planning objectives that alternative resource plans will be designed to serve.
(2) Specification of Performance Measures. The utility shall specify a set of quantitative measures for assessing the performance of alternative resource plans with respect to identified planning objectives. These measures shall include at least the following: present worth of utility revenue requirements, present worth of probable environmental costs, present worth of out-of-pocket costs to participants in demand-side programs, levelized annual average rates and maximum single-year increase in annual average rates. All present worth and levelization calculations shall use the utility discount rate and all costs and benefits shall be expressed in nominal dollars. Utility decision-makers may also specify other measures that they believe are appropriate for assessing the performance of resource plans relative to the planning objectives identified in 4 CSR 240-22.010(2).
(3) Development of Alternative Resource Plans. The utility shall use appropriate combinations of candidate demand-side and supply-side resources to develop a set of alternative resource plans, each of which is designed to achieve one (1) or more of the planning objectives identified in 4 CSR 240-22.010(2). The alternative resource plans developed at this stage of the analysis shall not include load-building programs, which shall be analyzed as required by section (5) of this rule.
(4) Analysis of Alternative Resource Plans. The utility shall assess the relative performance of the alternative resource plans by calculating for each plan the value of each performance measure specified pursuant to section (2). This calculation shall assume values for uncertain factors that are judged by utility decision-makers to be most likely. The analysis shall cover a planning horizon of at least twenty (20) years and shall be carried out with computer models that are capable of simulating the total operation of the system on a year-by-year basis in order to assess the cumulative impacts of alternative resource plans. These models shall be sufficiently detailed to accomplish the following tasks and objectives:
    (A) The financial impact of alternative resource plans shall be modeled in sufficient detail to provide comparative estimates of at least the following measures of the utility's financial condition for each year of the planning horizon: pretax interest coverage, ratio of total debt to total capital and ratio of net cash flow to capital expenditures;
    (B) The modeling procedure shall be based on the assumption that rates will be adjusted annually, in a manner that is consistent with Missouri law. This provision

does not imply any requirement for the utility to file actual rate cases or for the commission to accord any particular ratemaking treatment to actual costs incurred by the utility;

(C) The modeling procedure shall include a method to ensure that the impact of changes in electric rates on future levels of demand for electric service is accounted for in the analysis; and

(D) The modeling procedure shall treat supply-side and demand-side resources on a logically consistent and economically equivalent basis. This means that the same types or categories of costs, benefits and risks shall be considered, and that these factors shall be quantified at a similar level of detail and precision for all resource types.

(5) Analysis of Load-Building Programs. If the utility intends to continue existing load-building programs or implement new ones, it shall analyze these programs in the context of one (1) or more of the alternative plans developed pursuant to section (3) of this rule, including the preferred resource plan selected pursuant to 4 CSR 240-22.070(6). This analysis shall use the same modeling procedure and assumptions described in section (4) and shall include the following elements:

(A) Estimation of the impact of load-building programs on the electric utility's summer and winter peak demands and energy usage;

(B) A comparison of annual average rates in each year of the planning horizon for the resource plan with and without the load-building program;

(C) A comparison of the probable environmental costs of the resource plan in each year of the planning horizon with and without the proposed load-building program; and

(D) An assessment of any other aspects of the proposed load-building programs that affect the public interest.

(6) 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 prepare a report that contains at least the following information:

(A) A description of each alternative resource plan including the type and size of each resource addition and a listing of the sequence and schedule for retiring existing resources and acquiring each new resource addition;

(B) A summary tabulation that shows the performance of each alternative resource plan as measured by each of the measures specified in section (2) of this rule;

(C) For each alternative resource plan, a plot of each of the following over the planning horizon:

1. The combined impact of all demand-side resources on the base-case forecast of summer and winter peak demands;
2. The composition, by program, of the capacity provided by demand-side resources;
3. The composition, by supply resource, of the capacity (including reserve margin) provided by supply resources. Existing supply-side resources may be shown as a single resource;
4. The combined impact of all demand-side resources on the base-case forecast of annual energy requirements;

5. The composition, by program, of the annual energy provided by demand-side resources;
6. The composition, by supply resource, of the annual energy (including losses) provided by supply resources. Existing supply-side resources may be shown as a single resource;
7. The values of the three (3) measures of financial condition identified in subsection (4)(A);
8. Annual average rates;
9. Annual emissions of each environmental pollutant identified pursuant to 4 CSR 240-22.040(2)(B)1; and
10. Annual probable environmental costs.

(D) A discussion of how the impacts of rate changes on future electric loads were modeled and how the appropriate estimates of price elasticity were obtained;

(E) A description of the computer models used in the analysis of alternative resource plans; and

(F) A description of any proposed load-building programs, a discussion of why these programs are judged to be in the public interest and, for all resource plans that include these programs, plots of the following over the planning horizon:

1. Annual average rates with and without the load-building programs; and
2. Annual utility costs and probable environmental costs with and without the load-building programs.

Table 1-1
Summary of Compliance with Reporting Requirements for IRP Rule for Integrated Resource Analysis (4 CSR 240-22.060 (6))

Rule	Description	Location in Report
22.060 (6) (A)	Each alternative resource plan	Section 2.0, Table 2-10, Table 2-11, Appendix B
22.060 (6) (B)	Summary tabulation	Figure 2-3 through Figure 2-9
22.060 (6) (C)	Plots required	Figures 2-6, 2-7, 2-8, Table 2-10, Table 2-11, Appendix B, C, D, E
22.060 (6) (D)	Impact of rate changes on future loads	Volume II contains the load forecast. Low, base and high load forecasts developed in Volume II. Load analyzed as a critical uncertain factor as documented in Section 3.0 of this Volume
22.060 (6) (E)	Description of computer models	Appendix A
22.060 (6) (F)	Load-building program description	None planned

1.3.2 4 CSR 240-22.070 Risk Analysis and Strategy Selection

PURPOSE: This rule requires the utility to identify the critical uncertain factors that affect the performance of resource plans, establishes minimum standards for the methods used to assess the risks associated with these uncertainties and requires the utility to specify and officially adopt a resource acquisition strategy.

(1) The utility shall use the methods of formal decision analysis to assess the impacts of critical uncertain factors on the expected performance of each of the alternative resource plans developed pursuant to 4 CSR 240- 22.060(3), to analyze the risks associated with alternative resource plans, to quantify the value of better information concerning the critical uncertain factors and to explicitly state and document the subjective probabilities that utility decision-makers assign to each of these uncertain factors. This assessment shall include a decision-tree representation of the key decisions and uncertainties associated with each alternative resource plan.

(2) Before developing a detailed decision-tree representation of each resource plan, the utility shall conduct a preliminary sensitivity analysis to identify the uncertain factors that are critical to the performance of the resource plan. This analysis shall assess at least the following uncertain factors:
   (A) The range of future load growth represented by the low-case and high-case load forecasts;
   (B) Future interest rate levels and other credit market conditions that can affect the utility's cost of capital;
   (C) Future changes in environmental laws, regulations or standards;
   (D) Relative real fuel prices;
   (E) Siting and permitting costs and schedules for new generation and generation-related transmission facilities;
   (F) Construction costs and schedules for new generation and transmission facilities;
   (G) Purchased power availability, terms and cost;
   (H) Sulfur dioxide emission allowance prices;
   (I) Fixed operation and maintenance costs for existing generation facilities;
   (J) Equivalent or full- and partial-forced outage rates for new and existing generation facilities;
   (K) Future load impacts of demand-side programs; and
   (L) Utility marketing and delivery costs for demand-side programs.

(3) For each alternative resource plan, the utility shall construct a decision-tree diagram that appropriately represents the key resource decisions and critical uncertain factors that affect the performance of the resource plan.

(4) The decision-tree diagram for all alternative resource plans shall include at least two (2) chance nodes for load growth uncertainty over consecutive subintervals of the planning horizon. The first of these subintervals shall be not more than ten (10) years long.

(5) The utility shall use the decision-tree formulation to compute the cumulative probability distribution of the values of each performance measure specified pursuant to 4 CSR 240-22.060(2), contingent upon the identified uncertain factors and associated subjective probabilities assigned by utility decision makers pursuant to

section (1) of this rule. Both the expected performance and the risks of each alternative resource plan shall be quantified.

(A) The expected performance of each resource plan shall be measured by the statistical expectation of the value of each performance measure.

(B) The risk associated with each resource plan shall be characterized by some measure of the dispersion of the probability distribution for each performance measure, such as the standard deviation or the values associated with specified percentiles of the distribution.

(6) The utility shall select a preferred resource plan from among the alternative plans that have been analyzed pursuant to the requirements of 4 CSR 240-22.060 and sections (1)–(5) of this rule. The preferred resource plan shall satisfy at least the following conditions:

(A) In the judgment of utility decision makers, the preferred plan shall strike an appropriate balance between the various planning objectives specified in 4 CSR 240-22.010(2); and

(B) The trend of expected unserved hours for the preferred resource plan must not indicate a consistent increase in the need for emergency imported power over the planning horizon.

(7) The impact of the preferred resource plan on future requirements for emergency imported power shall be explicitly modeled and quantified. The requirement for emergency imported power shall be measured by expected unserved hours under normal-weather load conditions.

(A) The daily normal-weather series used to develop normal-weather loads shall contain a representative amount of day-to-day temperature variation. Both the high and low extreme values of daily normal-weather variables shall be consistent with the historical average of annual extreme temperatures.

(B) The supply-system simulation software used to calculate expected unserved hours shall be capable of accurately representing at least the following aspects of system operations:

1. Chronological dispatch, including unit commitment decisions that are consistent with the operational characteristics and constraints of all system resources;
2. Heat rates, fuel costs, variable operation and maintenance costs, and sulfur dioxide emission allowance costs for each generating unit;
3. Scheduled maintenance outages for each generating unit;
4. Partial- and full-forced-outage rates for each generating unit; and
5. Capacity and energy purchases and sales, including the full spectrum of possibilities, from long-term firm contracts or unit participation agreements to hourly economy transactions.
    A. The utility shall maintain the capability to model purchases and sales of energy both with and without the inclusion of sulfur dioxide emission allowances.
    B. The level of energy sales and purchases shall be consistent with forecasts of the utility's own production costs as compared to the forecasted production costs of other likely participants in the bulk power market; and

(C) The utility may use an alternative method of calculating expected unserved hours per year if it can demonstrate that the alternative method produces results that are equivalent to those obtained by a method that meets the requirements of subsection (7)(B).

(8) The utility shall quantify the expected value of better information concerning at least the critical uncertain factors that affect the performance of the preferred resource plan, as measured by the present value of utility revenue requirements.

(9) The utility shall develop an implementation plan that specifies the major tasks and schedules necessary to implement the preferred resource plan over the implementation period. The implementation plan shall contain:

(A) A schedule and description of ongoing and planned research activities to update and improve the quality of data used in load analysis and forecasting;

(B) A schedule and description of ongoing and planned demand-side programs, program evaluations and research activities;

(C) A schedule and description of all supply-side resource acquisition and construction activities; and

(D) Identification of critical paths and major milestones for each resource acquisition project, including decision points for committing to major expenditures.

(10) The utility shall develop, document and officially adopt a resource acquisition strategy. This means that the utility's resource acquisition strategy shall be formally approved by the board of directors, a committee of senior management, an officer of the company or other responsible party who has been duly delegated the authority to commit the utility to the course of action described in the resource acquisition strategy. The officially adopted resource acquisition strategy shall consist of the following components:

(A) A preferred resource plan selected pursuant to the requirements of section (6) of this rule;

(B) An implementation plan developed pursuant to the requirements of section (9) of this rule;

(C) A specification of the ranges or combinations of outcomes for the critical uncertain factors that define the limits within which the preferred resource plan is judged to be appropriate and an explanation of how these limits were determined;

(D) A set of contingency options that are judged to be appropriate responses to extreme outcomes of the critical uncertain factors and an explanation of why these options are judged to be appropriate responses to the specified outcomes; and

(E) A process for monitoring the critical uncertain factors on a continuous basis and reporting significant changes in a timely fashion to those managers or officers who have the authority to direct the implementation of contingency options when the specified limits for uncertain factors are exceeded.

(11) 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:

(A) A decision-tree diagram for each of the alternative resource plans along with narrative discussions of the following aspects of the decision analysis:

1. A discussion of the sequence and timing of the decisions represented by decision nodes in the decision tree and a description of the specific decision alternatives considered at each decision point; and
2. An explanation of how the critical uncertain factors were identified, how the ranges of potential outcomes for each uncertain factor were determined and how the subjective probabilities for each outcome were derived;

(B) Plots of the cumulative probability distribution of each performance measure for each alternative resource plan;

(C) For each performance measure, a table that shows the expected value and the risk of each resource plan;

(D) A plot of the expected level of annual unserved hours for the preferred resource plan over the planning horizon;

(E) A discussion of the analysis of the value of better information required by section (8), a tabulation of the key quantitative results of that analysis and a discussion of how those findings will be incorporated in ongoing research activities;

(F) A discussion of the process used to select the preferred resource plan, including the relative weights given to the various performance measures and the rationale used by utility decision-makers to judge the appropriate tradeoffs between competing planning objectives and between expected performance and risk; and

(G) The fully documented resource acquisition strategy that has been developed and officially adopted pursuant to the requirements of section (10) of this rule.

Table 1-2
Summary of Compliance with Reporting Requirements for IRP Rule for Risk Analysis and Strategy Selection (4 CSR 240-22.070 (11))

Rule	Description	Location in Report
22.070 (11) (A)	Decision-tree diagram	Section 3.0 – 3.4
22.070 (11) (B)	Cumulative probability distribution plots	Figures 3-6 through 3-23
22.070 (11) (C)	Table of expected value and risk	Table 3-2
22.070 (11) (D)	Annual unserved hours	Figure 4-12
22.070 (11) (E)	Value of better information	Section 3.4
22.070 (11) (F)	Process to develop preferred plan	Section 4.0
22.070 (11) (G)	Fully documented resource acquisition strategy	Section 6.0

1.3.3 Followup to the 2007 IRP Unanimous Stipulation and Agreement (dated May 6, 2008)

In the 2007 IRP Unanimous Stipulation and Agreement dated May 6, 2008, Empire agreed to undertake the following tasks related to integrated resource assessment, risk analysis and strategy selection prior to or as a part of its next IRP filing:

- Integrated Resource Analysis: Empire's analysis will include an evaluation of the potential load building implications for all existing and proposed demand-side

programs that include compensation for end-use measures where load building may occur.

- Integrated Resource Analysis: Contingency plans will be subjected to the same risk analysis as other alternate resource plans.
- Integrated Resource Analysis: Model demand-side resources (both energy efficiency resources and demand response resources) in some of its alternative resource plans for the entire planning horizon (i.e., 20 years) over which the costs and benefits of alternative resource plans are evaluated. At least two portfolios of demand-side resources (including both moderate and aggressive portfolios) will be modeled in some of the alternative resource plans.
- Risk Analysis and Strategy Selection: Prior to the next filing, work with signatory parties to clarify what is required of a preliminary sensitivity analysis prior to conducting such an analysis unless Empire is granted a waiver from this requirement or there is a change in this part of the IRP rule. The waiver request will include a discussion of why Empire believes the information is not necessary.
- Risk Analysis and Strategy Selection: Document the range of critical uncertain factors that define the limits within which the preferred resource plan has been judged to be appropriate unless Empire is granted a waiver from this requirement or there is a change in this part of the IRP rule.
- Risk Analysis and Strategy Selection: (1) clearly identify the uncertain factors that it determines to be critical to the performance of its alternative resource plans; and (2) document the subjective assessments of probabilities by Empire decision-makers for the likelihood of adverse outcomes for uncertain factors that are critical to the performance of the various alternative resource plans. The names and positions of these decision-makers will also be documented.
- Risk Analysis and Strategy Selection: Subject contingency plans to the same risk analysis that was applied to other alternate resource plans. This approach will further study the contingencies of more stringent environmental cases.
- Risk Analysis and Strategy Selection: Specify a set of contingency options for the critical uncertain factors as part of an officially adopted resources acquisition strategy unless Empire is granted a waiver from 4 CSR 240-22.070(9)(D) or there is a change in this part of the IRP rule.
- Risk Analysis and Strategy Selection: For each critical uncertain factor, develop a contingency option that would be triggered by extreme values for that critical uncertain factor, and for each unique combination of critical uncertain factors that is deemed by Empire to require separate contingency analysis, develop a contingency option that would be triggered by extreme values for that unique combination of critical uncertain factors, or seek a waiver of this rule if Empire believes it will provide an alternative analysis that will adequately examine critical uncertain factors and appropriate responses should any one, or a combination of extreme outcomes, occur.

Table 1-3 shows where in this volume of the IRP report a specific portion of the requirements from the 2007 IRP Unanimous Stipulation and Agreement has been addressed.

Table 1-3
Summary of Compliance with the Requirements of the 2007 IRP Unanimous Stipulation and Agreement

Description	Location in Report
Evaluation of load building	Not considered as an option
Contingency plans subject to risk analysis	Section 3.0
Model DSM programs in some of alternative resource plan for entire planning horizon	Section 2.0, Section 3.0
Two DSM portfolios modeled in alternative resource plans	Section 2.0, Section 3.0
Prior to filing, determination of what sensitivity analysis required	Volume III, Section 2.0, Section 3.0
Range of critical uncertain factors within which preferred plan judged to be appropriate	Section 6.0
Identification of critical uncertain factors	Section 3.0
Document subjective assessments of probabilities by Empire decision makers	Section 3.4
Document names and positions of decision makers	Section 6.0
Subject contingency plans to same risk analysis as other alternate resource plans	Section 3.0
Study the contingencies of more stringent environmental cases	Section 3.0
Specify set of contingency options for critical uncertain factors as part of official strategy	Section 6.0
Develop contingency options for each critical uncertain factor	Section 6.0

2.0 Alternative Resource Plans

Empire undertook detailed analysis in the performance of this integrated resource plan. A total of 17 alternative resource plans were developed. All plans were subjected to full financial modeling in the Strategic Planning model powered by MIDAS (MIDAS) (see Appendix A). All plans were evaluated in the decision analysis phase, represented by a decision tree in the MIDAS model. Detailed risk analysis was undertaken for each of these plans. The assumptions for the various plans and the results for those plans are described in this section of the IRP report. The load forecast assumptions are provided in Volume II of this IRP. Other assumptions and information on the screening for all conventional and renewable resource supply-side candidates is found in Volume III. Detailed information on the demand-side resources can be found in Volume IV.

2.1 Alternative Resource Plan Identification

Resource assumptions made for the base case, most of which are common to other cases, except where specified, include:

1) The expiration of the Westar contract for 162 MW.
2) An ownership share of 7.52% (approximately 50 MW) in the coal-fired Plum Point generating unit. The unit met in-service criteria on August 12, 2010.
3) A 50 MW Plum Point PPA (with the option to convert to ownership in 2015).
4) A 12% (approximately 102 MW) ownership share in Iatan 2 (scheduled to begin operation in the fall of 2010).
5) The assumption that five percent of any new wind capacity would count towards the capacity reserve margin.
6) **_____**
7) **_____**
8) **_____**

With these supply-side resource decisions and implementation of the slate of DSM programs, Empire's planning reserve margins appear to be satisfied until **_____**

IRP cases were developed and analyzed in this IRP filing for the following 17 sets of future assumptions.

- (Plan 1) Base Assumptions (all resources)
- (Plan 2) Base Assumptions (no future coal)
- (Plan 3) Base Assumptions (no future coal and no DSM)

- (Plan 4) **_____**
- (Plan 5) **_____**
- (Plan 6) **_____**
- (Plan 7) **_____**
- (Plan 8) **_____**
- (Plan 9) No CO_2 tax with correlated market and fuel prices
- (Plan 10) Low CO_2 tax with correlated market and fuel prices
- (Plan 11) High CO_2 tax with correlated market and fuel prices
- (Plan 12) High CO_2 tax with correlated market and fuel prices (no future coal)
- (Plan 13) Base assumptions with high load
- (Plan 14) Base assumptions with low load
- (Plan 15) High fuel and market prices – base CO_2
- (Plan 16) Low fuel and market prices CO_2
- (Plan 17) Base assumptions with no future coal option, all DSM programs passing base cost assumptions

Plan 3, Base Assumptions (no future coal and no DSM), was configured to enable Empire to examine the buildout required in the case that DSM programs, although implemented, were not as successful in reducing peak demand as envisioned at the time of implementation and as a baseline case to see how optimized DSM in other plans could potentially alter the timing of supply-side resources.

Both demand-side management (DSM) and supply-side resources were considered as available resources in this IRP. The only DSM program discussed in Volume IV that was not considered in the integrated resource analysis is Residential Solar photovoltaics (PV). This is because the program did not pass the cost screening.

The demand-side candidate resources options available for selection during the optimization modeling for all scenarios (detailed information on individual programs and the screening undertaken to select those programs as candidate resources are provided in Volume IV of this IRP) were:

- Low Income Efficiency
- Refrigerator Recycling
- ENERGY STAR® – Refrigerator
- ENERGY STAR® – Washer
- ENERGY STAR® – Dehumidifiers
- Lighting
- Central Air Conditioning
- Home Performance with ENERGY STAR® – Direct Install
- Home Energy Comparison
- Residential Direct Load Control
- C&I Prescriptive
- C&I Custom

- Small Business Direct Install
- BOC
- Large C&I – Turnkey
- Commercial Interruptible

No load building programs are planned by Empire.

The conventional and renewable supply-side resources available for selection during the optimization modeling (cost information and screening analysis conducted for supply-side resources are described in detail in Volume III of this IRP), were:

- Aeroderivative Combustion Turbine (CT)
- Simple Cycle Combustion Turbine (CT)
- 1 x 1 Combined Cycle (CC)
- Riverton 12 conversion to Combined Cycle (CC)
- Pulverized Coal
- Coal PPA
- Integrated Gasification Combined Cycle (IGCC)
- Future Wind Ownership
- Wind PPA
- Nuclear PPA only
- Distributed Generation (DG)
- Biomass
- Solar Thermal
- Landfill Gas

2.2 Alternative Resource Plan Results

The demand-side and supply-side resources selected in each of the alternative plans are shown in Tables 2-1 and 2-2. Figure 2-1 shows the PVRR for each plan based on the assumption that the futures that they were developed to address would actually occur. The sizes (MW) of the DSM resources from Plan 4, which has been designated as the Preferred Plan, are shown in Table 2-3. Capacity and resource balances for all alternative plans are shown in Appendix B. The tables in Appendix B show the DSM resources (in MW) added in each alternative resource plan in each year as well as the supply-side resources added in each alternative plan in each year. The capacity margin achieved in each year is also shown for each alternative plan.

Figure 2-1
****Highly Confidential in its Entirety****

Table 2-1
New Demand-Side Resources Selected in Alternative Resource Plans – Year Selected
****Highly Confidential in its Entirety****

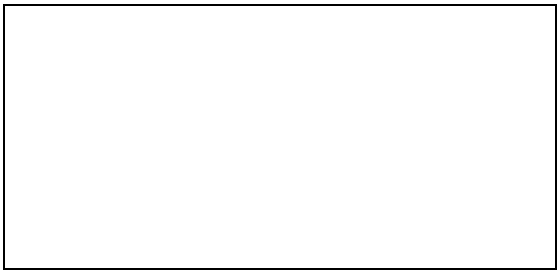
Table 2-2 **Highly Confidential in its Entirety**
New Supply-Side Resources Selected in Alternative Resource Plans (MW)

Table 2-3
DSM Resources – Plan 4 – Preferred Plan (MW)
****Highly Confidential in its Entirety****

2.3 Performance Measures

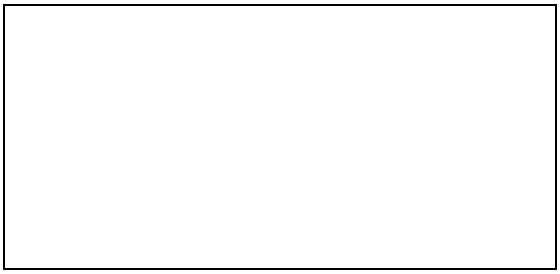
Other measures of how the plans compare are presented in Figures 2-2 through 2-12. Plots showing just the Preferred Plan's performance measures are interwoven with the plots for all of the scenarios. Annual rate increases as a percent of average system rates (Figures 2-2 and 2-3), the amount of plant in service in the rate base (Figure 2-4), the annual capacity margin (Figure 2-5), pre-tax interest coverage (Figure 2-6), the ratio of total debt to total capital (Figures 2-7 and 2-8), the ratio of net cash flow to capital expenditures (Figures 2-9 and 2-10), and the average system rates (Figure 2-11 and 2-12). Appendix F contains data tabulations for the performance measures required by the IRP Rule.

Figure 2-2
All Scenarios – Annual Rate Increases
****Highly Confidential in its Entirety****



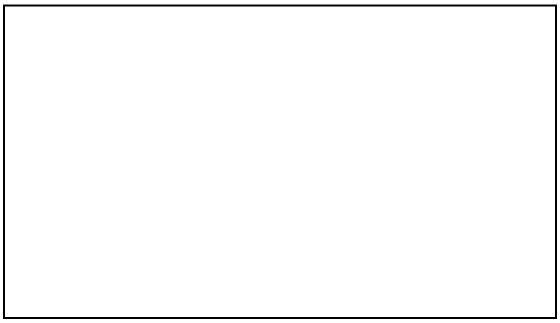
Source: Ventyx

Figure 2-3
Preferred Plan – Annual Rate Increases
****Highly Confidential in its Entirety****



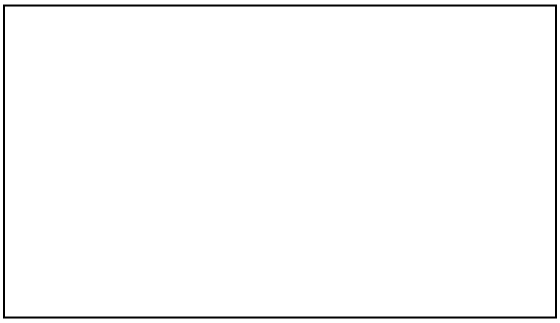
Source: Ventyx

Figure 2-4
All Scenarios – Plant in Service
****Highly Confidential in its Entirety****



Source: Ventyx

Figure 2-5
All Scenarios – Capacity Margin
****Highly Confidential in its Entirety****

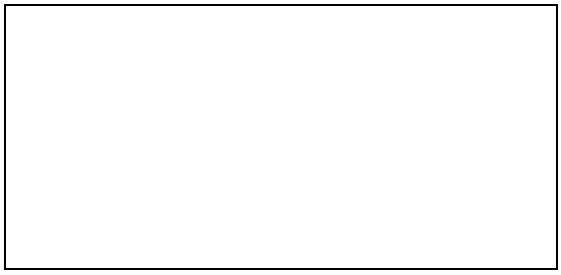


Source: Ventyx

Figure 2-6
All Scenarios – Pre-Tax Interest Coverage
****Highly Confidential in its Entirety****

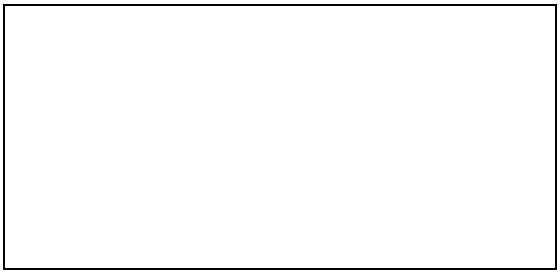
Source: Ventyx

Figure 2-7
All Scenarios – Ratio of Total Debt to Total Capital
****Highly Confidential in its Entirety****



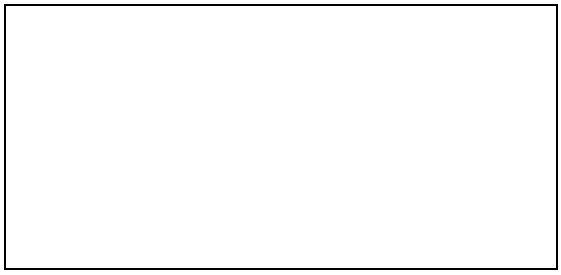
Source: Ventyx

Figure 2-8
Preferred Plan – Ratio of Total Debt to Total Capital
****Highly Confidential in its Entirety****



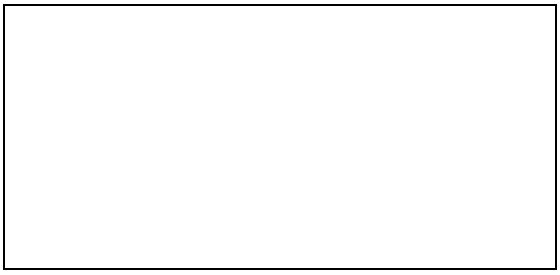
Source: Ventyx

Figure 2-9
All Scenarios – Ratio of Net Cash Flow to Capital Expenditures
****Highly Confidential in its Entirety****



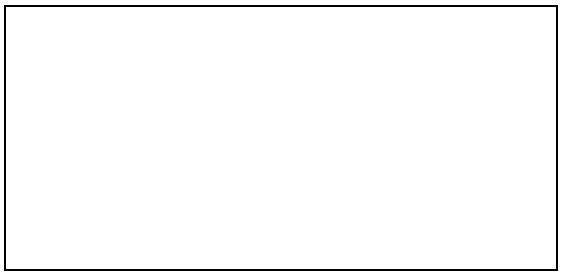
Source: Ventyx

Figure 2-10
Preferred Plan – Ratio of Net Cash Flow to Capital Expenditures
****Highly Confidential in its Entirety****



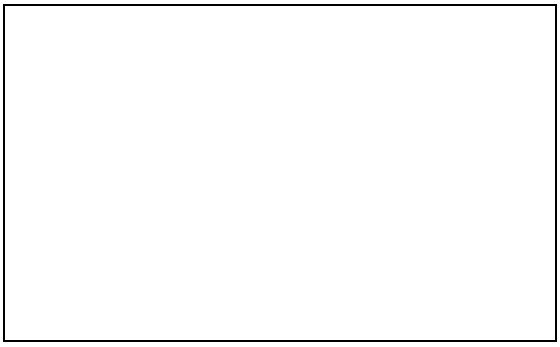
Source: Ventyx

Figure 2-11
All Scenarios – Average System Rates
****Highly Confidential in its Entirety****



Source: Ventyx

Figure 2-12
Preferred Plan - Average System Rates
****Highly Confidential in its Entirety****



Source: Ventyx

3.0 Risk Analysis

Planning for future generating resources in the electric utility industry involves the consideration and evaluation of many uncertainties. Those uncertainties have increased in number and magnitude over the last several decades. Empire has considered the impacts of, and will discuss in this section of its 2010 IRP, uncertainties that include the future of coal-fired generation, nuclear power plant technologies, smart grid, plug-in hybrid electric vehicles, Energy Efficiency Resource Standards (EERS), and decoupling. The future of coal-fired generation discussion touches on climate change legislation, carbon capture and sequestration technologies, and environmental regulatory requirements.

3.1 The Future of Coal-Fired Generation

For many years, most of the baseload energy needs in this country has been provided by coal-fired generation. As a fuel, coal has many merits:

- it is dense (meaning it has a high heating value in a compressed space)
- there are extensive and efficient supply chains that have been built over its many years of use
- it is relatively low cost and has experienced much less price volatility than other fuels, particularly natural gas

Coal is also quite abundant in this country (the estimated supply is hundreds of years of usage), helping to ensure national energy security.

One of the newer issues surrounding coal as a fuel for electricity generation is that it produces more carbon dioxide (CO_2) emissions per unit of energy output than any other fuel – about twice as much as natural gas. Today the future of coal-fired generation for electric utilities is a major uncertainty. Coal faces competitive pressure from natural gas in the short term and in the long term from renewable resources or other emerging technologies. But coal plants continue to be built in developing nations particularly China. Some sources report that China is on the average adding one new coal plant per week.

It took many decades to build up the current infrastructure of coal-fired power plants in the United States, so existing coal-fired generation will continue to be a large producer of energy during the 20-year planning horizon of this IRP and beyond. Carbon capture and sequestration (CCS) has yet to be proven on a commercial scale and may or may not be practical in any given location depending on the geology at the site.

As a result of potential greenhouse gas legislation, this IRP considers environmental costs (which include possible CO_2 costs) as a critical uncertain factor. As a result of the uncertainty of the future of coal-fired generation, some alternate plans assume that no future new coal-fired units will be built during the planning horizon.

3.1.1 Climate Change Legislation

The effects of greenhouse gases on the atmosphere and on the Earth's climate have been a subject of debate in the U.S. and worldwide for many years. On May 19, 2010, the National Research Council, an arm of the National Academies, issued three reports that concluded global climate change is occurring and that it is caused in large part by human activities. The reports recommend some form of carbon pricing system as the most cost-effective way to reduce emissions. The reports posit that cap-and-trade, taxing emissions or some combination of the two could provide the needed incentive to reduce the carbon emissions. The reports further state that major technological and behavioral changes will be required; business as usual will not address the climate change issue. Among those changes, the reports recommend the capturing and sequestering of CO_2 from power plants and factories as well as scrubbing CO_2 directly from the atmosphere.

How these reports will be translated into regulation and laws at the local, state and national levels remain to be seen, continuing this uncertainty in the planning period of Empire's IRP. Empire cannot predict if any particular carbon mitigation strategy will be enacted into law or when such might occur. As a result of this continuing uncertainty and to anticipate a broad range of future environmental regulatory strategies, Empire considered three levels of potential carbon costs in the current IRP as well as a scenario where no carbon cost legislation was enacted. In addition, Empire included environmental costs in the critical uncertain factors to be examined.

3.1.2 Carbon Capture and Sequestration Technologies[4]

Carbon capture and sequestration (CCS) technologies are currently being researched and tested in an effort to remove CO_2 from the atmosphere. Carbon capture is defined as the separation and entrapment of CO_2 from large stationary sources including power plants, cement manufacturing, ammonia production, iron and non-ferrous metal smelters, industrial boilers, refineries, and natural gas wells. Carbon sequestration means the capture and secure storage of CO_2 that would otherwise be emitted to or remain in the atmosphere. CO_2 can also be removed from the atmosphere through what is termed "enhancing natural sinks" by increasing its uptake in soils and vegetation (reforestation) or in the ocean (iron fertilization).

CO_2 capture processes fall into three general categories: (1) flue gas separation, (2) oxy-fuel combustion in power plants, and (3) pre-combustion separation. Each process has associated economic (cost) and energy (kWh) penalties.

For flue gas separation, the capture process is typically based on chemical absorption where the CO_2 is absorbed in a liquid solvent by formation of a chemically bonded compound. The captured CO_2 is used for various industrial and commercial processes such as the production of urea, foam blowing, carbonated beverages, and dry ice

[4] Howard Herzog and Dan Golomb, "Carbon Capture and Storage from Fossil Fuel Use," as published in the *Encyclopedia of Energy*, 2004.

production. Other processes being examined for CO_2 capture from the flue gas include membrane separation, cryogenic fractionation, and adsorption using molecular sieves.

An alternative to flue gas separation is to burn the fossil fuel in pure or enriched oxygen. The flue gas will then contain mostly CO_2 and water vapor. The water vapor can be condensed and the CO_2 can be compressed and piped directly to a storage site. Whereas for flue gas separation, the separation took place after combustion, now the separation occurs in the intake air where oxygen and nitrogen need to be separated. Just the air separation unit can impose a 15% efficiency penalty. Pilot scale studies have indicated that this method of carbon capture can be retrofitted on existing pulverized coal units.

Pre-combustion capture is usually applied in coal gasification combined cycle power plants. The process involves gasifying the coal to produce a synthetic gas. That gas reacts with water to produce CO_2 and hydrogen fuel. The hydrogen fuel is used in the turbine to produce electricity and the CO_2 is captured.

Once the CO_2 is captured, it must be stored in a manner in which it will not be emitted back into the atmosphere. Such storage needs to be: 1) long, preferably hundreds to thousands of years, 2) at minimal cost including transportation to the storage site, 3) with no risk of accident, 4) with minimal environmental impact, and 5) without violating any national or international laws or regulations. Potential storage media include geologic sinks and the deep ocean. Geologic sinks include deep saline formations – subterranean and sub-seabed), depleted oil and gas reservoirs, enhanced oil recovery, and unminable coal seams. Deep ocean storage includes direct injection into the water column at intermediate or deep depths.

With the belief that CO_2 will be regulated (either cap and trade or a tax) with an associated requirement to significantly reduce CO_2 emissions in the future, CCS will need to be proven as a viable technology in order for coal-fired generation to continue to be a resource option. As part of its efforts to examine CCS, Empire is one of the five electric utilities participating in the Missouri Carbon Sequestration Project (MCSP). This project is researching the feasibility of shallow carbon sequestration within geologic formations in Missouri.

Phase I of the MCSP has been completed and funds to move the project into its second phase were announced in April 2010. Carbon capture is under development by other groups elsewhere in the country. Because carbon sequestration is the other component necessary for successful CCS, the Missouri utilities are supporting research efforts to determine feasibility.

Other utility participants in the MCSP include AmerenUE, Associated Electric Cooperative, City Utilities of Springfield, and KCP&L. Research members of the project include City Utilities of Springfield, Missouri Department of Natural Resources, Missouri State University, and Missouri University of Science & Technology. Supporting Organizations include Missouri Energy Development Association, Missouri Public

Service Commission, Missouri Public Utility Alliance, and the U.S. Environmental Protection Agency (EPA) Region VII.

For purposes of this IRP, Empire assumed CCS has not progressed enough to be a viable alternative for this IRP during the entire twenty-year planning horizon.

3.1.3 Environmental Regulatory Requirements

Empire personnel are closely monitoring environmental regulations and requirements to determine what actions needed to be undertaken to ensure compliance and to understand the costs associated with that compliance. Among other issues, Empire is currently tracking issues relating to ozone; sulfur dioxide (SO_2); nitrogen dioxide (NO_2); the Clean Air Interstate Rule (CAIR) and its impending replacement rule, the Clean Air Transport Rule (CATR); water; particulate matter, specifically for 2.5 micrometers ($PM_{2.5}$); the Coal Combustion Residuals (CCR) rule relating to ash; mercury and hazardous air pollutants (Hg/HAPS); and carbon dioxide (CO_2), (see Figure 3-1[5]). The information gathered is discussed with senior management.

The uncertainty related to the myriad of rules expected from the U.S. Environmental Protection Agency (EPA) is large. The American Public Power Association (APPA) projects that the coal-fired power sector will see near-constant retrofits from 2012 through 2018, competition for scarce engineering and construction services and equipment, large-scale unit retirements, possible shortfalls in reserve margin requirements, an increase in natural gas generation, and a worrisome chance that financial resources could be misallocated and investments left stranded.[6]

APPA believes that the EPA hopes to force closure of 50% of the fleet of coal-fired generating units in the U.S. in the next 10 years which would reduce the CO_2 emissions by a commensurate 50%. The cost of such a transition is in the hundreds of billions of dollars.[7]

**_____

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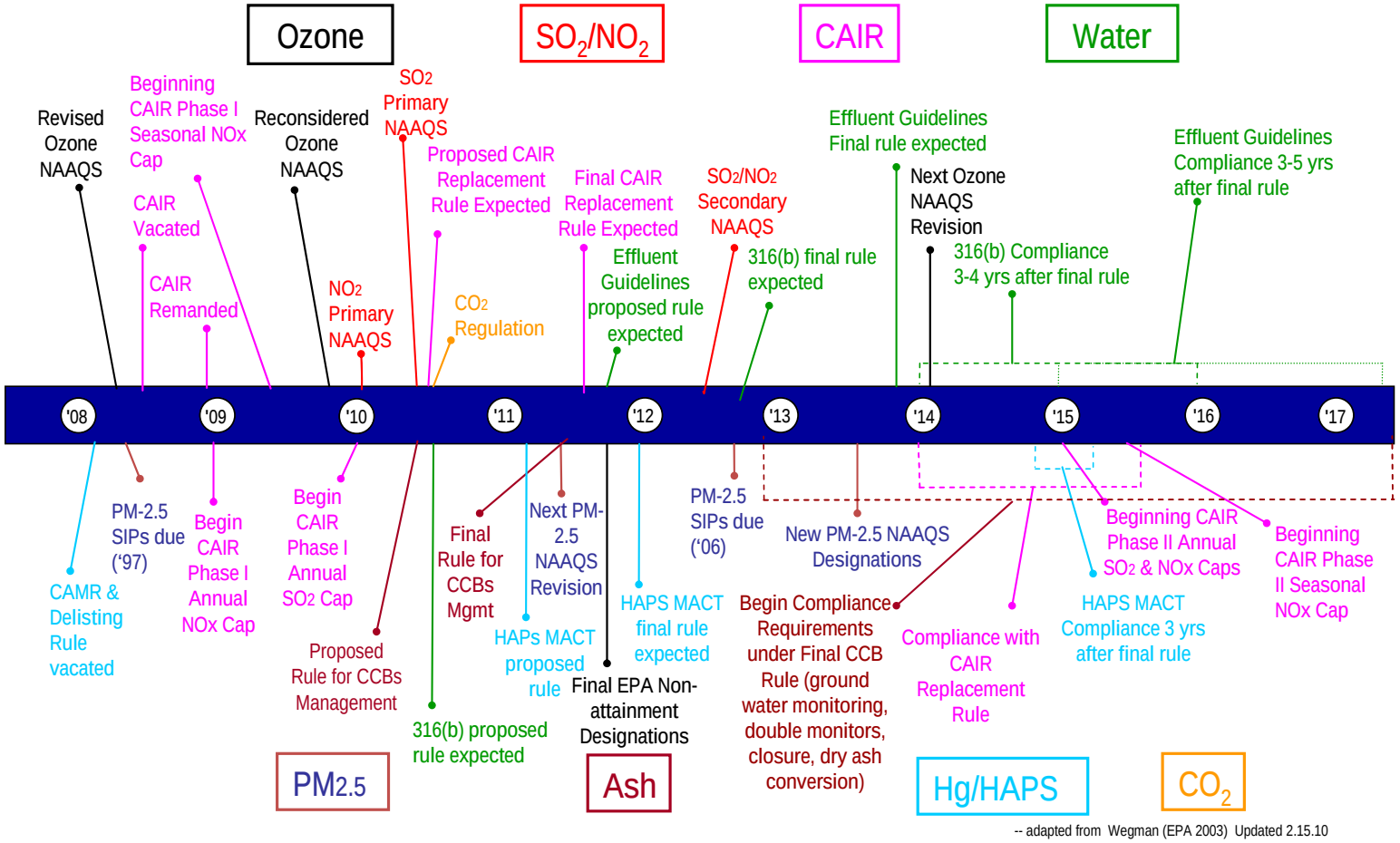
[5] "Generating Buzz," *Power Engineering*, July 2010, p. 80.
[6] Eric Wagman, "Expect a Mess as EPA Rules Take Hold," *Power Engineering*, July 2010, p. 4.
[7] Ibid.

Figure 3-1

Possible Timeline for Environmental Regulatory Requirements for the Utility Industry



3.2 Smart Grid

The term "Smart Grid" is frequently used in discussions among government agencies, equipment manufacturers, and the utility industry. However, the definition of that smart grid varies significantly depending on who is leading the discussion. For Empire's purposes in preparing this IRP, Smart Grid will mean integrating the electrical infrastructure with the communications network. This will lead to an automated electric power system that monitors and controls grid activities, ensuring two-way flow of electricity and information between power plants and consumers – and all points in-between. Such an enhanced system will facilitate:[8]

- improved electricity flows from power plants to consumers
- consumer interaction with the grid
- improved response to power demand
- reduced incidence of generation resource outages
- more consistent and reliable power quality
- increased reliability and security
- more efficient overall operation

Some of the technologies that will be required in order for the U.S. to realize this vision for the Smart Grid of the future include:[9]

- Smart meters for advanced measurement
- Integrated two-way communications
- Active customer interface including home area networks with in-home displays
- Meter data management system
- Distribution management system with advanced and ubiquitous sensors
- Distribution geographical information system
- Substation automation including sensors to monitor transformers, relays, digital fault recorders, breakers, and station batteries
- Advanced protection and control schemes
- Advanced grid control devices

The enhancements of the electricity infrastructure in this manner are expected to lead to many benefits including active management and control of electricity generation, transmission, distribution and usage in real time; an optimal balance between supply and demand; reduced numbers of outages; more consistent and reliable power quality; increased reliability and security; and more efficient overall operation, among others.[10]

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[8] "Smart Grid basics," www.smartgrid.gov/basics. "Wotruba, Bill, "Enabling the Smart Grid," *Power Engineering*, May 2010, p. 52.
[9] Joe Miller, Horizon Energy Group, "The Smart Grid – How do we get there?" http://www.smartgridnews.com/artman/publish/Business_Strategy_News/The_Smart_Grid_How_Do_We_Get_There-452.html.
[10] "Smart Grid basics," www.smartgrid.gov/basics. "Wotruba, Bill, "Enabling the Smart Grid," *Power Engineering*, May 2010, p. 52.

- **Reduced incidence of outages**. Smart grids rely on embedded automation and control devices. Thus energy producers and the operators of the transmission and distribution systems will be able to anticipate, detect, and respond to system problems more quickly than is possible with the technology in place currently.
- **More consistent and reliable power quality**. When supply and demand are more optimally balanced, operation will be leaner and more efficient which in turn leads to higher levels of customer service.
- **Increased reliability and security**. With the capabilities of the enhanced communication system and associated real-time monitoring, power companies will have increased visibility of the entire generation, transmission, and distribution systems and thus an increased ability to resist both physical threats and cyber attacks. Operations that are networked tend to have increased reliability and reduced expensive downtime. The smart grid may also increase redundancy, in turn leading to fewer service disruptions.
- **More efficient overall operation**. The smart grid should reduce bottlenecks and relieve grid congestion. Fewer outages and less congestion should lead to lower costs to customers and, potentially, fewer emissions.

In March 2010, Empire assembled a team to develop a pilot program that would research and test the available metering products and technologies for an advanced metering infrastructure system such as would be required for Smart Grid. The main benefits of such a system are automated meter reading, on-demand meter reads, and instant outage notification. The proposed pilot program will include residential, commercial, and industrial customers, and will cover single-phase and three-phase applications. The plan is for the pilot program to implement two different communication technologies via two separate phases. The details of the pilot program were pending completion as this IRP was being finalized.

3.3 Energy Efficiency Resource Standard

An Energy Efficiency Resource Standard (EERS) (also referred to as Energy Efficiency Portfolio Standard (EEPS) or energy efficiency target) is a mechanism to encourage more efficient generation, transmission, and use of electricity and natural gas. Like a Renewable Portfolio Standard (RPS), an EERS requires utilities to reduce energy use by a specified and typically increasing percentage or amount each year. Some states have a separate EERS and RPS, while other states combine the mechanisms by allowing energy efficiency to meet part or all of an RPS. Efficiency reduction requirements or targets may also be established by state public utility commissions.[11]

Electricity savings requirements for utilities may include flexibility to achieve the standard through a market-based trading system of energy savings certificates. All EERS include end-use energy savings. In some cases, distribution system efficiency improvements, combined heat and power (CHP) systems and other high-efficiency

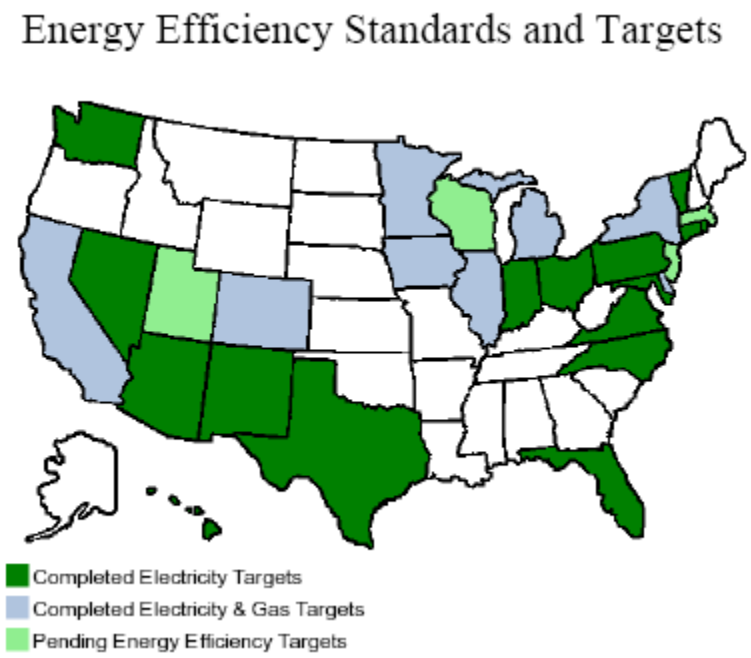
[11] http://www.pewclimate.org/what_s_being_done/in_the_states/efficiency_resource.cfm

distributed generation systems are also included. Penalties for non-compliance vary by state.[12]

Legislation has been introduced in Missouri (most recently as SB 983 in the 2010 legislative session), but has not been enacted to date. Empire considered EERS as an uncertain factor, but it was not chosen as a critical uncertain factor since none of the jurisdictions that Empire serves currently has an EERS.

Legislation at the national level has also been introduced, but to date has not been enacted. A map showing EERS status by state is shown in Figure 3-2.

Figure 3-2



Source:
http://www.pewclimate.org/what_s_being_done/in_the_states/efficiency_resource.cfm

3.4 Decision Tree Analysis

The critical uncertain factors to be used in Empire's IRP were selected from those required by 4 CSR 240-22.070 (2) (shown below as A – L) in conjunction with two additional factors: Smart Grid and Energy Efficiency Resource Standards.

(A) The range of future load growth represented by the low-case and high-case load forecasts;
(B) Future interest rate levels and other credit market conditions that can affect the utility's cost of capital;
(C) Future changes in environmental laws, regulations or standards;

[12] http://www.pewclimate.org/what_s_being_done/in_the_states/efficiency_resource.cfm

(D) Relative real fuel prices;
(E) Siting and permitting costs and schedules for new generation and generation-related transmission facilities;
(F) Construction costs and schedules for new generation and transmission facilities;
(G) Purchased power availability, terms and cost;
(H) Sulfur dioxide emission allowance prices;
(I) Fixed operation and maintenance costs for existing generation facilities;
(J) Equivalent or full- and partial-forced outage rates for new and existing generation facilities;
(K) Future load impacts of demand-side programs; and
(L) Utility marketing and delivery costs for demand-side programs.

From this list, Empire needed to make choices about the primary types of uncertainty to analyze in this IRP after consideration of its situation, industry best practices, and the key factors that impact its operation. The choices needed to be narrowed (in many cases uncertainties are grouped together) in order to make the modeling process reasonable. If all 12 uncertainties were to be selected with three endpoints each, the result would be the need to examine more than 530,000 endpoints. With 17 plans examined, this would result in over nine million endpoints. Thus, if all potential uncertainties listed in the rule were utilized, the resulting uncertainty analysis would take too long, would cost too much, and would not provide meaningful information.

The screening process examined each factor and determined the following:

(A) The range of future load growth is fundamental to Empire's need for generating resources in the future. It is deemed to be a critical uncertain factor.

(B) Interest rates and other financial market conditions significantly affect the capital costs for new generating resources. This effect is incorporated in the capital and transmission costs that has been deemed to be a critical uncertain factor.

(C) Future changes in environmental laws, regulations, or standards will have the effect of increasing environmental compliance costs in the future. This factor is deemed to be one the critical uncertain factors.

(D) Since fuel prices comprise such a significant portion of a utility's production costs, this factor is deemed to be a critical uncertain factor. It was paired with market prices in the uncertainty analysis.

(E) Siting and permitting costs and schedules for new generation and associated transmission facilities are incorporated in the capital and transmission costs variable which has been deemed to be a critical uncertain factor.

(F) Construction costs and schedules for new generation and transmission facilities are incorporated in the capital and transmission costs variable which has been deemed to be a critical uncertain factor.

(G) Purchased power costs are deemed to be a critical uncertain factor and are captured in the market price for power.

(H) The sulfur dioxide emission allowance market is now mature. The costs have stabilized and a history has been developed. This factor is incorporated in the environmental costs as sulfur dioxide emission costs were correlated with the carbon costs for the four scenarios examined.

(I) Fixed operation and maintenance costs at existing facilities are a very small component of overall production costs. Thus, this factor is not deemed to be a critical uncertain factor.

(J) Equivalent full and partial outage rates for new and existing generation are stable and reasonable. Empire performs scheduled maintenance on all of its units on a regular basis and in conformance with manufacturers' recommendations. Although not a critical uncertain factor, forced outages were addressed in the modeling with random monte carlo simulation outage draws.

(K) Future load impacts of DSM are implicitly included in the load forecast analysis through the evaluation of low, base and high load forecasts. In addition, Empire undertook a special series of cases to examine the impact if DSM were not successfully implemented. This evaluation is described in Section 3.8 of this Volume.

(L) Utility marketing and delivery costs for DSM programs are a very small component of overall production costs. Thus, this factor is not deemed to be a critical uncertain factor.

In addition to the A-L factors discussed above, Empire considered two additional factors in determining the critical uncertain factors to be examined in the risk analysis.

- Empire is currently planning to undertake a pilot program to test some aspects of Smart Grid sensors, communications and networking equipment. To date, implementation of a Smart Grid and its associated costs are not well understood. Empire expects to have a much better understanding of Smart Grid costs and impacts when it files its next IRP. This factor is not deemed to be a critical uncertain factor for this IRP.

- EERS legislation has been introduced in Missouri (most recently as SB 983 in the 2010 legislative session), but has not been enacted to date. Empire considered EERS as an uncertain factor, but it was not chosen as a critical uncertain factor since none of the jurisdictions that Empire serves currently has an EERS.

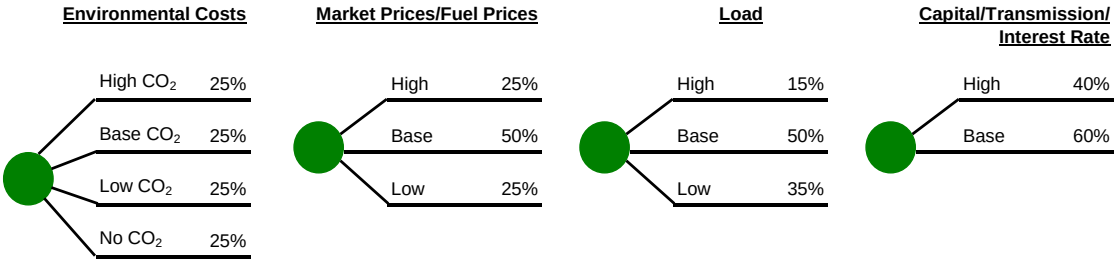
The results of the above analysis are shown in Table 3-1.

Table 3-1
Critical Uncertain Factors

Item	Description	Incorporated in an Uncertainty Factor in the IRP?
A	Load Growth – High and Low	YES
B	Interest rates and credit markets – cost of capital	YES
C	Changes in environmental laws	YES
D	Relative fuel prices	YES
E	Siting and permitting costs – generation and transmission	YES
F	Constructions costs for generation and transmission	YES
G	Purchased power availability and cost	Availability – No, costs - YES
H	Sulfur dioxide emission allowance prices	YES, indirectly
I	Fixed O&M costs	No
J	Forced outage rates	YES, indirectly,
K	Future load impacts of DSM programs	YES, indirectly, plus special study in Section 3.8 of this Volume
L	Costs for DSM programs	No
	Smart Grid	No
	Implementation of Energy Efficiency Resource Standard	YES, indirectly

The decision tree (Figure 3-3) developed for the uncertainty analysis examined many uncertain variables for each plan (critical uncertain factors). The uncertainties can be grouped into four main categories: 1) environmental costs, 2) market and fuel prices, 3) load forecast, and 4) capital and transmission costs and interest rates. For environmental costs, the base contains higher costs than the low and no CO_2 cost cases and lower costs than the high case. All environmental costs were correlated to the assumed CO_2 costs. For the market prices/fuel prices and load, the uncertainties reflect a high and low around a base. All high, low and base market and fuel prices were correlated with the corresponding CO_2 costs. For capital and transmission costs and interest rates, only a base and high level were examined. The critical uncertain factors are shown in Figure 3-3. With the 17 plans examined, this is 1,224 endpoints studied for this IRP. The probabilities assigned to each branch were developed by the IRP team in conjunction with Empire's senior management and reflect knowledge of the Empire system and the application of professional judgment, as further discussed below.

Figure 3-3
Critical Uncertain Factors



Source: Ventyx

3.4.1 Environmental Costs

The primary environmental cost uncertainty in this IRP is CO_2. No carbon tax or cap and trade system has been enacted since Empire filed its last IRP in 2007. The passage of carbon legislation remains uncertain. Because it is not possible to determine with any degree of certainty whether carbon legislation will be enacted or the resulting costs of any potential enactment during the planning horizon, Empire has determined that all four carbon futures are equally likely and has assigned a 25% probability to each of no CO_2 costs, low CO_2 costs, base CO_2 costs, and high CO_2 costs. In addition, emission costs were developed for SO_2, NO_x, and mercury that were correlated with these emission costs (see Volume III). Market prices and fuel prices were also correlated with these emission costs.

3.4.2 Market Prices/Fuel Prices

The market and fuel prices were developed by Ventyx to correlate with the levels of CO_2 costs assumed. The spread was assumed to be equal from the base decision tree branch for either lower or higher costs. Thus, the low and the high were assigned a 25% probability and the base case was assigned a 50% probability.

3.4.3 Load Forecast

An analysis of 30 years of Empire's load history yielded information about the frequency of lower load growth, average load growth, and higher load growth. This evaluation enabled Empire to assign probabilities to the likelihood of each level of forecast as: low (35%), base (50%) and high (15%). The important trend from the historical data is that lower loads are more likely than higher loads. Current economic conditions and the possibility of the enactment of future CO_2 legislation, all argue for a bias towards lower growth as opposed to higher growth.

3.4.4 Capital/Transmission/Interest Rate

The experience in the electric utility industry with major construction projects suggests that the project is more likely to be at or above budget. Thus, Empire did not consider a branch lower than the base branch for capital/transmission/interest rates in order to help limit the number of endpoints in the decision tree. The high case is assigned a 40% probability whereas the base case was assigned a 60% probability. These probabilities suggest that project costs are more likely to be near the project cost estimate than to deviate significantly from that estimate.

3.5 Comparison of the Plans

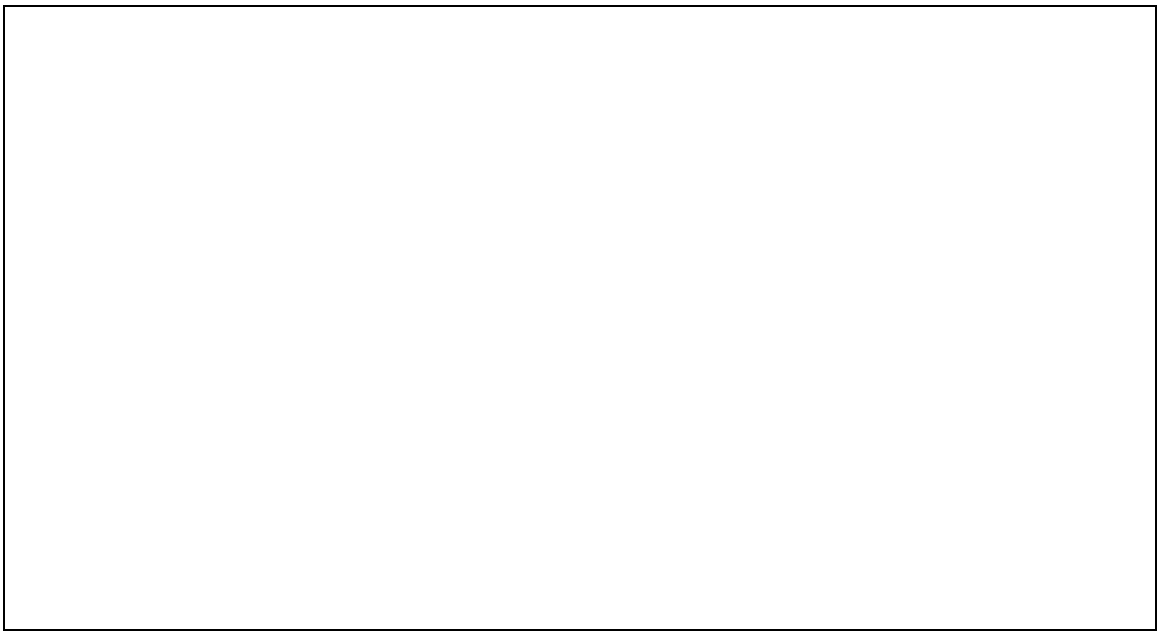
Not all cases can be directly compared due to their significantly different base assumptions. Those cases that are variations on the base assumptions and all cases that utilize the base CO_2 cost assumptions can be compared one versus the other. However, these plans do not directly compare with alternate scenarios that are based on significantly different CO_2 cost assumptions, i.e., high, low or no CO_2 costs. Yet plans with CO_2 costs other than the base cost assumptions were important contingency plans to analyze since the level of future CO_2 costs is unknown.

1. Base Assumptions (all resources)
2. Base Assumptions (no future coal)
3. Base Assumptions (no future coal and no DSM)
4. **_____**
5. **_____**
6. **_____**
7. **_____**
8. **_____**
9. No CO_2 tax with correlated market and fuel prices
10. Low CO_2 tax with correlated market and fuel prices
11. High CO_2 tax with correlated market and fuel prices
12. High CO_2 tax with correlated market and fuel prices (no future coal)
13. Base assumptions with high load
14. Base assumptions with low load
15. High fuel and market prices – base CO_2
16. Low fuel and market prices – base CO_2
17. Base assumptions with no future coal option, all DSM programs passing base cost assumptions

To compare plans and to comply with Empire's interpretation of the IRP rule, all 17 of the plans were each analyzed with the base assumptions of the critical uncertain factors to see how they would perform under those conditions (deterministic approach) (Figure 3-4). For example, in Plan 9, an optimal resource plan is developed assuming that no CO_2 tax were enacted. Yet, the base assumptions include a CO_2 tax. Figure 3-4 shows how

well that Plan 9 would perform on a PVRR given the base case assumptions as well as the results for each other plan taking this same approach.

Figure 3-4
All Scenarios – 20-Year Deterministic PVRR (2010-2029)
****Highly Confidential in its Entirety****



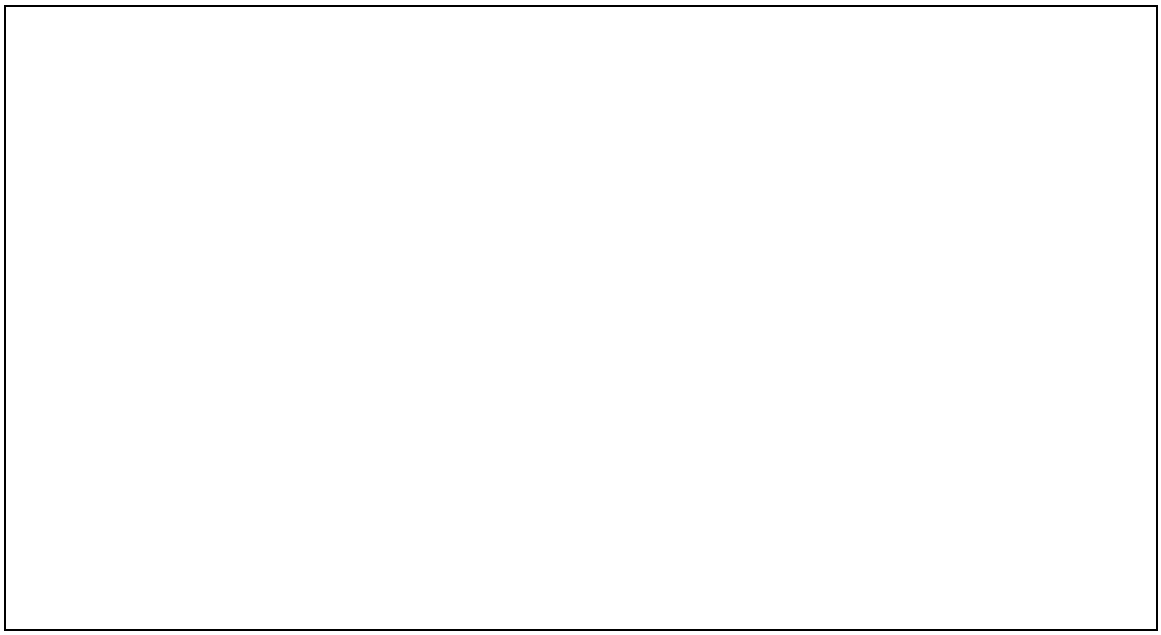
All of the cases were also analyzed stochastically in a decision tree by subjecting each plan to all of the levels of the critical uncertain factors, creating a 72 endpoint tree for each of the 17 plans. This analysis results in risk profiles for each plan which are discussed in the following section.

3.6 Risk Analysis Results

The Strategic Planning Risk Module was used by Ventyx to develop cumulative probability distributions which are also known as "Risk Profiles". Risk profiles provide the ability to visually assess the risks associated with a decision under uncertainty. The risk profile can be viewed to determine the probability that the PVRR will be any particular value.

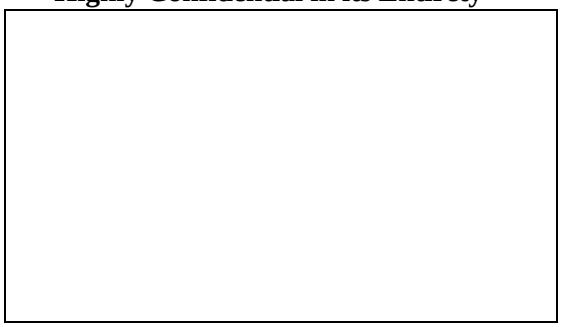
The risk profiles for the cases that utilize the base case assumptions (and that can be compared one with the other) are shown on Figure 3-5. The risk profile for Plan 4 can be seen to be the left-most curve on the figure and the one with the steepest profile, which translates into the lowest risk. Plan 4 was selected by Empire as the Preferred Plan.

Figure 3-5
All Base Scenarios – Risk Profiles (2010-2029)
****Highly Confidential in its Entirety****



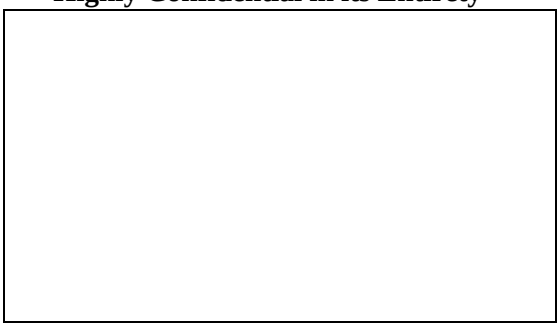
Source: Ventyx

Figure 3-6
Plan 1 – Risk Profile (2010 – 2029)
****Highly Confidential in its Entirety****



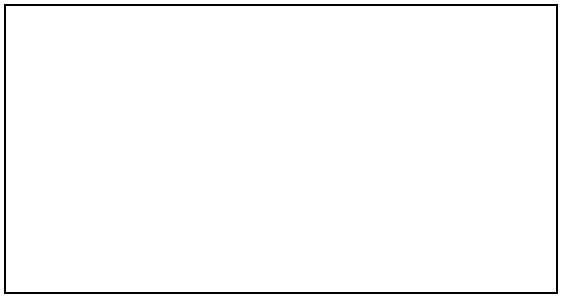
Source: Ventyx

Figure 3-7
Plan 2 – Risk Profile (2010 – 2029)
****Highly Confidential in its Entirety****



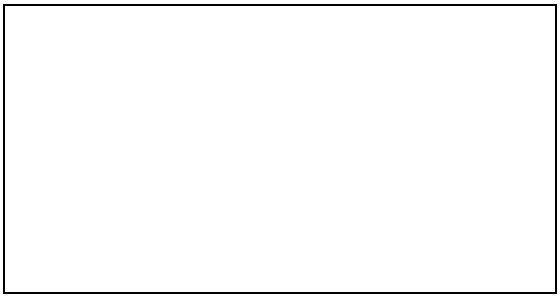
Source: Ventyx

Figure 3-8
Plan 3 – Risk Profile (2010 – 2029)
****Highly Confidential in its Entirety****



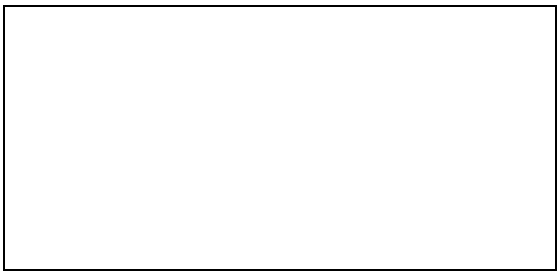
Source: Ventyx

Figure 3-19
Plan 4 – Risk Profile (2010 – 2029)
****Highly Confidential in its Entirety****



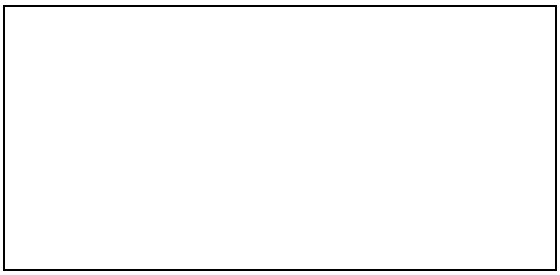
Source: Ventyx

Figure 3-10
Plan 5 – Risk Profile (2010 – 2029)
****Highly Confidential in its Entirety****



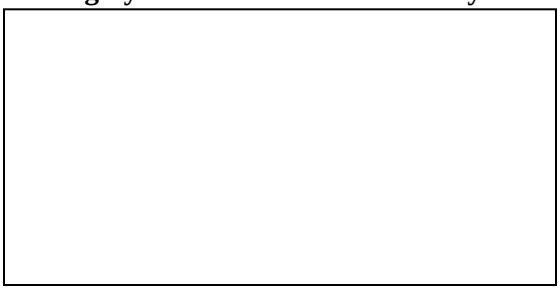
Source: Ventyx

Figure 3-11
Plan 6 – Risk Profile (2010 – 2029)
****Highly Confidential in its Entirety****



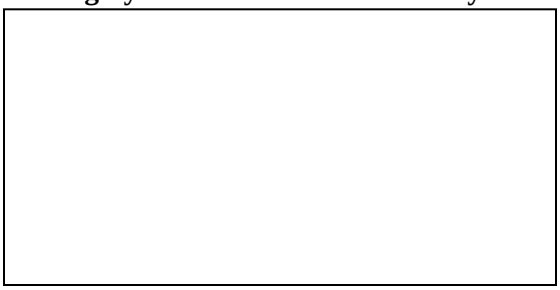
Source: Ventyx

Figure 3-12
Plan 7 – Risk Profile (2010 – 2029)
****Highly Confidential in its Entirety****



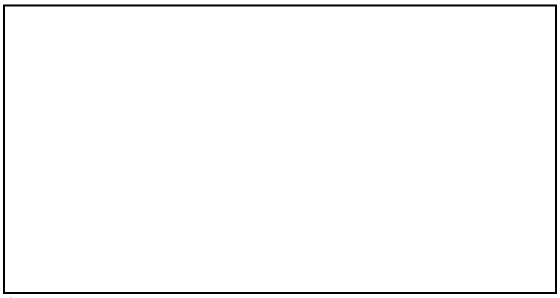
Source: Ventyx

Figure 3-13
Plan 8 – Risk Profile (2010 – 2029)
****Highly Confidential in its Entirety****



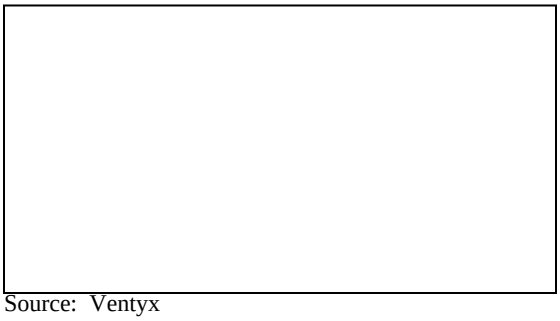
Source: Ventyx

Figure 3-14
Plan 9 – Risk Profile (2010 – 2029)
****Highly Confidential in its Entirety****



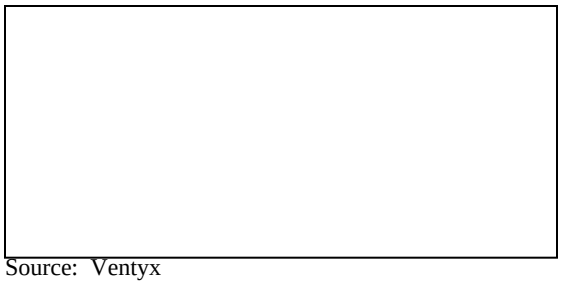
Source: Ventyx

Figure 3-15
Plan 10 – Risk Profile (2010 – 2029)
****Highly Confidential in its Entirety****



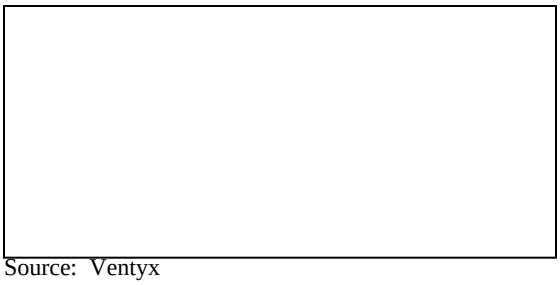
Source: Ventyx

Figure 3-16
Plan 11 – Risk Profile (2010 – 2029)
****Highly Confidential in its Entirety****



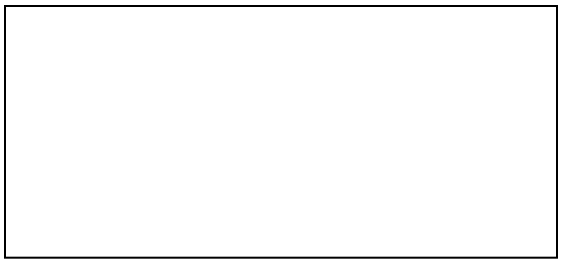
Source: Ventyx

Figure 3-17
Plan 12 – Risk Profile (2010 – 2029)
****Highly Confidential in its Entirety****



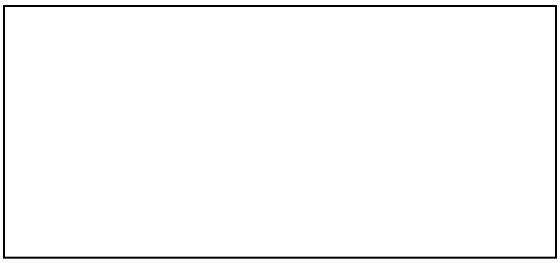
Source: Ventyx

Figure 3-18
Plan 13 – Risk Profile (2010 – 2029)
****Highly Confidential in its Entirety****



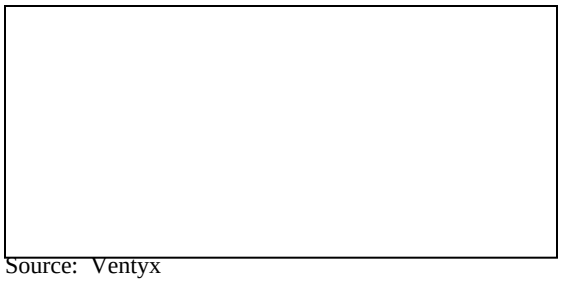
Source: Ventyx

Figure 3-19
Plan 14 – Risk Profile (2007 – 2026)
****Highly Confidential in its Entirety****



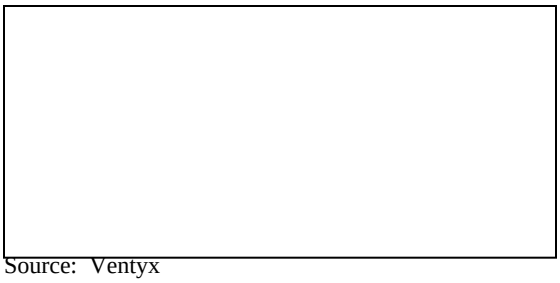
Source: Ventyx

Figure 3-20
Plan 15 – Risk Profile (2010 – 2029)
****Highly Confidential in its Entirety****



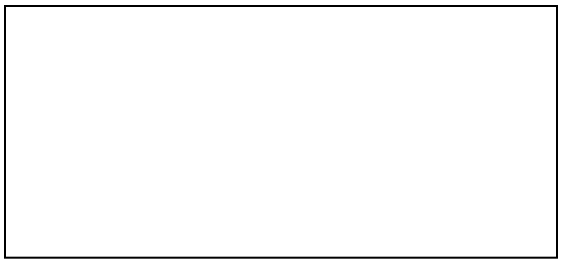
Source: Ventyx

Figure 3-21
Plan 16 – Risk Profile (2010 – 2029)
****Highly Confidential in its Entirety****



Source: Ventyx

Figure 3-22
Plan 17 – Risk Profile (2010 – 2029)
****Highly Confidential in its Entirety****



Source: Ventyx

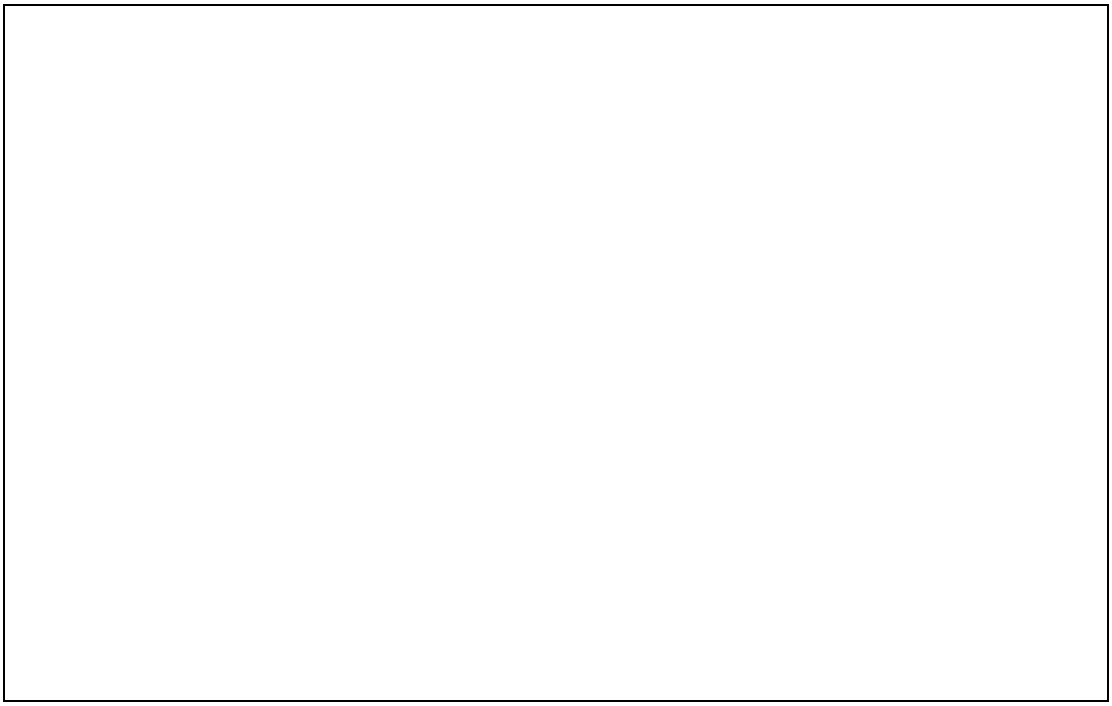
Information about the expected value of better information is found in Appendix G.

3.7 Sensitivity Drivers

The magnitude of the influence that any specific driving factor has in determining PVRR can be represented in what is called a "tornado chart". The values on this chart are determined through regression analysis and identify the contribution of each variable to the total risk. Tornado Charts provide information on the driving factors that influence PVRR and can also provide insight into where a risk aversion strategy could be focused to drive PVRR to lower levels or mitigate risk.

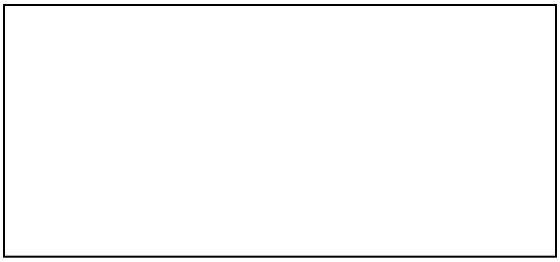
The Preferred Plan Tornado Chart indicates that the major driver of PVRR uncertainty is load uncertainty followed by environmental costs. The top two drivers of uncertainty change between load, environmental and market prices for all of the plans.
Figures 3-23 through 3-39 show the tornado charts for each scenario.

Figure 3-23
Plan 4 – Preferred Plan – Tornado Chart (2010 – 2029)
****Highly Confidential in its Entirety****



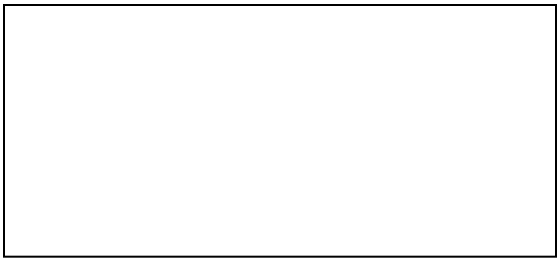
Source: Ventyx

Figure 3-24
Plan 1 – Tornado Chart (2010 – 2029)
****Highly Confidential in its Entirety****



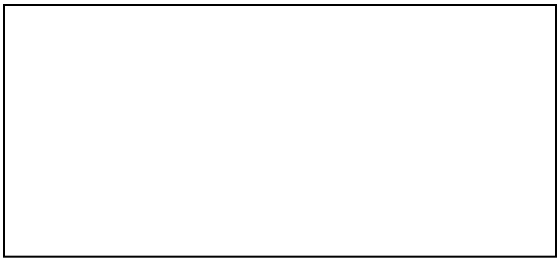
Source: Ventyx

Figure 3-25
Plan 2 – Tornado Chart (2010 – 2029)
****Highly Confidential in its Entirety****



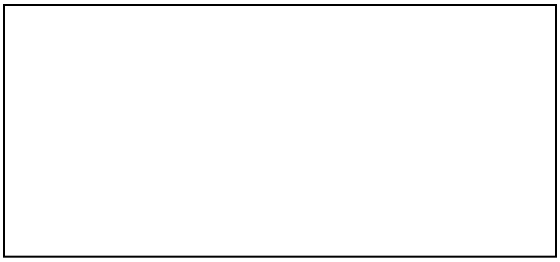
Source: Ventyx

Figure 3-26
Plan 3 – Tornado Chart (2010 – 2029)
****Highly Confidential in its Entirety****



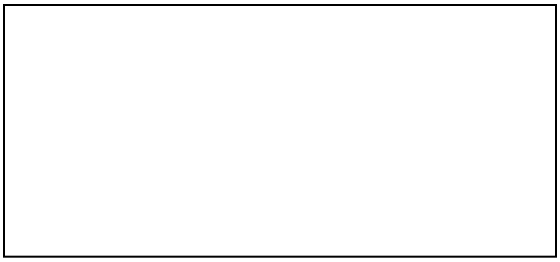
Source: Ventyx

Figure 3-27
Plan 5 – Tornado Chart (2010 – 2029)
****Highly Confidential in its Entirety****



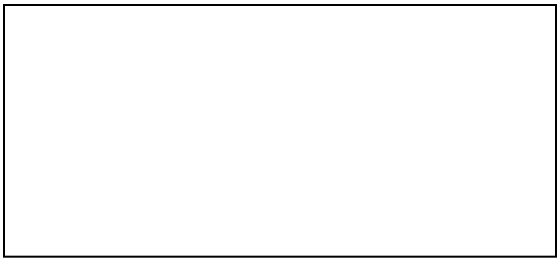
Source: Ventyx

Figure 3-28
Plan 6 – Tornado Chart (2010 – 2029)
****Highly Confidential in its Entirety****



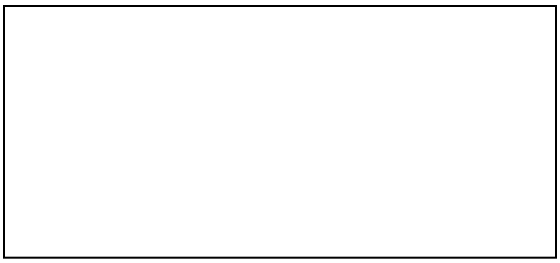
Source: Ventyx

Figure 3-29
Plan 7 – Tornado Chart (2010 – 2029)
****Highly Confidential in its Entirety****



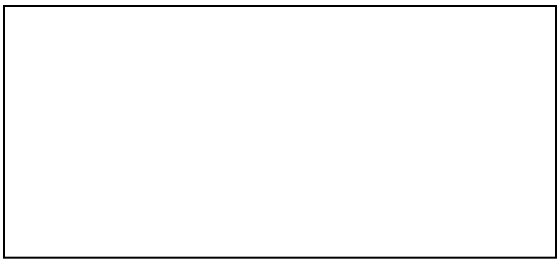
Source: Ventyx

Figure 3-30
Plan 8 – Tornado Chart (2010 – 2029)
****Highly Confidential in its Entirety****



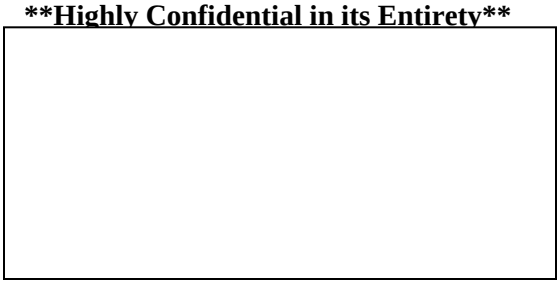
Source: Ventyx

Figure 3-31
Plan 9 – Tornado Chart (2010 – 2029)
****Highly Confidential in its Entirety****



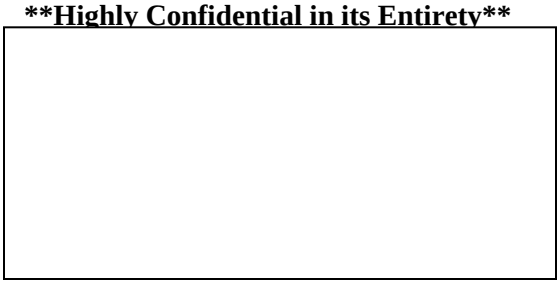
Source: Ventyx

Figure 3-32
Plan 10 – Tornado Chart (2010 – 2029)
****Highly Confidential in its Entirety****



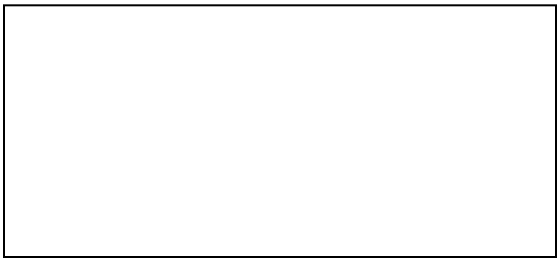
Source: Ventyx

Figure 3-33
Plan 11 – Tornado Chart (2010 – 2029)
****Highly Confidential in its Entirety****



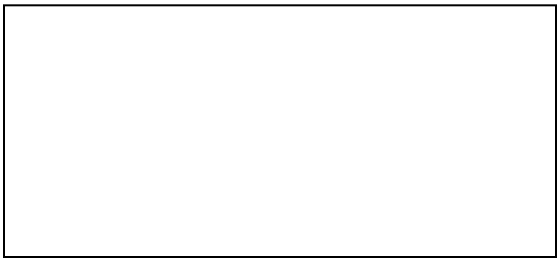
Source: Ventyx

Figure 3-34
Plan 12 – Tornado Chart (2010 – 2029)
****Highly Confidential in its Entirety****



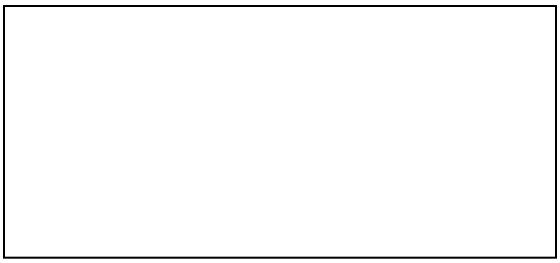
Source: Ventyx

Figure 3-35
Plan 13 – Tornado Chart (2010 – 2029)
****Highly Confidential in its Entirety****



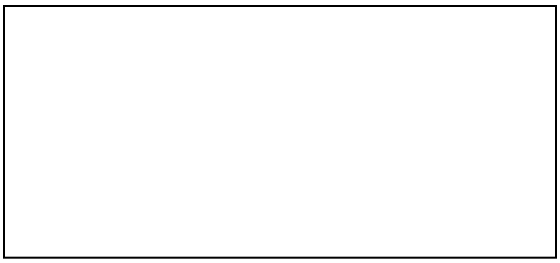
Source: Ventyx

Figure 3-36
Plan 14 – Tornado Chart (2010 – 2029)
****Highly Confidential in its Entirety****



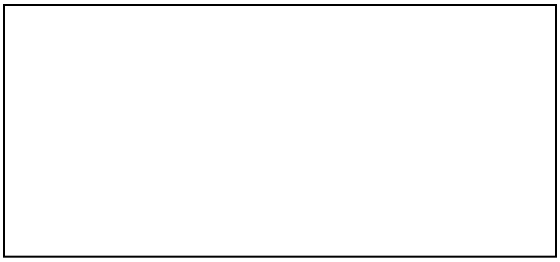
Source: Ventyx

Figure 3-37
Plan 15 – Tornado Chart (2010 – 2029)
****Highly Confidential in its Entirety****



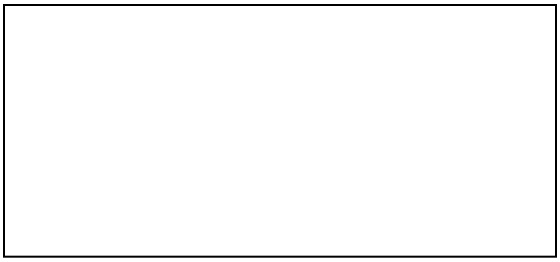
Source: Ventyx

Figure 3-38
Plan 16 – Tornado Chart (2010 – 2029)
****Highly Confidential in its Entirety****



Source: Ventyx

Figure 3-39
Plan 17 – Tornado Chart (2010 – 2029)
****Highly Confidential in its Entirety****



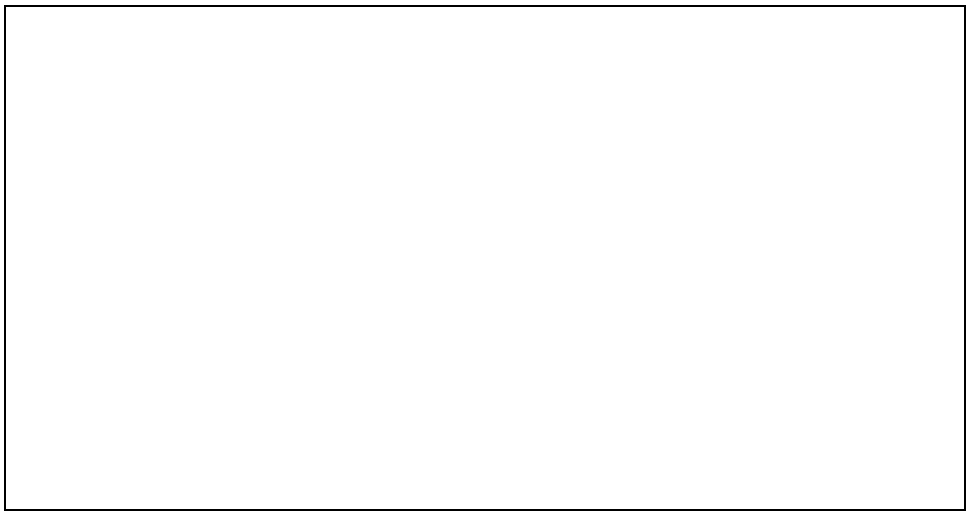
Source: Ventyx

3.8 DSM Sensitivity

An additional analysis was conducted to examine the risk of not having the DSM available when needed. Unlike most supply-side resources, DSM values are primarily estimates based on the projected number of participants and the projected energy savings expected per measure and/or per participant. In addition, even when evaluations are conducted, the values for DSM are still just estimates. The optimization modeling, however, assumes that the values it has been provided for DSM candidate resources for peak demand reduction and energy savings are achieved. Thus, there is a risk associated with counting on DSM resources to result in peak demand reduction coincident with the Empire system peak.

Four scenarios were developed around plan 17 (Base assumptions with no future coal option, all DSM programs passing base cost assumptions), the first having 25% of the expected DSM available and each successive scenario having an additional 25% of the expected DSM available. Figure 3-40 shows the additional cost of not having the DSM as planned on a PVRR basis.

Figure 3-40
Plan 17 DSM Risk Scenarios – PVRR
****Highly Confidential in its Entirety****



4.0 Preferred Plan

This periodic IRP analysis, in conjunction with Empire's normal planning process, assists Empire in making decisions concerning the timing and type of system expansion that should ultimately occur. The results of the IRP analysis documented in this report reflect only current and projected conditions as they were known at the time that the results were developed. Empire will re-examine its capacity expansion decisions as the need for additional resources, driven by load growth, and the influence of external factors, primarily environmental, become more evident. **_____ _____ _____ _____** Figure 4-1 shows the highlights from the early years of the Preferred Plan.

Figure 4-1
Preferred Plan Highlights for the Early Years of the IRP

- **Proposed Changes to Existing Resources**
  - **_____ _____**
  - _____
  - _____ _____
  - _____
  - _____ _____
  - _____**
- **Proposed New Supply-Side Resources**
  - Plum Point coal-fired unit begins operation in 2010
  - Iatan 2 coal-fired unit expected to begin operation in 2010
  - **_____**
- **Proposed New Demand-Side Management**
  - **_____ _____**
  - _____ _____
  - _____
  - _____ _____
  - _____
  - _____ _____**

Both DSM and supply-side resources were considered as available resources in this IRP. The integration and risk analysis proceeded in three phases. During Phase 1 (capacity expansion modeling), specific optimized resource plans that resulted in the lowest present

value of revenue requirements (PVRR) were developed for each of 17 different scenarios with a capacity expansion model. Each set of resources was developed specifically to perform the best under the assumptions made about the possible future for each plan. These cases or plans are not directly comparable since the assumptions about the future varied significantly between the plans.

During Phase 2 (stochastic analysis), each plan was subjected to decision analysis (with the critical uncertain factors) with full financial modeling over the planning horizon. These stochastic runs generated 72 endpoints for each of the 17 plans. The results and data points from the decision tree were then used in Phase 3 (risk analysis). In this phase, risk profiles and tornado charts were developed across all plans. All of these analyses were considered by Empire's decision makers during the development of the preferred plan. The preferred plan represents a balance between the planning objectives, planning risks, and financial impacts examined using the deterministic, stochastic, and risk analyses.

Resource assumptions made for the base case, most of which are common to other cases, except where specified, include:

1) The expiration of the Westar contract for 162 MW.
2) An ownership share of 7.52% (approximately 50 MW) in the coal-fired Plum Point generating unit. The unit met in-service criteria on August 12, 2010.
3) A 50 MW Plum Point PPA (with the option to convert to ownership in 2015).
4) A 12% (approximately 102 MW) ownership share in Iatan 2 (scheduled to begin operation in the fall of 2010).
5) The assumption that five percent of any new wind capacity would count towards the capacity reserve margin.
6) **_____**
7) **_____**
8) **_____**

With these supply-side resource decisions and implementation of the slate of DSM programs, Empire's planning reserve margins appear to be satisfied until **_____**

IRP cases were developed and analyzed in this IRP filing for the following 17 sets of future assumptions.

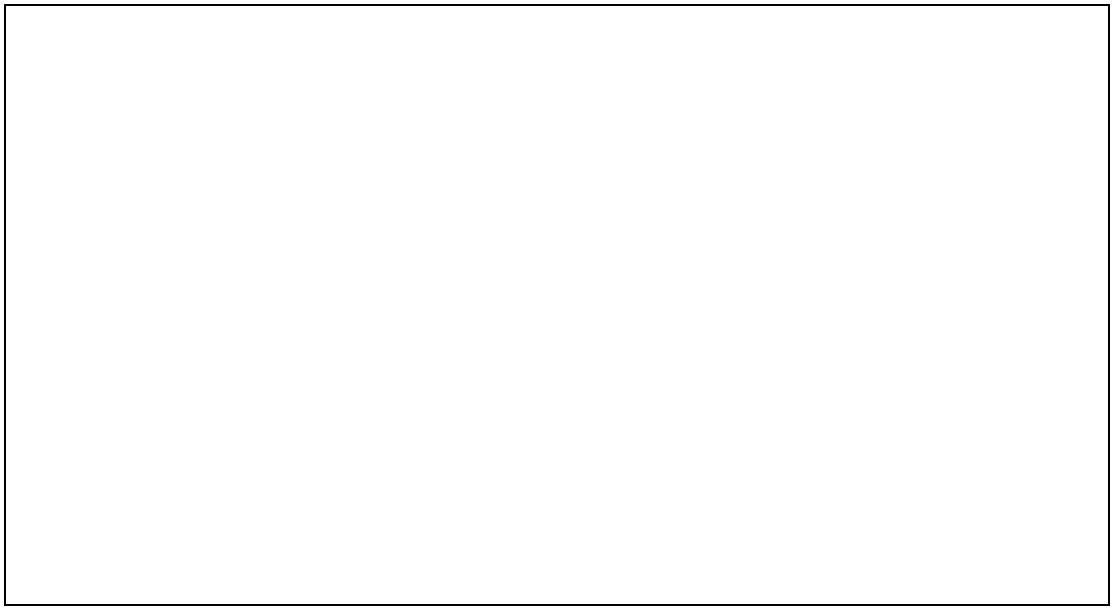
1. Base Assumptions (all resources)
2. Base Assumptions (no future coal)
3. Base Assumptions (no future coal and no DSM)

4. **_____**
5. **_____**
6. **_____**
7. **_____**
8. **_____**
9. No CO_2 tax with correlated market and fuel prices
10. Low CO_2 tax with correlated market and fuel prices
11. High CO_2 tax with correlated market and fuel prices
12. High CO_2 tax with correlated market and fuel prices (no future coal)
13. Base assumptions with high load
14. Base assumptions with low load
15. High fuel and market prices – base CO_2
16. Low fuel and market prices – base CO_2
17. Base assumptions with no future coal option, all DSM programs passing base cost assumptions

The examination of the seventeen plans led to a set of DSM and supply-side resource additions over the planning horizon that constitute Empire's preferred plan. Figure 4-2 shows the DSM and supply-side resources in the preferred plan along with the existing resources. Figure 4-3 shows only the new supply-side resources added over the planning horizon in the preferred plan. Figure 4-4 shows the DSM programs selected in the preferred plan.

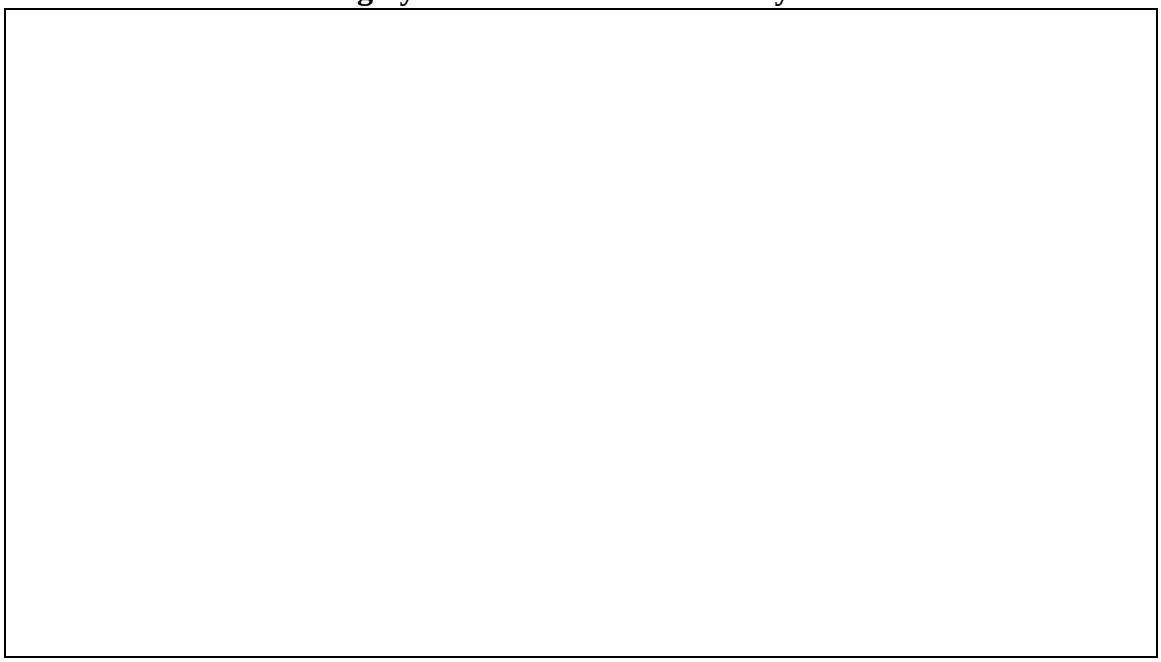
Table 4-1 details the supply-side and DSM resources that in total constitute the resources in the preferred plan.

Figure 4-2
Existing and Preferred Plan Proposed New Resources
****Highly Confidential in its Entirety****



(Source: Ventyx)

Figure 4-3
Proposed New Supply-Side Resources in Preferred Plan
****Highly Confidential in its Entirety****



(Source: Ventyx)

The additional supply-side resources contemplated in the Preferred Plan, as shown in Figures 4-2, include**_____
_____
_____
_____
_____
_____
_____
_____**

Figure 4-4
Preferred Plan – Proposed New Demand-Side Management Programs
****Highly Confidential in its Entirety****

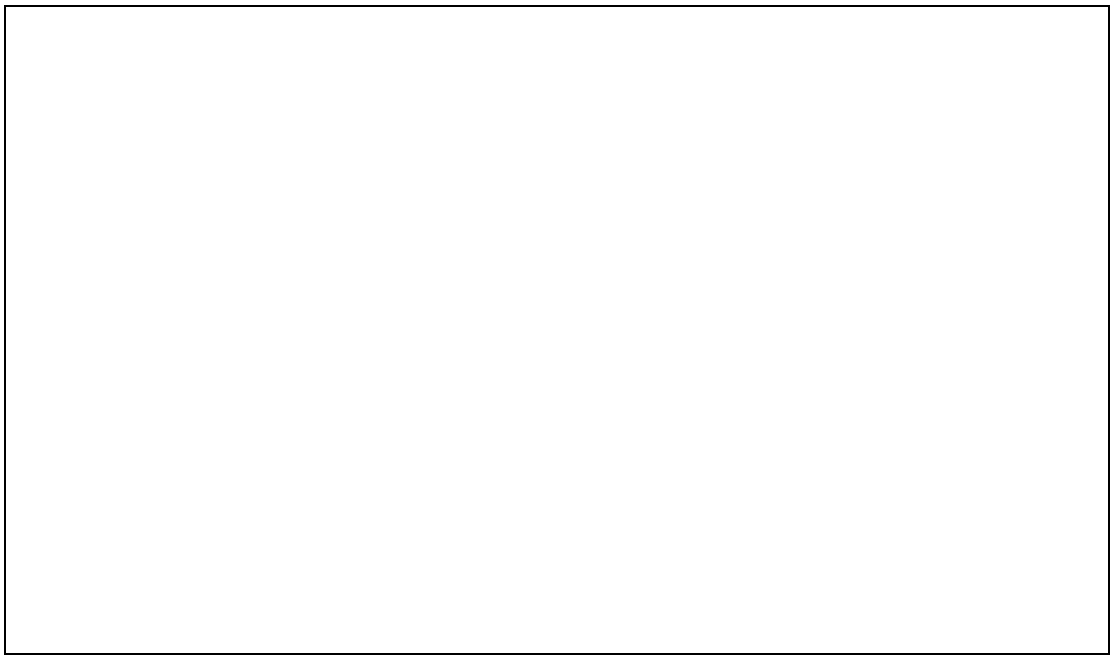
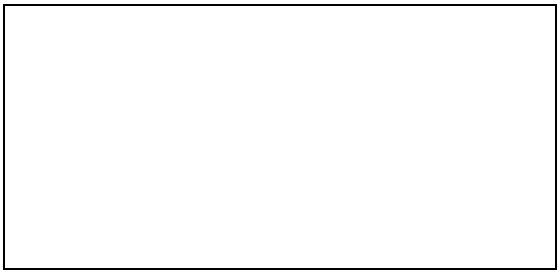


Table 4-1 **Highly Confidential in its Entirety**
Empire's Preferred Plan – Proposed Changes to Existing Resources, New DSM and New Supply-Side Resources

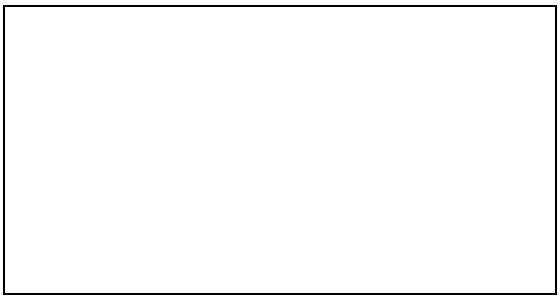
Additional information about the results of the Preferred Plan is provided on Figures 4-5 through 4-13. This information includes: cumulative rate increases (Figure 4-5), capital forecast (Figure 4-6), capitalization ratios (Figure 4-7), pretax interest coverage excluding AFUDC (Figure 4-8), and the reliability assessment (Figure 4-9).

Figure 4-5
Preferred Plan – Cumulative Rate Increases
****Highly Confidential in its Entirety****



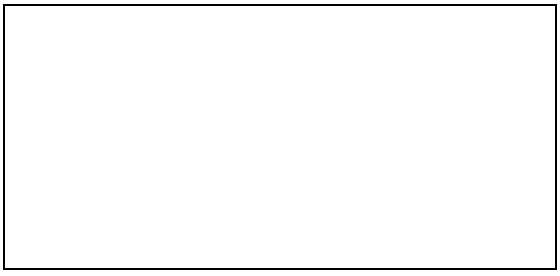
Source: Ventyx

Figure 4-6
Preferred Plan – Capital Forecast
****Highly Confidential in its Entirety****



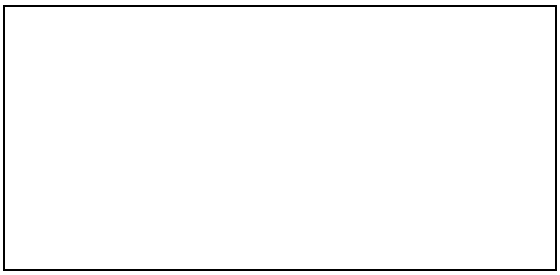
Source: Ventyx

Figure 4-7
Preferred Plan – Capitalization Ratios
****Highly Confidential in its Entirety****



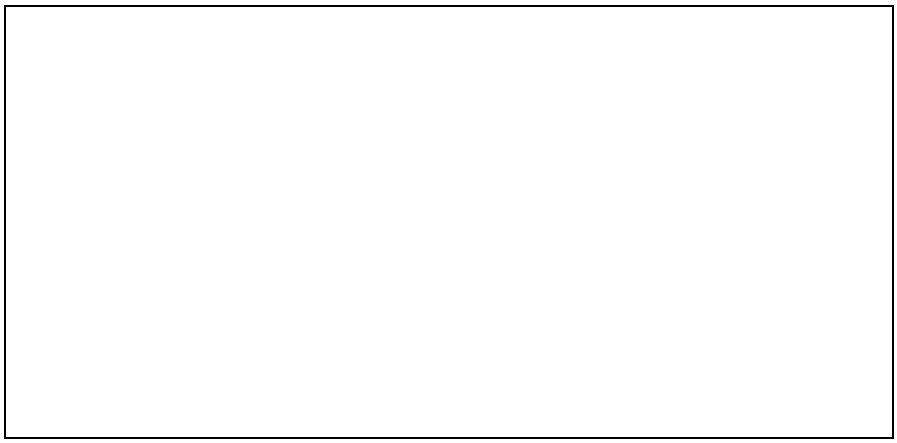
Source: Ventyx

Figure 4-8
Preferred Plan – Pretax Interest Coverage excluding AFUDC
****Highly Confidential in its Entirety****



Source: Ventyx

Figure 4-9
Preferred Plan – Reliability Assessment (2010 – 2029)
****Highly Confidential in its Entirety****



Source: Ventyx

The expected unserved hours in Figure 4-9 would be experienced only if Empire were not interconnected with neighboring utilities. Because Empire does have access to the market to purchase power when generating units unexpectedly go out of service, the actual unserved energy over the course of any year is actually expected to be 0 MWh.

5.0 Implementation Plan

During 2010, the construction of the Plum Point coal-fired generating unit has been completed and the unit met its in-service criteria on August 12, 2010. Empire has a 7.52% (approximately 50 MW) undivided ownership share of the unit plus a 50 MW power purchase agreement (PPA). Iatan 2 is anticipated to enter commercial operation during the fall of 2010. Kansas City Power & Light is the majority owner-operator of the coal-fired Iatan 2 unit; Empire's share of the unit is 12% (approximately 102 MW).

The demand-side management (DSM) programs that have been implemented include:

- Low Income Weatherization
- Low Income – New Homes
- Home Performance with ENERGY STAR®
- Residential High Efficiency Lighting (ENERGY STAR® Change a Light)
- Residential High Efficiency Central Air Conditioning (CAC)
- ENERGY STAR® Homes
- Commercial and Industrial (C&I) Rebate
- Building Operator Certification Program
- Interruptible Service Rider

Evaluation, Measurement & Verification (EM&V) studies for several of these programs have been completed since the 2007 IRP was filed or are currently in process.

As a result of its current resource commitments in conjunction with the analysis results from this IRP, Empire will:

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- Track and evaluate results of the implementation of DSM programs and keep the Customer Programs Collaborative (CPC) informed as to the results.[13]
- Monitor federal efforts regarding carbon regulations.

As of the date of this IRP filing (September 2010), Empire has selected a Preferred Plan that represents the actions that it would take if the conditions that existed at the time of the analysis still existed at the time of the filing. As part of Empire's normal budget cycle, an updated five-year load forecast has been developed. **

**

Table 5-1 outlines the steps that Empire might take to implement the DSM programs selected in the Preferred Plan, **

**

[13] The Customer Programs Collaborative was established as a result of a stipulation and agreement and, in addition to Empire personnel, is comprised of Missouri Public Service Commission (MPSC) staff, Office of Public Counsel, Missouri Department of Natural Resources, and other interested parties. The CPC is charged with making decisions pertaining to the development, implementation, monitoring, and evaluation of Empire's affordability, energy efficiency, and demand response programs.

NP

Table 5-1
Implementation Plan Timeline
****Highly Confidential in its Entirety****

Empire will continue to monitor federal legislative and regulatory requirements associated with renewable portfolio standards (RPS) in addition to tracking changes in other environmental regulations. With its current purchases of wind energy from both the Elk River and Meridian Way Wind Farms, Empire meets the percentages of renewable energy now required by the States of Missouri and Kansas for the near-term time period covered in the implementation plan.

5.1 Load Forecasting Schedule

The order granting Empire's application for variance (June 2010 in EE-2010-0246) provided, subject to a condition agreed upon by Empire and MPSC Staff, that:

After the completion of the September 2010 IRP, Empire has agreed to provide the Missouri Public Service Commission Staff with a plan that addresses the feasibility of changing the Company's forecasting method for the IRP filing that will follow the September 2010 filing. This plan will include a proposed time line and cost estimate that can be used for further discussions. The plan will consider the use of economic variables; forecasting at the class cost of service level; and the requirements in the Load Analysis and Forecasting rule that will be in place at the time of the IRP filing that is subsequent to the September 2010 filing.

5.2 New DSM Implementation Plan

The current DSM portfolio, consisting of nine energy efficiency programs, has been successfully implemented. Table 5-2 shows the status of each program in its five-year plan.

Table 5-2
DSM Implementation Schedule

Program	2006	2007	2008	2009	2010	2011	2012
Low Income Weatherization	x	x	Xe	x	x		
Change a Light	x	x	Xe	x	x		
Low Income New Homes		x	x	x	X e	x	
Central AC		x	x	Xe	x	x	
C&I Rebate		x	x	Xe	x	x	
BOC			x	x	Xe	x	x
Home Perform w/ES				x	x	Xe	x
ES Homes				x	x	Xe	x
Interruptible Rider				x	x	x	x
x = program implemented. Xe = evaluation year based on portfolio plan.							

5.2.1 Proposed Continuation of the Existing DSM Portfolio

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_____** Empire anticipates that the rules for the Missouri Energy Efficiency Investment Act (SB 376) will be finalized and implemented.

5.2.2 Proposed New DSM

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Empire plans to bring to the CPC the new programs comprising the DSM portfolio from the IRP Preferred Plan, including any modifications to existing programs that are being considered. The evaluation of all programs will follow the EM&V guidelines established in the SB 376 rules. Empire expects both process and impact evaluations to occur on most programs.

5.3 Supply-Side Implementation Plan

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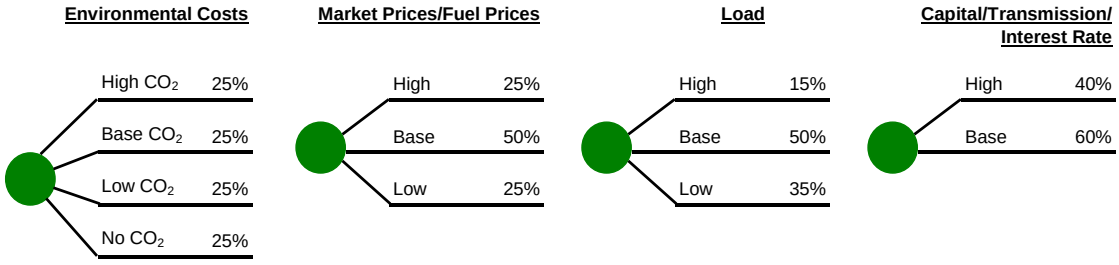
Table 5-3
Supply-Side Implementation Schedule
****Highly Confidential in its Entirety****

6.0 Resource Acquisition Strategy

The Empire Resource Acquisition Strategy (RAS), required as part of the filing of this IRP, was formally approved by a committee of senior management at a meeting on August 30, 2010.[14] The Preferred Plan incorporated in this IRP is documented in Section the Executive Summary Volume and further discussed in Section 4.0 of this Volume. The Implementation Plan is documented in the Executive Summary Volume and further discussed in Section 5.0 of this Volume.

The critical uncertain factors Empire has identified include environmental costs, market prices/fuel prices, load, and capital/transmission/interest costs (See Figure 6-1). As part of the normal course of business, these factors are monitored very closely by Empire personnel in coordination with senior management.

Figure 6-1
Critical Uncertain Factors



6.1 Monitoring Environmental Costs

Company personnel monitor environmental regulations and requirements to determine what actions need to be undertaken to ensure compliance and to determine the costs associated with that compliance. Among the environmental issues Empire is currently tracking are issues relating to ozone; sulfur dioxide (SO_2); nitrogen dioxide (NO_2); the Clean Air Interstate Rule (CAIR) and its impending replacement rule, the Clean Air Transport Rule (CATR); water; particulate matter, specifically for 2.5 micrometers ($PM_{2.5}$); the Coal Combustion Residuals (CCR) rule relating to ash; mercury and hazardous air pollutants (Hg/HAPS); and carbon dioxide (CO_2). The information gathered is shared through discussions with senior management.

Environmental issues are monitored by the Strategic Projects and Safety and Environmental Services department. The Energy Supply department works with this department and the Director of Environmental Policy to monitor environmental costs and issues at the Company's generation facilities. Strategic Projects and Safety and Environmental Services and Energy Supply provide management with The Annual NO_x Allocation Projection, The Annual SO_2 Report, the SO_2 Allowance Management Policy (SAMP) and the Greenhouse Gas Projections and Emissions Inventory. The Annual SO_2

[14] The senior management team composition was previously documented in this Volume. A listing of the entire IRP team is shown in Appendix A.

Report is filed with the state of Missouri by February 1 of each year. Empire also subscribes to JD Energy environmental forecasting services. The Safety and Environmental Services department provides management with a quarterly Environmental Key Issues Summary. As important environmental issues develop, management is updated. Personnel from the Environmental staff are in regular contact with local, state and federal environmental agencies. They attend events such as the Electric Utilities Environmental Conference annually in Arizona, Edison Electric Institute (EEI) Environmental meetings, Kansas Environmental Conference, Midwest Energy Policy and Climate Conference, and the Kansas Clean Air Advisory Committee. Empire is an active member of the Air and Waste Management Association, the EEI, the Regulatory Environmental Group for Missouri (REGFORM) and the Missouri Electric Utilities Environmental committee (MEUEC). Strategic Projects and Safety and Environmental staff members serve on the environmental committees of the Missouri Chamber of Commerce and Industry and the Missouri Energy Development Association.

6.2 Monitoring Market and Fuel Prices

Power prices and fuel prices are regularly monitored by operational personnel. Both operational personnel and senior management are kept abreast of the processes and procedures being implemented in the Southwest Power Pool (SPP) that directly impacts the availability and pricing of power. The price of natural gas is closely monitored. As documented in Volume III, Empire implemented a natural gas risk management policy that has an objective of minimizing the impact of natural gas price volatility. The risk management policy includes monitoring of natural gas prices. The natural gas risk management policy is overseen and positions taken are approved annually by senior management.

Empire purchases fuel and power on a continuous basis. Each month fuel and energy accountants prepare reports for management, such as reports known as the Summary of Fuel and Purchased power Report, the Electric Fuel Report and the Purchased and Exchanged Power Allocation Report. The Summary of Fuel and Purchased Power Report compares generation, fuel costs and purchase costs, actual to budget on a monthly, year-to-date and twelve-months-ended basis. The Electric Fuel Report contains detailed fuel usage and cost information by generating unit, plant and entire system on a monthly, year-to-date and twelve-months-ended basis. The Purchased and Exchanged Power Allocation Report is a detailed list of power purchases for the month. Explanations for variances from budget are also reported to management. The Company's Electric Gas Position Report is supplied to management on a weekly basis. It reports detailed natural gas price and natural gas hedged amount information. This report contains a natural gas position summary, trading detail, market detail, storage balance and other information. It tracks both hedged and spot market natural gas activity. The market detail section lists current natural gas market futures prices and basis adjustment estimates for the next several years. A month to date Summary of Fuel and Purchased Power report is also provided to management to keep current of system costs on a weekly basis. Updated production cost simulation runs are provided to management on a monthly basis which incorporates actual information with a simulation for the remainder of the current year

and the proceeding year, using the most recent natural gas information.

6.3 Monitoring Load Growth

Empire's load forecast is revised annually and close attention is paid to the levels of peak demand during the summer and winter months. Scheduled reviews on the load forecast are held with senior management. Each month, Empire prepares a variance report related to the demand and energy forecast and the actual results.

Each month the Planning and Regulatory Department prepares the Electric Sales and Revenue Variance Report for management. This report compares actual electric peaks, net system input (NSI) sales and revenue versus the forecast of each. It also provides an explanation of variance. This comparison and variance reporting is done at both the revenue class and total system level on a monthly, year-to-date, twelve-months-ended and same month as last year basis. Each month, the Customer Report and Weather Report is prepared by the Planning and Regulatory department and distributed to management. The Customer Report exhibits the number of customers and the change in customer growth by Commercial Operation Area. Since weather is a key factor for the monthly peak, NSI, sales and revenue, a Weather Report shows how the current month's heating and cooling degrees compared to history. When the load forecasts are developed, input is provided from several areas of the Company including management, Industrial and Commercial Services, and the Commercial Operations areas.

6.4 Monitoring Construction/Transmission/Interest Rates

The capital costs associated with generation and transmission projects are monitored by Empire in a variety of ways. A project development team is formed for each major generation project with direct line reporting to a member of senior management. Finance personnel monitor the markets daily to track interest rates, are in frequent contact with the rating agencies, and are kept abreast of planned budgets for new projects. These efforts are coordinated with members of senior management.

Empire monitors the state of current estimates of construction costs for supply-side resources via industry periodicals such as Platts and the Energy Information Administration (EIA) Annual Energy Outlook. Empire has contracted with engineering firms such as Black & Veatch, Burns and McDonnell, Sega, Inc., and others for construction cost estimates on an as needed basis. Empire has recent experience with several new generation construction projects with various technologies including combined-cycle, simple cycle combustion turbine, aeroderivative combustion turbine, wind turbines and coal plants. These types of construction projects are monitored by Project Managers. Strategic Projects and Safety and Environmental reports are provided to management on a monthly basis. Empire actively participates in the Southwest Power Pool Inc. regional transmission organization's (SPP RTO) transmission planning studies. SPP conducts three studies directly associated with transmission planning: Large Generation Interconnection Studies, Aggregate Transmission Service Studies and the SPP Transmission Expansion Plan.

6.5 Range of Outcomes

Empire's operating structure is organized in such a manner that senior management is both involved in and well-informed as to the key factors that have been identified in this IRP as the critical uncertain factors. Due to the level of communication and information flow within the Company, significant changes in these factors can be addressed immediately with appropriate changes to the Preferred Plan, implementation plan, or any other portion of the IRP prior to the next scheduled IRP filing (2013).

Empire will determine the range of outcomes within which the Preferred Plan is judged to be appropriate in accordance with 4 CSR 240-22.070. **

** Through its monitoring of the critical uncertain factors, Empire may decide that changes to its Preferred Plan are warranted.

Appendix A – Supply-Side Model Descriptions

SOFTWARE USED FOR ANALYSIS

Strategic Planning powered by MIDAS Gold® was utilized to measure and analyze the consumer value of competition.

Strategic Planning includes multiple modules for an enterprise-wide strategic solution. These modules are:

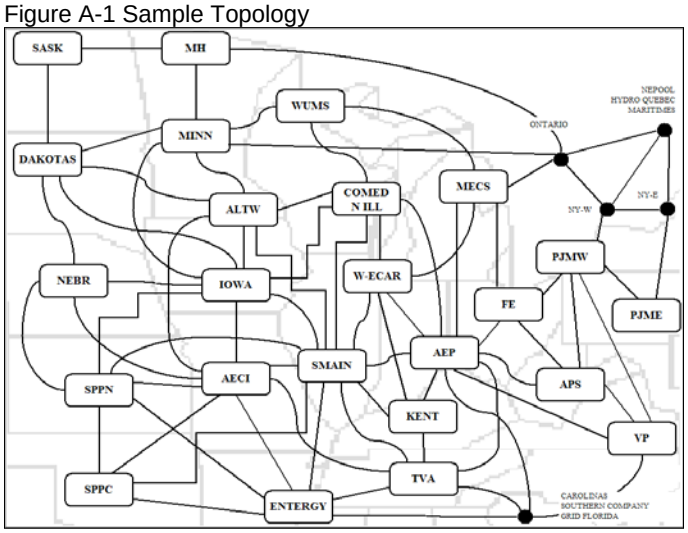
- Markets
- Portfolio
- Financial
- Risk

Strategic Planning is an integrated, fast, multi-scenario zonal market model capable of capturing many aspects of regional electricity market pricing, resource operation, asset and customer value. The markets and portfolio modules are hourly, multi-market, chronologically correct market production modules used to derive market prices, evaluate power contracts, and develop regional or utility-specific resource plans. The financial and risk modules provide full financial results and statements and decision making tools necessary to value customers, portfolios and business unit profitability.

Markets Module

Generates zonal electric market price forecasts for single and multi-market systems by hour and chronologically correct for 30 years. Prices may be generated for energy only, bid- or ICAP-based bidding processes. Prices generated reflect trading between transaction groups where transaction group may be best defined as an aggregated collection of control areas where congestion is limited and market prices are similar. Trading is limited by transmission paths and constraints quantities.

Figure A-1 Sample Topology



SOURCE: Ventyx

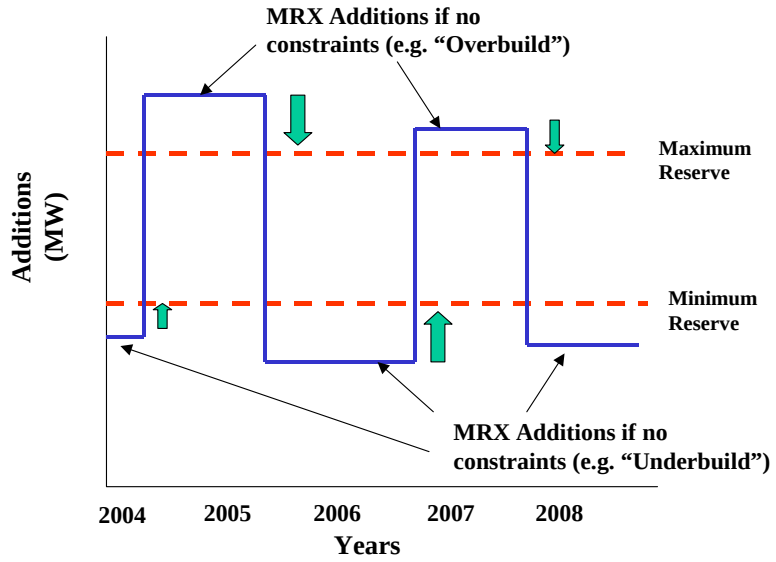
The database is populated with Ventyx Intelligence – Market Ops information.

- Operational information provided for over 10,000 generating units
- Load forecasts by zone (where zone may be best defined as utility level) and historical hourly load profiles
- Transmission capabilities
- Coal price forecast by plant with delivery adders from basin
- Gas price forecast from Henry Hub with basis and delivery adders

When running the simulation in markets module, the main process of the simulation is to determine hourly market prices. Plants outages are based on a unit derate and maintenance outages may be specified as a number of weeks per year or scheduled.

The market based resource expansion algorithm builds resources by planning region based on user-defined profitability and/or minimum and maximum reserve margin requirements in determining prices. In addition, strategic retirements are made of non-profitable units based on user-defined parameters.

Figure A-2 MRX Decision Basis



SOURCE: Ventyx

The markets module simulation process performs the following steps to determine price:

- Hourly loads are summed for all customers within each Transaction Group.
- For each Transaction Group in each hour, all available hydro power is used to meet firm power sales commitments.
- For each Transaction Group and Day Type, the model calculates production cost data for each dispatchable thermal unit and develops a dispatch order.
- The model calculates a probabilistic supply curve for each Transaction Group considering forced and planned outages.
- Depending on the relative sum of marginal energy cost + transmission cost + scarcity cost between regions, the model determines the hourly transactions that would likely occur among Transaction Groups.

- The model records and reports details about the generation, emissions, costs, revenues, etc. associated with these hourly transactions.

Portfolio Module

Once the price trajectories have been completed in the markets module, the portfolio module may be used to perform utility or region specific portfolio analyses. Simulation times are faster and it allows for more detailed operational characteristics for a utility specific fleet. The generation fleet is dispatched competitively against pre-solved market prices from the markets module or other external sources. Native load may also be used for non-merchant/regulated entities with a requirement to serve.

Operates generation fleet based on unit commitment logic which allows for plant specific parameters of:

- Ramp rates
- Minimum/maximum run times
- Start up costs

The decision to commit a unit may be based on one day, three day, seven day and month The decision to commit a unit may be based on one day, three day, seven day and month criteria. Forced outages may be based on monte-carlo or frequency duration with the capability to perform detailed maintenance scheduling. Resources may be de-committed based on transmission export constraints. Portfolio module has the capability to operate a generation fleet against single or multiple markets to show interface with other zones. In addition, physical, financial and fuel derivatives with pre-defined or user-defined strike periods, unit contingency, replacement policies, or load following for full requirement contracts are active.

Capacity Expansion Module

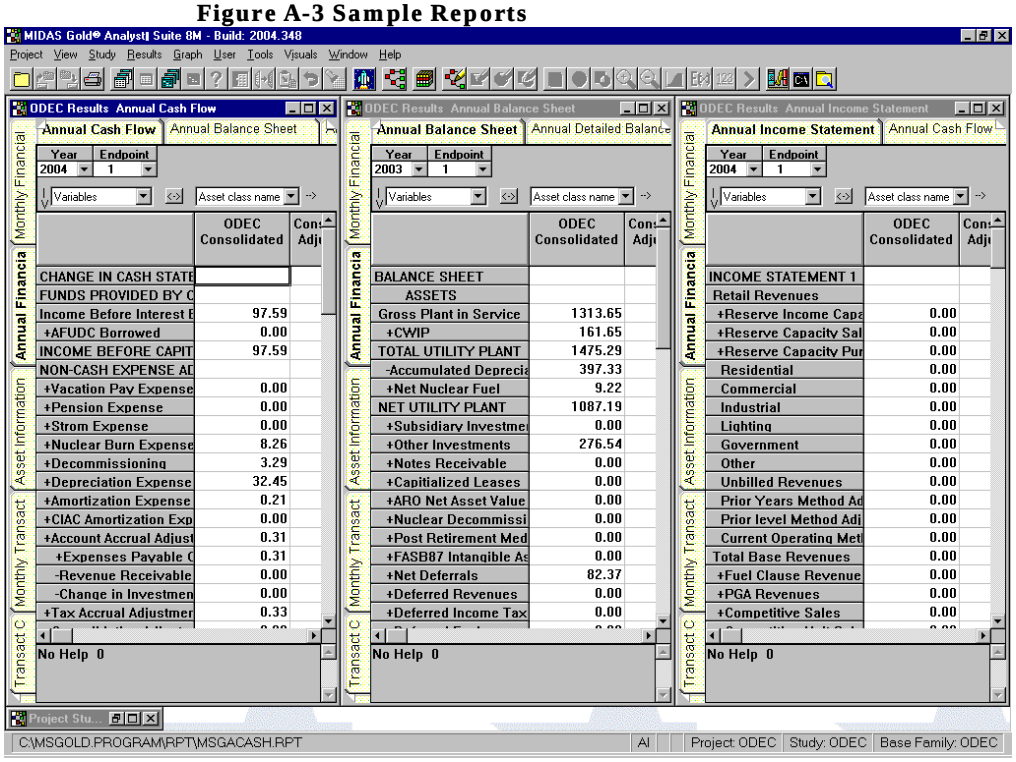
Capacity Expansion automates screening and evaluation of generation capacity expansion, transmission upgrades, strategic retirement, and other resource alternatives. It is a detailed and fast economic optimization model that simultaneously considers resource expansion investments and external market transactions. With Capacity Expansion, the optimal resource expansion strategy is determined based on an objective function subject to a set of constraints. The typical criterion for evaluation is the expected present value of revenue requirements (PVRR) subject to meeting load plus reserves, and various resource planning constraints.

- Develop long-term resource expansion plans with type, size, location, and timing of capital projects over a 30-year horizon
- Access significant production and costing detail in results
- S Include a complete range of technologies, including renewables, DSM, retirements, and transmission upgrades, today and in the future
- Consider interactions with external markets and between internal regions

Financial Module

The financial module allows the user the ability to model other financial aspects regarding costs exterior to the operation of units and other valuable information that is necessary to properly evaluate the economics of a generation fleet. The financial module produces bottom-line financial statements to evaluate profitability and earnings impacts.

Figure A-3 Sample Reports



Source: Ventyx

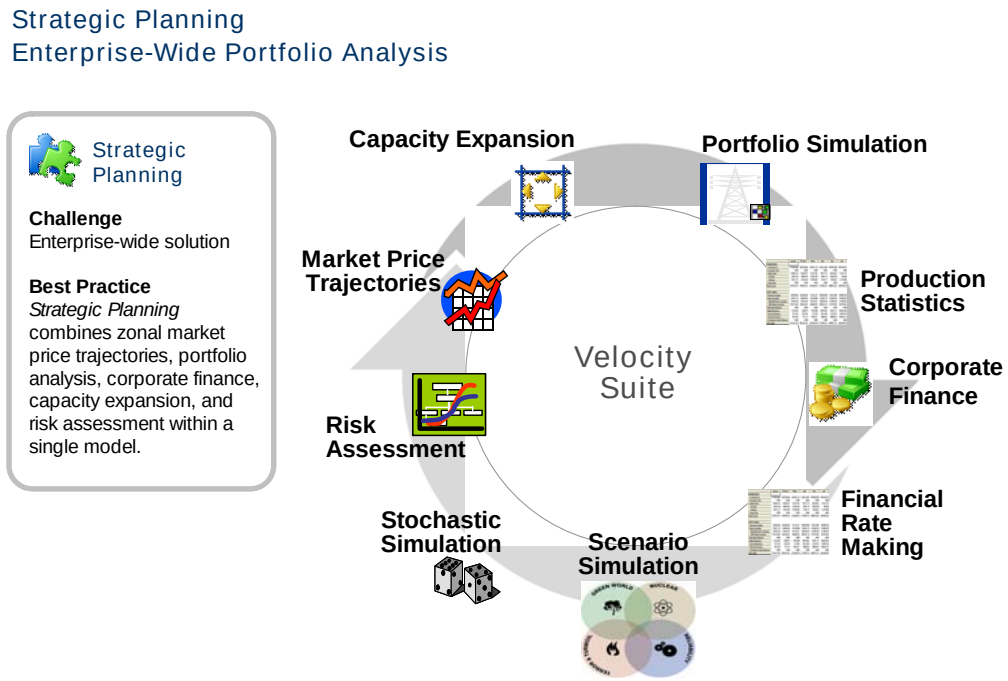
Risk Module

Risk module provides users the capability to perform stochastic analyses on all other modules and review results numerically and graphically. Stochastics may be performed on both production and financial variables providing flexibility not available in other models.

Strategic Planning has the functionality of developing probabilistic price series by using a four-factor structural approach to forecast prices that captures the uncertainties in regional electric demand, resources and transmission. Using a Latin Hypercube-based stratified sampling program, Strategic Planning generates regional forward price curves across multiple scenarios. Scenarios are driven by variations in a host of market price "drivers" (e.g. demand, fuel price, availability, hydro year, capital expansion cost, transmission availability, market electricity price, reserve margin, emission price, electricity price and/or weather) and takes into account statistical distributions, correlations, and volatilities for three time periods (i.e. Short-Term hourly, Mid-Term

monthly, and Long-Term annual) for each transact group. By allowing these uncertainties to vary over a range of possible values a range or distribution of forecasted prices are developed.

Figure A-4 Overview of Process



SOURCE: Ventyx

Table B-1 **Highly Confidential in its Entirety**

Table B-2 **Highly Confidential in its Entirety**

Table B-3 **Highly Confidential in its Entirety**

Table B-4 **Highly Confidential in its Entirety**

Table B-5 **Highly Confidential in its Entirety**

Table B-6 **Highly Confidential in its Entirety**

Table B-7 **Highly Confidential in its Entirety**

Table B-8 **Highly Confidential in its Entirety**

Table B-9 **Highly Confidential in its Entirety**

Table B-10 **Highly Confidential in its Entirety**

Table B-11 **Highly Confidential in its Entirety**

Table B-12 **Highly Confidential in its Entirety**

Table B-13 **Highly Confidential in its Entirety**

Table B-14 **Highly Confidential in its Entirety**

Table B-15 **Highly Confidential in its Entirety**

Table B-16 **Highly Confidential in its Entirety**

Table B-17 **Highly Confidential in its Entirety**

Table C-1 Demand-Side Management Impact Coincident with System Peak Demand (MW)
****Highly Confidential in its Entirety****

Table C-1 Demand-Side Management Impact Coincident with System Peak Demand (MW) (continued)
****Highly Confidential in its Entirety****

Table C-1 Demand-Side Management Impact Coincident with System Peak Demand (MW) (continued)
****Highly Confidential in its Entirety****

Table C-1 Demand-Side Management Impact on Peak Demand (MW) (continued)
****Highly Confidential in its Entirety****

Table C-2 Demand-Side Management – Impact on Annual Energy (MWh) **Highly Confidential in its Entirety**

Table C-2 Demand-Side Management – Impact on Annual Energy (MWh) (continued)
****Highly Confidential in its Entirety****

Table D-1
Emissions for All Plans **Highly Confidential in its Entirety**

Table D-1
Emissions for All Plans (continued) **Highly Confidential in its Entirety**

Table E-1
Annual Generation by Supply-Side Resource – Plan 1
****Highly Confidential in its Entirety****

Table E-2
Annual Generation by Supply-Side Resource – Plan 2
****Highly Confidential in its Entirety****

Table E-3
Annual Generation by Supply-Side Resource – Plan 3
****Highly Confidential in its Entirety****

Table E-4
Annual Generation by Supply-Side Resource – Plan 4
****Highly Confidential in its Entirety****

Table E-5
Annual Generation by Supply-Side Resource – Plan 5
****Highly Confidential in its Entirety****

Table E-6
Annual Generation by Supply-Side Resource – Plan 6
****Highly Confidential in its Entirety****

Table E-7
Annual Generation by Supply-Side Resource – Plan 7
****Highly Confidential in its Entirety****

Table E-8
Annual Generation by Supply-Side Resource – Plan 8
****Highly Confidential in its Entirety****

Table E-9
Annual Generation by Supply-Side Resource – Plan 9
****Highly Confidential in its Entirety****

Table E-10
Annual Generation by Supply-Side Resource – Plan 10
****Highly Confidential in its Entirety****

Table E-11
Annual Generation by Supply-Side Resource – Plan 11
****Highly Confidential in its Entirety****

Table E-12
Annual Generation by Supply-Side Resource – Plan 12
****Highly Confidential in its Entirety****

Table E-13
Annual Generation by Supply-Side Resource – Plan 13
****Highly Confidential in its Entirety****

Table E-14
Annual Generation by Supply-Side Resource – Plan 14
****Highly Confidential in its Entirety****

Table E-15
Annual Generation by Supply-Side Resource – Plan 15
****Highly Confidential in its Entirety****

Table E-16
Annual Generation by Supply-Side Resource – Plan 16
****Highly Confidential in its Entirety****

Table E-17
Annual Generation by Supply-Side Resource – Plan 17
****Highly Confidential in its Entirety****

Table F-1
All Plans – Average System Rates
****Highly Confidential in its Entirety****

Table F-2
All Plans – Annual Percent Increase in Average System Rates
****Highly Confidential in its Entirety****

Table F-3
All Plans – Pretax Interest Coverage
****Highly Confidential in its Entirety****

Table F-4
All Plans – Ratio of Total Debt to Total Capital
****Highly Confidential in its Entirety****

Table F-5
All Plans – Net Cash Flow to Capital Expenditures
****Highly Confidential in its Entirety****

Table F-6
All Plans – 20-Year PVRR – Deterministic (2010 – 2029)
****Highly Confidential in its Entirety****

Table F-7
PVRR of Out-Of-Pocket Costs to Participants in DSM Programs
****Highly Confidential in its Entirety****

Appendix G Expected Value of Better Information

If Empire had the opportunity to conduct a research study that would evaluate each of the four critical uncertainties identified in the Risk Section of this report, such a study (if it were even possible to do such a study) might help by improving the probability assessments that were assigned to each of these outcomes. However, if the cost of obtaining the research information exceeds its value, Empire should not conduct the study.

To determine the maximum possible value that Empire should pay for better information, it was assumed Empire could obtain perfect information regarding the states of nature, that is, Empire could determine with certainty which state of nature will occur. To make use of perfect information, a payoff table was developed. The payoff table illustrates the optimal resource alternative given perfect knowledge of the future. For this IRP, Plan 4 wins in all cases for the study period 2010-2029, so the tree was built using Plan 17 for comparison as it was the next best plan. By taking the probabilistic expected value of Plan 4 and subtracting the expected value with perfect information, Ventyx determined the expected value of perfect information (EVPI). EVPI represents the theoretical maximum amount of money Empire could spend to obtain additional information about the states of nature.

Table G-1
Expected Value of Better Information – States of Nature
****Highly Confidential in its Entirety****

Source: Ventyx

Table G-2
Expected Value of Better Information – Summary ($ millions)
****Highly Confidential in its Entirety****

Source: Ventyx

The calculation process and track along the decision tree to arrive at the bottom row of Table 3-3 for each state of nature are provided in Figures G-1, G-2, G-3, and G-4.

Figure G-1
EVPI – Environmental (2010 – 2029)
****Highly Confidential in its Entirety****

Figure G-2
EVPI – Market and Fuel Prices (2010 – 2029)
****Highly Confidential in its Entirety****

Figure G-3
EVPI – Loads (2010 – 2029)
****Highly Confidential in its Entirety****

Figure G-4
EVPI – Capital, Transmission and Interest Rates (2010 – 2029)
****Highly Confidential in its Entirety****

Abbreviations

A/C – Air Conditioning
ACFB – Atmospheric Circulating Fluidized Bed
AQCS – Air Quality Control System
BACT – Best Available Control Technology
B&V – Black & Veatch
C&I – Commercial and Industrial
CAC – Central Air Conditioning
CAIR – Clean Air Interstate Rule
CATR – Clean Air Transport Rule
CC – Combined Cycle
CCR – Coal Combustion Residuals
CDS – Circulating Dry Scrubber
CEM – Capacity Expansion Model
CO_2 – Carbon dioxide
CPC – Customer Programs Collaborative
CT – Combustion Turbine
DG – Distributed Generation
DSM – Demand-Side Management
EEI – Edison Electric Institute
EERS – Energy Efficiency Resource Standard
EIA – Energy Information Administration
EM&V – Evaluation, measurement and verification
EPA – Environmental Protection Agency
ES – Energy Star®
EVPI – Expected Value of Perfect Information
Hg/HAPS – Mercury/Hazardous Air Pollutants
IGCC – Integrated Gasification Combined Cycle
IRP – Integrated Resource Plan or integrated resource planning
KCP&L – Kansas City Power & Light
kV – kilovolt
kW – kilowatt
kWh – kilowatthour
MACT – Maximum Achievable Control Technology
MEUEC – Missouri Electric Utilities Environmental committee
MMBtu – Millions of British thermal units
MPSC – Missouri Public Service Commission
MW – Megawatt
MWh – Megawatthour
NO_2 – Nitrogen dioxide
NO_x – Nitrous oxides
PAC – Powder Activated Carbon
PJFF – Pulse-Jet Fabric Filter
$PM_{2.5}$ – Particulate matter, 2.5 micrometers
PPA – Power Purchase Agreement

PV – Photovoltaics (solar technology)
PVRR – Present Value of Revenue Requirements
REGFORM – the Regulatory Environmental Group for Missouri
RFP – Request for Proposals
RPS – Renewable Portfolio Standard
SAMP – SO_2 Allowance Management Policy
SCR – Selective Catalytic Reduction
SO_2 – Sulfur dioxide
SPP – Southwest Power Pool
SPP RTO – Southwest Power Pool Regional Transmission Organization