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VOLUME 6

INTEGRATED RESOURCE PLAN AND RISK ANALYSIS

THE EMPIRE DISTRICT
ELECTRIC COMPANY D/B/A LIBERTY ("LIBERTY-EMPIRE")

20 CSR 4240-22.060

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INTEGRATED RESOURCE PLAN AND RISK ANALYSIS

Commission Rule 20 CSR 4240-22.060, Integrated Resource Plan and Risk Analysis, provides in part as follows:

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. This rule also requires the utility to identify the critical uncertain factors that affect the performance of alternative resource plans and establishes minimum standards for the methods used to assess the risks associated with these uncertainties.

SECTION 1 RESOURCE PLANNING OBJECTIVES

(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 meet. The utility shall describe and document its additional planning objectives and its guiding principles to design alternative resource plans that satisfy all of the planning objectives and priorities.

1.1 Resource Planning Objectives

The fundamental objective of the electric utility resource planning process as stated in 20 CSR 4240-22.010 is to provide the public with energy services that are safe, reliable, and efficient, at just and reasonable rates, consistent with state energy and environmental policies, in compliance with all legal mandates, and in a manner that serves the public interest. In support of the fundamental objective, Liberty-Empire's 2022 Integrated Resource Plan ("IRP") considered and analyzed demand-side resources and supply-side renewable and non-renewable resources on an equivalent basis, subject to compliance with legal mandates that may affect the selection of electric energy resources in the resource planning process.

The minimization of the present worth of long-run utility costs was the primary criterion for evaluating the comparative performance of the alternative resource plans, subject to certain constraints as defined in 20 CSR 4240-22.010(2)(C). In addition, Liberty-Empire identified and, where possible, quantitatively analyzed other considerations that were critical to meeting the

fundamental resource planning objective and evaluated them in conjunction with the minimization of the present worth of long-run expected utility costs. Pursuant to 20 CSR 4240-22.010(2)(C), these considerations included, but were not limited to, mitigation of:

1. Risks associated with critical uncertain factors that would affect the actual costs associated with alternative resource plans;
2. Risks associated with new or more stringent legal mandates that might be imposed at some point within the planning period; and
3. Rate increases associated with alternative resource plans.

Liberty-Empire's decision-makers further identified long-term objectives associated with reliability and environmental stewardship that were also evaluated as part of the IRP process. More specifically, they were defined as the ability to provide *reliable* energy services to Liberty-Empire's customers and the commitment to achieve *significant reductions in carbon emissions* over the long term.

Together, these priorities drove the development of the 2022 IRP alternative resource plans, as well as the metrics against which Liberty-Empire evaluated the alternative plans and selected the preferred plan.

1.1.1 2022 IRP Planning Objectives and Scorecard Approach

To better document the process and rationale used by Liberty-Empire's decision-makers to assess the tradeoffs and determine the appropriate balance between minimization of expected utility costs and other resource planning considerations, Liberty-Empire's 2022 IRP utilized an IRP scorecard approach to transparently illustrate the comparative performance of the alternative resource plans across several key metrics. The scorecard is a means of reporting key metrics for different alternative resource plans to facilitate the evaluation of relative portfolio performance and key tradeoffs. Liberty-Empire's scorecard was not intended to produce a single ranking of

portfolios but served as a tool to help validate and rationalize decisions, facilitate structured tradeoff discussions, and support the internal decision-making and approval process.

Consistent with 20 CSR 4240-22.010(2), Liberty-Empire's 2022 IRP analysis was intended to select a resource strategy that provides energy services that are safe, reliable, and efficient, at just and reasonable rates, consistent with state energy and environmental policies, in compliance with all legal mandates, and in a manner that serves the public interest. Further, consistent with 20 CSR 4240-22.010(2)(C), the selected resource strategy was intended to be based on the minimization of the present value of long-run utility costs and the mitigation of risks associated with critical uncertain factors, legal compliance, and rate increases. Liberty-Empire also evaluated the performance measures as specified at 20 CSR 4240-22.060(2)(A). Finally, Liberty-Empire also considered the capability of the preferred plan to allow for the significant reduction of carbon emissions over the long term. While Liberty-Empire used the minimization of the present worth of long-run utility costs as the primary selection criterion for the preferred plan, it also considered these objectives as priorities and used them as guidelines for developing and evaluating the alternative resource plans.

Liberty-Empire identified five major planning objectives and seven performance metrics as summarized in Figure 6-1. The objectives included Customer Affordability, Risk Mitigation, Reliability, Environmental Sustainability, and Compliance and Safety. By populating the 2022 IRP Scorecard metrics for all of the alternative resource plans, Liberty-Empire was able to evaluate the plans holistically and recommend a preferred resource plan based on a transparent set of selection criteria, as further discussed in Volume 7.

Figure 6-1 – 2022 IRP Scorecard Metrics

Objective	Metric	Metric Description
Customer Affordability	NPV Revenue Requirement	NPV of long-term (30-year) total annual costs paid by ratepayers under the Base Case scenario
Risk Mitigation	Resilience to Critical Uncertain Factors	Expected value of 30-year PVRRs when evaluated against all critical uncertain factor probabilities
		Range between higher-cost (P95) and median (P50) PVRR outcomes when calculated against the CUF probabilities
Reliability	Operational Flexibility	Dispatchable capacity (Summer UCAP MW) included in portfolio by 2041
Environmental Sustainability	Carbon Reduction	Million short tons CO2 emissions in 2041 (scope 1/2 only)
Compliance and Safety	Environmental and Legal Compliance	Adherence to legal mandates and energy policies
	Safety	Adherence to safety standards

The scorecard was presented to stakeholders and to the Missouri Public Service Commission at Liberty-Empire's 2022 IRP Stakeholder Meeting #1 on September 15, 2021.

1.2 Planning and Analysis

As specified in 20 CSR 4240-22.010(2)(A), Liberty-Empire considered and analyzed demand-side resources, renewable energy, and supply-side resources on an equivalent basis. As discussed further in this volume, Liberty-Empire and its IRP modeling consultant, Charles River Associates ("CRA"), developed and analyzed a set of fifteen alternative resource plans based on substantively different mixes of supply-side resources and demand-side resources and variations in the timing of resource acquisition to assess their relative performance under expected future conditions as well as their robustness under a broad range of future conditions. The fifteen alternative resource plans differed based on the timing of potential resource retirements, the inclusion of various types of demand-side management ("DSM") programs, and the timing and inclusion of different levels of supply-side generation technology types. Once the alternative resource plans were developed, Liberty-Empire calculated the present worth of long-run utility costs for each plan by calculating the present value of revenue requirements ("PVRR") over the IRP analysis period and used the minimization of PVRR as the primary criterion for determining

the economic rank of each plan. Liberty-Empire also documented a set of quantitative measures for assessing the performance of the alternative plans, including all metrics defined in the IRP Scorecard and all metrics defined at 20 CSR 4240-22.060(2)(A).

The remainder of this volume describes and documents the details of Liberty-Empire's alternative resource plan development, evaluation, and risk analysis.

SECTION 2 PERFORMANCE MEASURES

(2) Specification of Performance Measures. The utility shall specify, describe, and document a set of quantitative measures for assessing the performance of alternative resource plans with respect to resource planning objectives.

(A) These performance measures shall include at least the following:

2.1 Present Worth of Utility Revenue Requirements

1. Present worth of utility revenue requirements, with and without any rate of return or financial performance incentives for demand-side resources the utility is planning to request;

The annual revenue requirement includes the total cost of Liberty-Empire's electric operations including any costs for probable environmental compliance. The annual revenue requirement is the total of Liberty-Empire's annual expenses including operating costs[1] plus its authorized return on rate base, less any revenues Liberty-Empire receives. Capital expenditures for investments in plant increase the rate base, while depreciation and amortization of assets reduce the rate base. The PVRR is calculated by applying Liberty-Empire's utility discount rate, equal to Liberty-Empire's after-tax weighted average cost of capital ("WACC"), to the future long-term annual revenue requirements to arrive at the net present value ("NPV") of future utility costs. This value was calculated for each alternative resource plan and was used as the primary measure for preferred plan selection.

2.2 Present Worth of Probable Environmental Costs

2. Present worth of probable environmental costs;

The present worth of probable environmental costs was calculated based on the cost to implement potential future CO_2 regulations under the 2022 IRP Base Case assumptions. Although no federal policies directly regulating carbon emissions are in effect as of March 2022, given

[1] Note that DSM program costs are expensed in annual revenue requirements in the year they are incurred and do not increase rate base or rate of return. The impact of financial performance incentives for DSM programs have been shown in the performance measures.

previous federal efforts to regulate carbon emissions, the Base Case federal CO2 regulation scenario includes a modest price on carbon emissions of $9-10/short ton beginning in 2026, rising slightly over the planning period to achieve approximately 70-80% carbon-free generation from the U.S. power sector over the long-term. This price represents a proxy for several different potential pathways for legislative action or executive regulation (not explicitly a carbon tax).

2.3 Present Worth of DSM Participant's Costs

3. Present worth of out-of-pocket costs to participants in demand-side programs and demand-side rates;

Demand-side management ("DSM") program costs were inputs to the integrated resource plan and risk analysis. As described in Volume 5, Liberty-Empire considered multiple levels of incentives in its DSM program analysis: Realistic Achievable Potential ("RAP") and Maximum Achievable Potential ("MAP"). MAP is defined as the maximum amount of savings that can be realized under ideal market, implementation, and customer preference conditions, and has higher incentives than RAP due to higher program participation. Within the RAP and MAP scenarios, Liberty-Empire's DSM analysis consultant, AEG, bundled DSM programs together based on the $/kWh cost of the programs (low, mid, and high-cost energy efficiency bundles plus a demand side rates bundle) for use in the integrated portfolio analysis. The DSM bundles were incorporated into the IRP as eligible resources in the portfolio optimization analysis along with supply-side resources in the alternative plan development stage.

The present value of DSM program costs over a 30-year period (2022-2051), calculated using the estimated future cost of the programs with the discount factor per 20 CSR 4240-22.060(2)(B), is shown by bundle in Table 6-1. Additional information regarding these program bundle definitions can be found in Volume 5.

The present value of DSM program costs over a 30-year period (2022-2051), calculated using the estimated future cost of the programs with the discount factor per 20 CSR 4240-22.060(2)(B), is shown by bundle in Table 6-1. Additional information regarding these program bundle definitions

can be found in Volume 5 and in Section 3.3.18.

Table 6-1 – DSM Out of Pocket Costs

DSM	Program Bundle	30-Year NPV of Program Costs
RAP	Low Cost	$4,024,278
	Mid Cost	$26,317,175
	High Cost	$24,172,865
	Demand Side Rates ("DSR")	$13,350,069
MAP	Low Cost	$11,283,087
	Mid Cost	$69,371,960
	High Cost	$57,074,280
	Demand Side Rates ("DSR")	$18,965,391

2.4 Levelized Rates

4. Levelized rates;

The levelized rate represents the levelized present value of the annual rates over a given period. Annual rates are calculated by dividing the annual revenue requirements by the forecasted annual retail energy sales, resulting in annual $/MWh values. The levelized rate is then determined by calculating the net present value of the stream of annual rates over time and amortizing the net present value into a levelized rate applicable to the full study period. Liberty-Empire's utility discount rate, equal to Liberty-Empire's after-tax weighted average cost of capital ("WACC") is used in this calculation.

2.5 Maximum Single-Year Increase in Annual Average Rates

5. Maximum single-year increase in annual average rates;

For each alternative resource plan, the year-over-year percent change in annual average rates was calculated to determine the maximum single year increase. The maximum value of year-over-year percent change in annual average rates represents the maximum single-year increase in annual average rates. This value was calculated for each alternative plan under the 2022 IRP Base Case.

2.6 Financial Ratios

6. Financial ratios (e.g., pretax interest coverage, ratio of total debt to total capital, ratio of net cash flow to capital expenditures) or other credit metrics indicative of the utility's ability to finance alternative resource plans; and

For each alternative resource plan, Liberty-Empire calculated the pre-tax interest coverage, ratio of total debt to total capital, and ratio of net cash flow to capital expenditures to indicate Liberty-Empire's ability to finance alternative resource plans.

2.7 Other Measures for Assessing Relative Performance Plans

7. Other measures that utility decision-makers believe are appropriate for assessing the performance of alternative resource plans relative to the planning objectives identified in 4 CSR 240-22.010(2).

As discussed in Section 1.1.1, Liberty-Empire used an IRP Scorecard approach in the 2022 IRP to select a resource strategy that provides energy services that are safe, reliable, and efficient, at just and reasonable rates, consistent with state energy and environmental policies, in compliance with all legal mandates, and in a manner that serves the public interest. As a part of its scorecard development, Liberty-Empire developed five major planning objectives and seven performance metrics, summarized in Figure 6-1. The objectives include Customer Affordability, Risk Mitigation, Reliability, Environmental Sustainability, and Compliance and Safety. While Liberty-Empire used the minimization of the present worth of long-run utility costs as the primary selection criterion for the preferred plan, it also considered these objectives as priorities and used them as guidelines for developing and evaluating the alternative resource plans.

2.8 Utility Discount Rate

(B) All present worth and levelization calculations shall use the utility discount rate and all costs and benefits shall be expressed in nominal dollars.

Liberty-Empire utilized a discount rate of 6.20 percent for all analyses of alternative resource plans. This discount rate is equal to Liberty-Empire's after-tax WACC. All PVRR dollar amounts were discounted back to 2022 dollars.

SECTION 3 ALTERNATIVE RESOURCE PLANS

(3) Development of Alternative Resource Plans. The utility shall use appropriate combinations of demand-side resources 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). Demand-side resources are the demand-side candidate resource options and portfolios developed in 4 CSR 240-22.050(6). Supply-side resources are the supply-side candidate resource options developed in 4 CSR 240-22.040(4). The goal is to develop a set of alternative plans based on substantively different mixes of supply-side resources and demand-side resources and variations in the timing of resource acquisition to assess their relative performance under expected future conditions as well as their robustness under a broad range of future conditions.

3.1 Overview of Alternative Resource Plan Development

(A) The utility shall develop, and describe and document, at least one (1) alternative resource plan, and as many as may be needed to assess the range of options for the choices and timing of resources, for each of the following cases. Each of the alternative resource plans for cases pursuant to paragraphs (3)(A)1.-(3)(A)5. shall provide resources to meet at least the projected load growth and resource retirements over the planning period in a manner specified by the case. The utility shall examine cases that—

For 2022 IRP analysis purposes, Liberty-Empire developed a set of alternative plans based on substantively different mixes of supply-side resources and demand-side resources and variations in the timing of resource acquisition. All alternative resource plans were developed under the following key planning constraints:

- Minimum SPP reserve margin requirement in both summer and winter (12 percent), with a maximum reserve margin of 35 percent
- Maximum annual net energy market sales position (50 percent of annual load volume)

In addition to the key planning constraints, each resource portfolio was subject to resource acquisition strategy constraints that defined the type of resources that could be added to the portfolio over the IRP study period. Given these resource selection constraints, the additions in each portfolio were optimized in terms of their amount and timing using a long-term portfolio optimization model known as Aurora. A description of the Aurora model can be found in Section

4.2.15. Section 3.1.1 describes the alternative resource plan definitions in more detail.

3.1.1 Summary of 2022 IRP Alternative Resource Plans

Liberty-Empire developed 15 alternative resource plans for purposes of the 2022 IRP analysis. Nine of the 15 alternative resource plans assumed "baseline" (i.e., age-based) retirement dates and expected PPA expirations for the existing resources in Liberty-Empire's portfolio. During the 20-year study horizon explicitly covered by this 2022 triennial IRP (2022-2041), the assumed resource retirements and PPA expirations of the existing resources are as follows:

- Retirement of Riverton 10 and 11 in 2025;*
- Expiration of the Elk River Wind PPA in 2025;
- Expiration of the MJMEUC Capacity Sale PPA in 2025;
- Expiration of the Meridian Way Wind PPA in 2028;
- Retirement of Energy Center 1 and 2 in 2026 or 2035;*
- Retirement of Iatan 1 in 2039;
- Expiration of the Plum Point PPA in 2040

* Note: See discussion later in this section for additional detail on the retirement of Riverton 10 and 11 and Energy Center 1 and 2.

The remaining six of the 15 alternative resource plans were intended to examine the feasibility and tradeoffs of achieving two different hypothetical long-term net zero carbon emissions goals: Net Zero by 2035 and Net Zero by 2050.[2] Given that most of Liberty-Empire's long-term scope 1 and 2 emissions come from its two natural gas-fired CCs,[3] in addition to the expected retirements

[2] Net Zero refers to the reduction of carbon emissions from Liberty-Empire's generating portfolio towards levels that are close to zero. Given the potential for "offsets" from outside the electric sector to cover small amounts of emissions from the portfolio, such as those from natural gas peaking units, the term *Net* Zero is used.

[3] Scope 1 emissions refer to direct greenhouse gas emissions from sources that are controlled or owned by Liberty-Empire. Scope 2 emissions refer to indirect greenhouse gas emissions associated with the purchase of electricity. Scope 3 emissions are the result of activities from assets not owned or controlled by the reporting organization. For Liberty-Empire, all emissions except those associated with the owned portion of Plum Point and Iatan 1 and 2

and PPA expirations listed previously, the "net zero" portfolios assumed the retirement or conversion of Riverton 12 and State Line CC at various points in time.

Given the assumed retirements of the existing resources, each resource portfolio was subject to constraints on resource acquisition strategy, which defined the type of resources that could be added to the portfolio over the IRP study period. For the "baseline" portfolios, these included a subset of plans that allowed the addition of only thermal resources vs. only renewable and storage resources, a subset of plans that allowed the addition of distributed resources vs. did not allow the addition of distributed resources, and a subset of plans that allowed the addition of RAP DSM vs. MAP DSM programs. For the "net zero" portfolios, the existing natural gas-fired CCs were assumed to be replaced by a combination of renewables and emerging technologies such as advanced storage, nuclear SMR, and/or hydrogen.

Finally, Liberty-Empire also included two key decisions in all alternative plans that differed from the "baseline" retirements and assumptions originally modeled in the 2019 IRP. First, given the advanced age of the original equipment at the Riverton 10 and Riverton 11 facilities, Liberty-Empire assumed the retirement of both units in 2025.[4] To preserve the units' dual-fuel **[redacted]** capability,[5] Riverton 10 and 11 were assumed to be replaced directly at the site by a dual-fuel **[redacted]**capable RICE unit, taking advantage of Riverton 10 and 11's existing interconnection rights at the site.

Second, Liberty-Empire evaluated the cost of maintaining two of its older natural gas peaking units, Energy Center 1 and 2, until 2035 relative to the cost of retiring them as planned in 2026. Although these units were originally assumed to retire by 2026 in the previous IRP analysis based

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are scope 1 and 2 emissions and are counted against Liberty-Empire's net zero goals. Scope 3 emissions are subject to environmental costs but do not count against Liberty-Empire's emissions accounting.

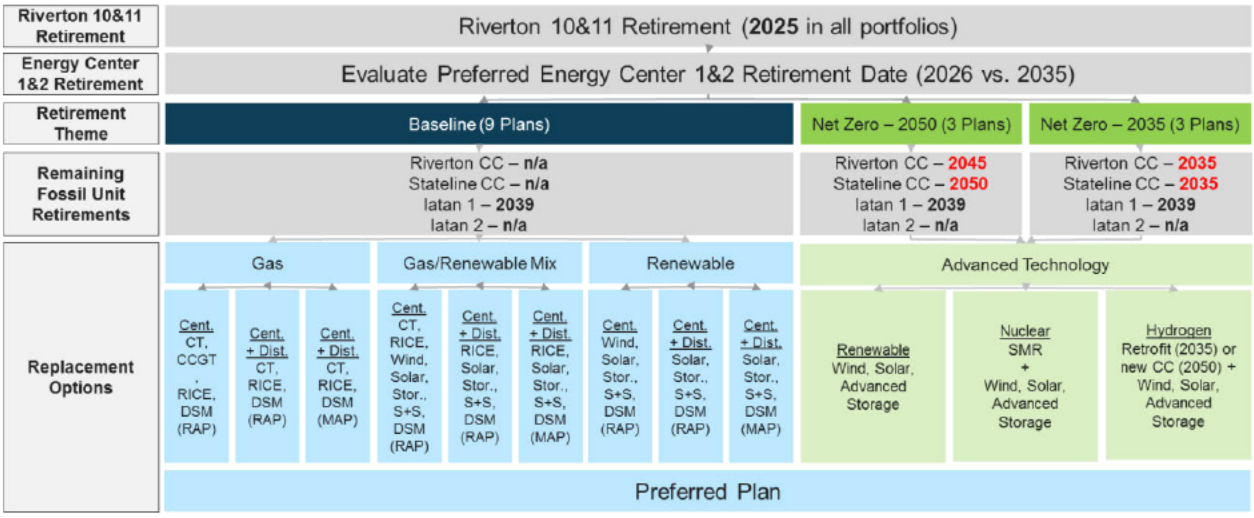
[4] In the 2019 IRP, Liberty-Empire assumed an age-based retirement date of 2033 for both Riverton 10 and 11. However, the 2033 retirement date assumption from the 2019 IRP was based on the date that Riverton 10 and 11 were installed at the Liberty-Empire system (1988). The primary equipment used at Riverton 10 and 11 is actually of 1960s vintage.

[5] **[redacted]**

on their age, their low average historical capacity factors and high potential reliability benefits, as demonstrated during Storm Uri, suggests that maintaining them until 2035 with some capital investment could help provide reliable energy services to customers. In addition, Liberty-Empire intends to explore co-locating renewable resources (i.e., solar and storage) directly at the site prior to unit retirement to complement Energy Center 1 and 2's low expected capacity factors and take advantage of surplus interconnection rights. To facilitate the retirement decision, Liberty-Empire performed an initial economic analysis to determine the preferred retirement date for Energy Center 1 and 2, to be carried through in all alternative plans. The Energy Center retirement analysis is described further in Section 3.2.

A summary of the 15 alternative resource plans is illustrated in Figure 6-2. The definitions of the 15 alternative plans were presented to stakeholders and Missouri Public Service Commission staff at Stakeholder Meeting #2 on October 26, 2021.

Figure 6-2 – Themes for Development of Alternative Resource Plans



Liberty-Empire also evaluated ** [redacted] ** This analysis can be found in Volume 7.

Table 6-2 provides a high-level summary of Liberty-Empire's alternative resource plans.

Table 6-2 - Summary of Alternative Resource Plans

Plan	Plan Description	Replacement Tech.	Scale	Key Retirements*	DSM Bundle
1	Gas Only – Utility-Scale	Natural Gas	Utility		RAP
2	Gas Only – Utility-Scale + Distributed	Natural Gas	Utility/Distributed		RAP
3	Gas Only – Utility-Scale + Distributed	Natural Gas	Utility		MAP
4	Gas/Renew Mix – Utility-Scale	Natural Gas + Renew.	Utility		RAP
5	Gas/Renew Mix – Utility-Scale + Distributed	Natural Gas + Renew.	Utility/Distributed		RAP
6	Gas/Renew Mix – Utility-Scale + Distributed	Natural Gas + Renew.	Utility/Distributed		MAP
7	Renewable – Utility-Scale	Renewable	Utility		RAP
8	Renewable – Utility-Scale + Distributed	Renewable	Utility/Distributed		RAP
9	Renewable – Utility-Scale + Distributed	Renewable	Utility/Distributed		MAP
10	Net Zero 2050 – Renewable + Storage	Renewable	Utility/Distributed	Riverton CC 2045 Stateline CC 2050	RAP
11	Net Zero 2050 – Nuclear SMR	Nuclear + Renew.	Utility/Distributed	Riverton CC 2045 Stateline CC 2050	RAP
12	Net Zero 2050 – Hydrogen	Hydrogen + Renew.	Utility/Distributed	Riverton CC 2045 Stateline CC 2050	RAP
13	Net Zero 2035 – Renewable / Storage	Renewable	Utility/Distributed	Riverton CC 2035 Stateline CC 2035	RAP
14	Net Zero 2035 – Nuclear SMR	Nuclear + Renew.	Utility/Distributed	Riverton CC 2035 Stateline CC 2035	RAP
15	Net Zero 2035 – Hydrogen	Hydrogen + Renew.	Utility/Distributed	Riverton CC 2035 Stateline CC 2035	RAP

DSM = "Demand-Side Management"
RAP = "Realistic Achievable Potential"
MAP = "Maximum Achievable Potential"
Renewable options include storage. Advanced storage options are allowed only in the net zero portfolios.

* Key Retirements are incremental to retirements and PPA expirations that are common across all plans:

- Retirement of Riverton 10 and 11 in 2025
- Expiration of the Elk River Wind PPA in 2025
- Expiration of the MJMEUC Capacity Sale PPA in 2025
- Expiration of the Meridian Way Wind PPA in 2028
- Retirement of Energy Center 1 and 2 by 2035
- Retirement of Iatan 1 in 2039
- Expiration of the Plum Point PPA in 2040

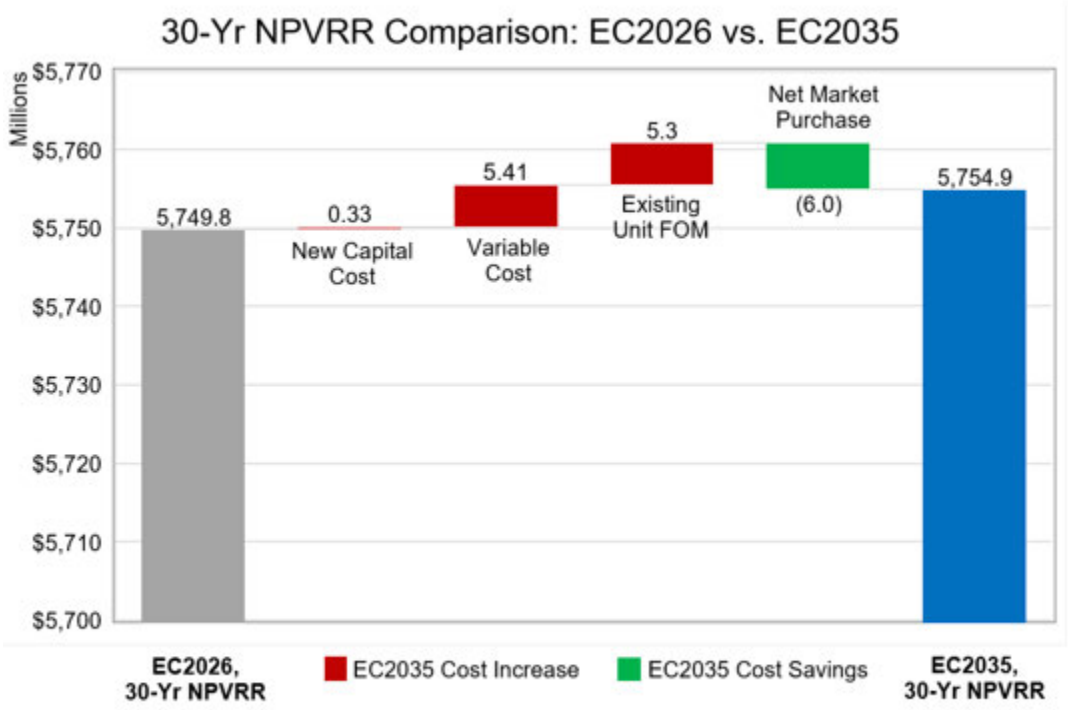
3.2 Energy Center 1 and 2 Retirement Analysis

To evaluate the Energy Center 1 and 2 retirement decision, Liberty-Empire developed two resource portfolios: one that retired Energy Center 1 and 2 in 2026, and one that retired Energy Center in 2035. Both portfolios assumed that solar and/or lithium-ion battery storage resources could be co-located at the site prior to unit retirement up to the interconnection availability, with 2025 being the first feasible in-service year. Although co-located resources could avoid paying generator interconnection costs and could provide energy value to the portfolio by selling generation into the market and/or serving Liberty-Empire load in times of interconnection availability, they were assumed to not receive capacity credit from SPP until Energy Center 1 and 2 were retired.[6] Other capacity additions (including the co-located resources) were determined using the Aurora portfolio optimization model, which aims to solve for an optimal mix of resources that minimizes the net present value of a given portfolio, subject to key planning and operational constraints. New capacity additions between the 2026 and 2035 Energy Center retirement portfolios were intentionally kept as similar as possible to isolate the economic impact of Energy Center's retirement and were dominated by a mix of solar and storage.

Once the two portfolios were defined, Liberty-Empire calculated the PVRR of the portfolios to determine the relative costs of retiring Energy Center earlier than later. On a 30-year PVRR basis (2022-2051), Liberty-Empire found that the Energy Center 2035 retirement was only slightly ($5.1 million in PVRR) more expensive than the Energy Center 2026 retirement case. The higher costs in the Energy Center 2035 case were driven primarily by higher FOM, VOM, and maintenance capex expenditures at Energy Center 1 and 2 in the years 2027 to 2035. However, these higher costs were partially offset by slightly greater net energy market sales between 2027 and 2035 due to Energy Center's energy contribution to the portfolio for an additional decade. These differences are illustrated in the waterfall chart in Figure 6-3. Note that the PVRR figures below represent *only* the generation component of revenue requirements.

[6] This is because the existing capacity at Energy Center 1 and 2 retains the capacity value up to the interconnection rights.

Figure 6-3 – Generation-Only PVRR Impact of Retiring Energy Center 1-2 in 2026 vs. 2035



Note: EC1-2 maintenance CapEx savings in the EC2026 retirement scenario are partially offset by increased CapEx reallocated to EC3-4

Given the very small cost difference over the 30-year period (representing less than 0.1% of total portfolio costs) and Energy Center 1 and 2's low expected average capacity factors, Liberty-Empire determined that it would be prudent to maintain a 2035 retirement for the units for reliability and other benefits. These include Energy Center 1 and 2's value in providing dual fuel capability, Liberty-Empire's ability to take advantage of surplus interconnection rights at the site by co-locating renewables, and the value of dispatchable capacity during unexpected, low probability, high impact events, such as Storm Uri. The decision was also determined to be in line with the fundamental resource planning objective specified at 20 CSR 4240-22.060(2) to provide the public with energy services that are safe, reliable, and efficient, at just and reasonable rates. The 2035 retirement date was carried through all fifteen alternative resource plans.

3.3 Development of Alternative Resource Plans

3.3.1 Rule Compliant Alternative Resource Plans

1. Minimally comply with legal mandates for demand-side resources, renewable energy resources, and other mandated energy resources. This constitutes the compliance benchmark resource plan for planning purposes;

All alternative resource plans developed for the 2022 IRP consider the impact of future renewable generation requirements for Liberty-Empire. Liberty-Empire is required under 393.1030 RSMo and 20 CSR 4240-20.100 to comply with the state Renewable Energy Standard ("RES"), which is based on the total retail electric sales or the total retail electric usage that Liberty-Empire delivers each year to its Missouri retail customers. The Missouri RES requirements are summarized in Table 6-3. These values are based on a percentage of an electric utility's Missouri annual retail sales. 2 percent of the RES requirement must be met with solar resources. Each eligible kWh of energy generated within the state of Missouri counts as 1.25 kWh. Additionally, some or all of the requirement may be satisfied by the purchase of Renewable Energy Credits ("RECs").

Table 6-3 - Missouri RES Requirements

Current Dates	Current RES Percentage (no less than)
2011-2013	2%
2014-2017	5%
2018-2020	10%
Beginning in 2021	15%

As of March 2022, Liberty-Empire currently complies with the RES by utilizing the Elk River Windfarm PPA, the Ozark Beach hydroelectric facility, and a solar component supplied by the Customer Solar Rebate program. The Meridian Way Windfarm PPA, which expires in December 2028, could be further used if needed. The addition of the Neosho Ridge Wind Project, North Fork Ridge Wind Farm, and Kings Point Wind Farm in 2020 and 2021 further provide RECs that can be used for compliance after the expiration of the Elk River and Meridian Way Windfarm PPAs. If new renewable energy requirements are implemented in the future, the Company is in a favorable position to meet additional requirements.

Given that Liberty-Empire complies with the RES through the IRP horizon with existing resources, Liberty-Empire interpreted any alternative plan that does not add new renewables through the horizon as representative of a plan that is minimally compliant with legal mandates for renewable resources. For purposes of the 2022 IRP, this plan is identified as Plans 1 through 3.

To further develop an alternative plan that is also minimally compliant with legal mandates for demand-side resources, Liberty-Empire developed a "Plan 1A," which does not allow any new DSM resources. Given that at least some level of new DSM resources was found to be cost-effective in all plans, Plan 1A was analyzed primarily for compliance purposes and only under base planning assumptions.

3.3.2 All-Renewable Resource Plan

> *2. Utilize only renewable energy resources, up to the maximum potential capability of renewable resources in each year of the planning horizon, if that results in more renewable energy resources than the minimally-compliant plan. This constitutes the aggressive renewable energy resource plan for planning purposes;*

Liberty-Empire met this planning requirement through the development of several of the alternative resource plans. Specifically, alternative resource plans 7, 8, 9, 10, and 13 utilize only renewable energy resources to meet capacity needs.

3.3.3 All-Demand-Side Resource Plan

> *3. Utilize only demand-side resources, up to the maximum achievable potential of demand-side resources in each year of the planning horizon, if that results in more demand-side resources than the minimally-compliant plan. This constitutes the aggressive demand-side resource plan for planning purposes;*

Alternative Resource Plans 3, 6, and 9 are designed to utilize MAP DSM programs.

3.3.4 All Other Mandated Resources Plan

4. In the event that legal mandates identify energy resources other than renewable energy or demand-side resources, utilize only the other energy resources, up to the maximum capability of the other energy resources in each year of the planning horizon, if that results in more of the other energy resources than the compliance benchmark resource plan. For planning purposes, this constitutes the aggressive legally-mandated other energy resource plan;

No other legal mandates were identified.

3.3.5 Optimally Compliant DSM, Renewable, and Other Targeted Resource Plans

5. Optimally comply with legal mandates for demand-side resources, renewable energy resources, and other targeted energy resources. This constitutes the optimal compliance resource plan, where every legal mandate is at least minimally met, but some resources may be optimally utilized at levels greater than the mandated minimums;

As discussed in Section 3.3.1, all alternative plans developed by Liberty-Empire comply with minimum legal mandates for demand-side resources, renewable energy resources, and other targeted energy resources.

3.3.6 Special Contemporary Issue Plan

6. Any other plan specified by the commission as a special contemporary issue pursuant to 4 CSR 240-22.080(4);

In Docket No. EO-2022-0057, the Commission issued an order on October 27, 2021, effective November 6, 2021, establishing six (6) special contemporary planning issues for Liberty-Empire to analyze and document in its 2022 triennial Integrated Resource Plan. These issues are addressed in Section 8 of this volume. No other plans incremental to those defined in Section 3.1 were specified by the commission in the special contemporary issues.

3.3.7 Other Commission-Specified Plans

7. Any other plan specified by commission order; and

No other plans were specified by Commission order.

3.3.8 Other Utility-Suggested Plans

8. Any additional alternative resource plans that the utility deems should be analyzed.

Including the alternative plans specified in 20 CSR 4240-22.060(3)(A) discussed in Sections 3.3.1 through 3.3.7, Liberty-Empire developed and analyzed a total of 15 alternative plans that test for the contributions from a variety of future resources. The rationale and definition of these alternative plans are described in Section 3.1. Collectively, these 15 alternative resource plans provide a reasonable basis of information for Commission and stakeholder review.

3.3.9 Load-Building Programs in Plans

(B) The alternative resource plans developed at this stage of the analysis shall not include load-building programs, which shall be analyzed as required by 4 CSR 240-22.070(5).

No load-building plans were included in any of Liberty-Empire's alternative resource plans.

3.3.10 Potential Retirement or Life Extension of Existing Generating Plants

(C) The utility shall include in its development of alternative resource plans the impact of—

1. The potential retirement or life extension of existing generation plants;

Riverton 10 and 11 were assumed to retire in 2025 in all alternative plans. The retirement of Energy Center 1 and 2 was evaluated for 2026 and 2035, with the preferred option applied to all portfolios. Based on the Energy Center retirement analysis, which was described and documented in Section 3.2, Liberty-Empire concluded that extending the life of Energy Center 1

and 2 to 2035 was prudent. Table 6-2 summarizes the retirement assumptions for all other existing generation plants across all alternative plans.

3.3.11 Additions of Environmental Equipment at Generating Plants

2. The addition of equipment and other retrofits on generation plants to meet environmental requirements; and

No other major upgrades or additional environmental equipment are expected to be necessary at Liberty-Empire's existing supply-side resources during the planning period for this IRP.

3.3.12 Conclusion of Any Currently-Implemented DSM Resources

3. The conclusion of any currently-implemented demand-side resources.

Previously, Liberty-Empire offered a demand-side portfolio in each of the states it served (Missouri, Arkansas, Kansas, and Oklahoma). Currently, Liberty-Empire offers demand-side programs in Missouri and Arkansas only. DSM customer programs began in Missouri in mid-2007 and in Arkansas in October 2007. Customer programs that began in Oklahoma in 2010 were discontinued on May 1, 2014 (Order No. 624718 in Oklahoma PUC Cause No. PUD 201300203), and the three-year Kansas pilot program that began in June 2010 concluded in June 2013. In its current general rate case before the Oklahoma Corporation Commission, filed in PUD Case No. 202100163, Liberty-Empire expressed desire and willingness to begin offering DSM programs in Oklahoma again, but no resolution on this issue has been achieved at this time.

In January 2022, Liberty-Empire began offering its first portfolio of programs under the regulatory framework prescribed by the Missouri Energy Efficiency Investment Act ("MEEIA"). Liberty-Empire's new portfolio represents a three-fold increase in its investment in energy efficiency in its Missouri service territory.

The current Missouri and Arkansas programs are shown in Table 6-4 below. Currently, Liberty-

Empire has an Energy Efficiency Cost Recovery rider in Arkansas that was designed to recover the full cost of implementing energy efficiency programs with a rate that is reconfigured annually. Liberty-Empire also received approval for a cost-recovery mechanism in Missouri, as prescribed in the MEEIA rule. This Demand-Side Investment Mechanism ("DSIM") will comprehensively recover the costs of delivering energy efficiency programs.

Table 6-4 - Demand-Side Programs by State

Missouri	Arkansas
● Efficient Products	● Residential Products
● Low-Income Weatherization	● Residential Weatherization
● Low-Income Multi-Family	● School-Based Energy Education
● HVAC Rebate	● High-efficiency Residential Lighting (LED)
● Pay As You Save ("PAYS")	● Online Audit and Energy Calculator
● Small Business Direct Install ("SBDI")	● Commercial and Industrial Rebate Program
● Commercial and Industrial Rebate Program	

3.3.13 Description of Alternative Resource Plans

(D) The utility shall provide a description of each alternative resource plan including the type and size of each demand-side resource and supply-side resource addition and a listing of the sequence and schedule for the end of life of existing resources and for the acquisition of each new resource.

Liberty-Empire developed 15 alternative resource plans for purposes of the 2022 IRP analysis. Nine of the 15 alternative resource plans assumed "baseline" (i.e., age-based) retirement dates and expected PPA expirations for the existing resources in Liberty-Empire's portfolio. Three of the remaining six plans were designed to achieve net zero scope 1 and 2 carbon emissions by 2035 and include the retirement or retrofit of Liberty-Empire's two existing gas CCs, Riverton 12 and State Line CC, in 2035. The final three plans were designed to achieve net zero carbon emissions by 2050 and include the retirement of Riverton 12 in 2045 and State Line CC in 2050.

In all plans, Riverton 10 and 11 were assumed to retire in 2025 and to be replaced directly at the site by 30 MW of reciprocating dual-fuel capable diesel/jet fuel engines. Energy Center 1 and 2 are retired in 2035, although co-located resources are installed at the site prior to retirement beginning in 2026, providing energy value to the portfolio without facing incremental

interconnection costs. Energy Center 1 and 2 remain in operation until 2035 to supplement system reliability as a back-up generation source.

On top of the assumed retirements of the existing resources, each resource portfolio was subject to constraints on resource acquisition strategy, which defined the type of resources that could be added to the portfolio over the IRP study period. For the "baseline" portfolios, these included plans that allowed the addition of only thermal resources vs. only renewable and storage resources, plans that allowed the addition of distributed resources vs. did not allow the addition of distributed resources, and plans that allowed the addition of RAP DSM vs. MAP DSM programs. For the "net zero" portfolios, the existing natural gas-fired CCs were assumed to be replaced by a combination of renewables and emerging technologies such as advanced storage, nuclear SMR, and/or hydrogen.

The following is a summary of the 15 alternative resource plans modeled by Liberty-Empire:

- Plan 1 (Utility-Scale Natural Gas): Plan 1 was developed to assess the value of a portfolio which utilizes only utility-scale natural gas-fueled options for resource replacement. Liberty-Empire identified three main types of utility-scale thermal units that were available as potential resource options: natural gas combined cycle, natural gas RICE, and aeroderivative natural gas combustion turbine. Plan 1 adds 150 MW of utility-scale RICE in 2035 and 240 MW of utility-scale CT Frame in 2039. Plan 1 also adds both the low-cost bundle and mid-cost bundle of RAP DSM.

- Plan 2 (Utility-Scale and Distributed-Scale Natural Gas Mix): Plan 2 was developed to analyze the value of building some level of natural gas located at the distribution-level, instead of all new capacity additions being located at the utility scale. As described in Volume 4 and in Volume 4.5, Liberty-Empire developed estimates for potential distribution system projects that could be avoided if replaced with a distributed energy resource. These avoided distribution costs informed the availability, size, and timing of potential distributed resource

additions. Liberty-Empire evaluated one distributed natural gas resource option: distribution-level RICE. Plan 2 adds 90 MW of utility-scale RICE in 2035, 22 MW total of distributed RICE between 2035 and 2038, and 240 MW of utility-scale CT Frame in 2039. Plan 2 also adds both the low-cost bundle and mid-cost bundle of RAP DSM.

- Plan 3 (Utility- and Distributed-Scale Natural Gas Mix + MAP DSM): Plan 3 was developed to analyze the same combination of available utility and distributed-scale natural gas fueled options for resource replacement as in Plan 2, although with MAP DSM instead of RAP. Plan 2 adds 120 MW of utility-scale RICE in 2035, 22 MW total of distributed RICE between 2035 and 2038, and 240 MW of utility-scale CT Frame in 2039. Plan 3 also adds the low-cost bundle of MAP DSM.

- Plan 4 (Utility-Scale Natural Gas and Renewable Mix): Plan 4 was developed to assess the value of a portfolio which utilizes a combination of natural gas-fueled and renewable options at the utility scale for resource replacement. Liberty-Empire identified several types of utility-scale renewable technologies that were available as a potential resource option: wind, solar, 4-hour lithium-ion battery storage, solar paired with 4-hour lithium-ion battery storage in a 2:1 solar to storage ratio or in a 4:1 solar to storage ratio, and 8-hour vanadium flow battery. The Ozark Beach hydro plant upgrade was also included as an option in portfolios that allowed the selection of renewables. Although Plan 4 was allowed to select from natural gas resource options, Liberty-Empire found that renewable resources were preferred over natural gas based on the portfolio optimization modeling, and no natural gas resources were selected. Thus, Liberty-Empire "forced in" a small amount (60 MW) of RICE in 2035 to produce and enable the evaluation of a distinct "natural gas and renewable mix" plan. Plan 4 also adds 175 MW of solar and storage at existing interconnection sites in a 4:1 solar to storage ratio by 2030. By 2041, Plan 4 also includes 300 MW utility-scale solar and 480 MW utility-scale 2:1 solar + storage. Plan 4 adds the low-cost bundle of RAP DSM.

- Plan 5 (Utility- and Distributed-Scale Natural Gas and Renewable Mix): Plan 5 was developed to analyze the value of allowing for diverse combinations of gas and renewable resources located at both the distribution level and the utility scale. Potential distributed renewable resource options included distributed solar, distributed storage, and distributed 2:1 solar + storage. Although Plan 5 was allowed to select from natural gas resource options, Liberty-Empire found that renewable resources were preferred over natural gas based on the portfolio optimization modeling. Thus, Liberty-Empire "forced in" 60 MW of RICE in 2035 to produce and enable the evaluation of a distinct "natural gas and renewable mix" plan. Plan 5 also adds 175 MW of solar and storage at existing interconnection sites in a 4:1 solar to storage ratio by 2030. By 2041, Plan 5 adds 200 MW utility-scale solar, 480 MW utility-scale 2:1 solar + storage, and 120 MW distributed solar. Plan 5 adds the low-cost bundle of RAP DSM.

- Plan 6 (Utility- and Distributed-Scale Natural Gas and Renewable Mix + MAP): Plan 6 was developed to analyze the availability of the same diverse combinations of gas and renewable resources located at both the utility and distributed scale as in Plan 5, although with MAP DSM instead of RAP. Plan 6 includes the same buildout as Plan 5, but with the low-cost bundle of MAP DSM instead of RAP DSM.

- Plan 7 (Utility-Scale Renewable): Plan 7 was developed to assess the value of a portfolio which includes only utility scale renewable options for resource replacement. Plan 7 adds 175 MW of solar and storage at existing interconnection sites in a 4:1 solar to storage ratio by 2030. By 2041, Plan 7 includes 350 MW utility-scale solar, 600 MW utility-scale 2:1 solar + storage, and 50 MW flow battery. Plan 7 also adds the low-cost bundle of RAP DSM.

- Plan 8 (Utility- and Distributed-Scale Renewable Mix): Plan 8 was developed to analyze the value of building some renewables at the distribution-level, instead of all at the utility scale. Plan 8 adds 175 MW of solar and storage at existing interconnection sites in a 4:1 solar to storage ratio by 2030. By 2041, Plan 8 adds 200 MW utility-scale solar, 600 MW utility-scale

2:1 solar + storage, 50 MW flow battery, and 132 MW of distributed solar and/or storage. Plan 8 also adds the low-cost bundle of RAP DSM.

- Plan 9 (Utility- and Distributed-Scale Renewable Mix + MAP): Plan 9 was developed to analyze the same combination of available utility and distributed scale renewable options for resource replacement as for Plan 8, although with MAP DSM instead of RAP. Plan 9 includes the same buildout as Plan 8, but with the low-cost bundle of MAP DSM instead of RAP DSM.

- Plan 10 (Net Zero 2050, Renewable): Plan 10 was developed to analyze a portfolio that achieves net-zero carbon emissions by 2050 using utility scale and distributed renewables and advanced storage options (i.e., lithium-ion battery, flow, or gravity storage) as replacements. Net-zero by 2050 requires the retirement of combined cycle gas units at Riverton in 2045 and State Line in 2050, in addition to the other baseline resource retirements. While these retirements are outside of the core IRP study period of 2022-2041, they were still evaluated with renewables and advanced storage replacements. During the study period, Plan 10 adds 175 MW of solar and storage at existing interconnection sites in a 4:1 solar to storage ratio by 2030. By 2041, Plan 10 also includes 200 MW utility-scale solar, 540 MW utility-scale 2:1 solar + storage, 100 MW gravity storage, and 132 MW of distributed solar and/or storage. Plan 10 also adds the low-cost bundle of RAP DSM.

- Plan 11 (Net Zero 2050, Nuclear SMR and Renewables): Plan 11 was developed to analyze a portfolio that achieves net-zero carbon emissions by 2050 using nuclear SMR supplemented by utility scale renewables and advanced storage. Net-zero by 2050 requires the retirement of combined cycle gas units at Riverton in 2045 and State Line in 2050, in addition to the other baseline resource retirements. While these retirements are outside of the core IRP study period of 2022-2041, they were still evaluated with nuclear SMR, renewables, and advanced storage. replacements During the study period, Plan 11 adds 175 MW of solar and storage at existing interconnection sites in a 4:1 solar to storage ratio by 2030. By 2041, Plan 11 includes 200 MW utility-scale solar, 150 MW lithium-ion battery storage, 60 MW utility-scale 2:1 solar

+ storage, 150 MW gravity storage, and 132 MW of distributed solar and/or storage. Plan 11 also adds the low-cost bundle of RAP DSM.

- Plan 12 (Net Zero 2050, Hydrogen and Renewables): Plan 12 was developed to analyze a portfolio that achieves net-zero carbon emissions by 2050 using 100% hydrogen fuel in a new combined cycle supplemented by utility scale renewables and advanced storage. Net-zero by 2050 requires the retirement of combined cycle gas units at Riverton in 2045 and State Line in 2050, in addition to the other baseline resource retirements. While these retirements are outside of the core IRP study period of 2022-2041, they were still evaluated with replacement by a new 100% hydrogen-fired CC, renewables, and advanced storage. The hydrogen-fired CC is assumed to operate at the same 50-60% annual average capacity factor as the natural gas-fired CCs. During the study period, Plan 12 builds the same capacity as Plan 11 except for the addition of 100 MW of lithium-ion storage in 2039 instead of 150 MW and 150 MW 2:1 utility-scale solar + storage instead of 60 MW. Plan 11 also adds the low-cost bundle of RAP DSM.

- Plan 13 (Net Zero 2035, Renewable): Plan 13 was developed to analyze a portfolio that achieves net-zero carbon emissions by 2035 using utility scale renewables and advanced storage options as replacements. Net-zero by 2035 requires the retirement of combined cycle gas units at Riverton and State Line in 2035, in addition to the other baseline resource retirements. Plan 13 adds 175 MW of solar and storage at existing interconnection sites in a 4:1 solar to storage ratio by 2030. By 2041, Plan 13 adds 150 MW utility-scale solar, 850 MW lithium-ion battery storage, 640 MW utility-scale 2:1 solar + storage, 130 MW distributed solar and/or storage, and 200 MW gravity storage. 433 MW solar and storage is also picked up directly at existing retirement sites, avoiding generator interconnection costs. Plan 13 also adds the low-cost bundle of RAP DSM.

- Plan 14 (Net Zero 2035, Nuclear SMR and Renewable): Plan 14 was developed to analyze a portfolio that achieves net-zero carbon emissions by 2035 using nuclear SMR supplemented by utility scale renewables. Net-zero by 2035 requires the retirement of combined cycle gas

units at Riverton and State Line in 2035, in addition to the other baseline resource retirements. Plan 14 adds 175 MW of solar and storage at existing interconnection sites in a 4:1 solar to storage ratio by 2030. By 2041, Plan 14 adds 450 MW utility-scale solar, 350 MW lithium-ion battery storage, 540 MW utility-scale 2:1 solar + storage, 300 MW flow battery, 50 MW gravity storage, and 135 MW of distributed solar and/or storage. 433 MW solar and storage is also picked up directly at existing retirement sites, avoiding generator interconnection costs. Plan 14 also adds the low-cost bundle of RAP DSM.

- Plan 15 (Net Zero 2035, Hydrogen and Renewable): Plan 15 was developed to analyze a portfolio that achieves net-zero carbon emissions by 2035 using hydrogen in a combined cycle combustion turbine supplemented by utility scale renewables. Net-zero by 2035 using hydrogen assumes the existing combined cycle gas units at Riverton and State Line are retrofitted to operate on 100% hydrogen and are assumed to run at a similar 50-60% annual average capacity factor as pre-retrofit. In addition to the hydrogen retrofit, by 2041, Plan 15 adds 150 MW utility-scale solar, 100 MW lithium-ion battery storage, 50 MW utility-scale 4:1 solar + storage, 585 MW utility-scale 2:1 solar + storage, and 120 MW distributed solar and/or storage. Plan 15 also adds the low-cost bundle of RAP DSM.

As mentioned previously, in addition to the 15 alternative plans, Liberty-Empire developed one compliance benchmark plan based on Plan 1, which assumes no new renewables and no new DSM resources are added. The compliance benchmark plan is called “Plan 1A.”

3.3.14 Schedule of Alternative Resource Plan Supply-Side Additions

The following tables summarize the demand-side and supply-side resource additions in each of Liberty-Empire’s alternative resource plans.

Table 6-5 - ICAP Capacity Additions for Plans 1 through 3

	Plan 1	Plan 1A	Plan 2	Plan 3
2022	RAP DSM (Low- and Mid-Cost Bundle)		RAP DSM (Low- and Mid-Cost Bundle)	MAP DSM (Low-Cost Bundle)
2023				
2024				
2025	RICE (30 MW utilizing existing IC)	RICE (30 MW utilizing existing IC)	RICE (30 MW utilizing existing IC)	RICE (30 MW utilizing existing IC)
2026				
2027				
2028				
2029				
2030				
2031				
2032				
2033				
2034				
2035	RICE (150 MW utilizing existing IC)	RICE (150 MW utilizing existing IC)	RICE (90 MW utilizing existing IC); Dist. Solar (10 MW)	RICE (120 MW utilizing existing IC); Dist. Solar (10 MW)
2036			Dist. RICE (6 MW)	Dist. RICE (6 MW)
2037			Dist. RICE (6 MW)	Dist. RICE (6 MW)
2038			Dist. RICE (6 MW)	Dist. RICE (6 MW)
2039	CT Frame (240 MW)	CT Frame (240 MW)	CT Frame (240 MW)	CT Frame (240 MW)
2040				
2041				

Table 6-6 – ICAP Capacity Additions for Plans 4 through 6

	Plan 4	Plan 5	Plan 6
2022	RAP DSM (Low-Cost Bundle)	RAP DSM (Low-Cost Bundle)	MAP DSM (Low-Cost Bundle)
2023			
2024			
2025	RICE (30 MW utilizing existing IC)	RICE (30 MW utilizing existing IC)	RICE (30 MW utilizing existing IC)
2026			
2027	Utility-Scale 2:1 S+S utilizing existing IC (105 MW)	Utility-Scale 2:1 S+S utilizing existing IC (105 MW); Dist. Solar (5 MW)	Utility-Scale 2:1 S+S utilizing existing IC (105 MW); Dist. Solar (5 MW)
2028			
2029			
2030	Utility-Scale Solar utilizing existing IC (70 MW)	Utility-Scale Solar utilizing existing IC (70 MW); Dist. Solar (10 MW)	Utility-Scale Solar utilizing existing IC (70 MW); Dist. Solar (10 MW)
2031		Dist. Solar (10 MW)	Dist. Solar (10 MW)
2032		Dist. Solar (10 MW)	Dist. Solar (10 MW)
2033	Utility-Scale Solar (150 MW)	Utility-Scale Solar (50 MW); Dist. Solar (10 MW)	Utility-Scale Solar (50 MW); Dist. Solar (10 MW)
2034		Dist. Solar (10 MW)	Dist. Solar (10 MW)
2035	RICE (60 MW)	RICE (60 MW); Dist. Solar (10 MW)	RICE (60 MW); Dist. Solar (10 MW)
2036		Dist. Solar (10 MW)	Dist. Solar (10 MW)
2037		Dist. Solar (10 MW)	Dist. Solar (10 MW)
2038	Utility-Scale Solar (50 MW)	Utility-Scale Solar (50 MW); Dist. Solar (10 MW)	Utility-Scale Solar (50 MW); Dist. Solar (10 MW)
2039	Utility-Scale 2:1 S+S (480 MW)	Utility-Scale 2:1 S+S (480 MW); Dist. Solar (10 MW)	Utility-Scale 2:1 S+S (480 MW); Dist. Solar (10 MW)
2040		Dist. Solar (10 MW)	Dist. Solar (10 MW)
2041	Utility-Scale Solar (100 MW)	Utility-Scale Solar (100 MW); Dist. Solar (5 MW)	Utility-Scale Solar (100 MW); Dist. Solar (5 MW)

Table 6-7 – ICAP Capacity Additions for Plans 7 through 9

	Plan 7	Plan 8	Plan 9
2022	RAP DSM (Low-Cost Bundle)	RAP DSM (Low-Cost Bundle)	MAP DSM (Low-Cost Bundle)
2023			
2024			
2025	RICE (30 MW utilizing existing IC)	RICE (30 MW utilizing existing IC)	RICE (30 MW utilizing existing IC)
2026			
2027	Utility-Scale 2:1 S+S utilizing existing IC (105 MW)	Utility-Scale 2:1 S+S utilizing existing IC (105 MW); Dist. Solar (5 MW)	Utility-Scale 2:1 S+S utilizing existing IC (105 MW); Dist. Solar (5 MW)
2028			
2029			
2030	Utility-Scale Solar utilizing existing IC (70 MW)	Utility-Scale Solar utilizing existing IC (70 MW)	Utility-Scale Solar utilizing existing IC (70 MW)
2031		Dist. Solar (10 MW); Dist. 2:1 S+S (3 MW)	Dist. Solar (10 MW); Dist. 2:1 S+S (3 MW)
2032		Dist. Solar (10 MW); Dist. 2:1 S+S (6 MW)	Dist. Solar (10 MW); Dist. 2:1 S+S (6 MW)
2033	Utility-Scale Solar (200 MW)	Utility-Scale Solar (100 MW); Dist. Solar (10 MW)	Utility-Scale Solar (100 MW); Dist. Solar (10 MW)
2034		Dist. Solar (10 MW)	Dist. Solar (10 MW)
2035	Utility-Scale Solar (50 MW)	Dist. Solar (10 MW)	Dist. Solar (10 MW)
2036		Dist. Solar (10 MW)	Dist. Solar (10 MW)
2037		Dist. Solar (10 MW)	Dist. Solar (10 MW)
2038	Utility-Scale Solar (50 MW)	Utility-Scale Solar (50 MW); Dist. Solar (10 MW)	Utility-Scale Solar (50 MW); Dist. Solar (10 MW)
2039	Utility-Scale 2:1 S+S (480 MW)	Utility-Scale 2:1 S+S (480 MW); Dist. Solar (10 MW)	Utility-Scale 2:1 S+S (480 MW); Dist. Solar (10 MW)
2040		Dist. Storage (4 MW); Dist. Solar (10 MW)	Dist. Storage (4 MW); Dist. Solar (10 MW)
2041	Utility-Scale Solar (50 MW); Utility-Scale 2:1 S+S (120 MW); Flow Battery (50 MW)	Utility-Scale Solar (50 MW); Utility-Scale 2:1 S+S (120 MW); Dist. Storage (1 MW); Dist. 2:1 S+S (3 MW); Dist. Solar (10 MW); Flow Battery (50 MW)	Utility-Scale Solar (50 MW); Utility-Scale 2:1 S+S (120 MW); Dist. Storage (1 MW); Dist. 2:1 S+S (3 MW); Dist. Solar (10 MW); Flow Battery (50 MW)

Table 6-8 - ICAP Capacity Additions for Plans 10 through 12

	Plan 10	Plan 11	Plan 12
2022	RAP DSM (Low-Cost Bundle)	RAP DSM (Low-Cost Bundle)	RAP DSM (Low-Cost Bundle)
2023			
2024			
2025	RICE (30 MW utilizing existing IC)	RICE (30 MW utilizing existing IC)	RICE (30 MW utilizing existing IC)
2026			
2027	Utility-Scale 2:1 S+S utilizing existing IC (105 MW); Dist. Solar (5 MW)	Utility-Scale 2:1 S+S utilizing existing IC (105 MW); Dist. Solar (5 MW)	Utility-Scale 2:1 S+S utilizing existing IC (105 MW); Dist. Solar (5 MW)
2028			
2029			
2030	Utility-Scale Solar utilizing existing IC (70 MW)	Utility-Scale Solar utilizing existing IC (70 MW)	Utility-Scale Solar utilizing existing IC (70 MW)
2031	Dist. Solar (10 MW); Dist. 2:1 S+S (3 MW)	Dist. Solar (10 MW); Dist. 2:1 S+S (3 MW)	Dist. Solar (10 MW); Dist. 2:1 S+S (3 MW)
2032	Dist. Solar (10 MW); Dist. 2:1 S+S (6 MW)	Dist. Solar (10 MW); Dist. 2:1 S+S (6 MW)	Dist. Solar (10 MW); Dist. 2:1 S+S (6 MW)
2033	Utility-Scale Solar (100 MW); Dist. Solar (10 MW)	Utility-Scale Solar (100 MW); Dist. Solar (10 MW)	Utility-Scale Solar (100 MW); Dist. Solar (10 MW)
2034	Dist. Solar (10 MW)	Dist. Solar (10 MW)	Dist. Solar (10 MW)
2035	Dist. Solar (10 MW)	Dist. Solar (10 MW)	Dist. Solar (10 MW)
2036	Dist. Solar (10 MW)	Dist. Solar (10 MW)	Dist. Solar (10 MW)
2037	Dist. Solar (10 MW)	Dist. Solar (10 MW)	Dist. Solar (10 MW)
2038	Utility-Scale Solar (50 MW); Dist. Solar (10 MW)	Utility-Scale Solar (50 MW); Dist. Solar (10 MW)	Utility-Scale Solar (50 MW); Dist. Solar (10 MW)
2039	Utility-Scale 2:1 S+S (480 MW); Dist. Solar (10 MW)	Li-Ion Storage (150 MW); Utility-Scale 2:1 S+S (60 MW); Dist. Solar (10 MW)	Li-Ion Storage (100 MW); Utility-Scale 2:1 S+S (150 MW); Dist. Solar (10 MW)
2040	Dist. Storage (4 MW); Dist. Solar (10 MW)	Dist. Storage (4 MW); Dist. Solar (10 MW); Gravity Storage (50 MW)	Dist. Storage (4 MW); Dist. Solar (10 MW); Gravity Storage (50 MW)
2041	Utility-Scale Solar (50 MW); Utility-Scale 2:1 S+S (60 MW); Dist. Storage (1 MW); Dist. 2:1 S+S (3 MW); Dist. Solar (10 MW); Gravity Storage (100 MW)	Utility-Scale Solar (50 MW); Dist. Storage (1 MW); Dist. 2:1 S+S (3 MW); Dist. Solar (10 MW); Gravity Storage (100 MW)	Utility-Scale Solar (50 MW); Dist. Storage (1 MW); Dist. 2:1 S+S (3 MW); Dist. Solar (10 MW); Gravity Storage (100 MW)

Table 6-9 – ICAP Capacity Additions for Plans 13 through 15

	Plan 13	Plan 14	Plan 15
2022	RAP DSM (Low-Cost Bundle)	RAP DSM (Low-Cost Bundle)	RAP DSM (Low-Cost Bundle)
2023			
2024			
2025	RICE (30 MW utilizing existing IC)	RICE (30 MW utilizing existing IC)	RICE (30 MW utilizing existing IC)
2026			
2027	Utility-Scale 2:1 S+S utilizing existing IC (105 MW); Dist. Solar (10 MW)	Utility-Scale 2:1 S+S utilizing existing IC (105 MW)	Utility-Scale 2:1 S+S utilizing existing IC (105 MW)
2028			
2029			
2030	Utility-Scale Solar utilizing existing IC (70 MW)	Utility-Scale Solar utilizing existing IC (70 MW); Dist. Solar (10 MW)	Utility-Scale Solar utilizing existing IC (70 MW); Dist. Solar (5 MW)
2031	Dist. Solar (10 MW)	Dist. Solar (10 MW)	Dist. Solar (10 MW)
2032	Dist. Solar (10 MW)	Dist. Solar (10 MW)	Dist. Solar (10 MW)
2033	Utility-Scale Solar (100 MW); Dist. Solar (10 MW)	Utility-Scale Solar (150 MW); Dist. Solar (10 MW)	Utility-Scale Solar (100 MW); Dist. Solar (10 MW)
2034	Dist. Solar (10 MW)	Dist. Solar (10 MW)	Dist. Solar (10 MW)
2035	Li-Ion Storage (550 MW); Dist. Solar (10 MW); Utility-Scale Solar (96 MW utilizing existing IC); Li-Ion Storage (150 MW utilizing existing IC); Utility-Scale 2:1 S+S (92 MW utilizing existing IC); Utility-Scale 4:1 S+S (96 MW utilizing existing IC)	Utility-Scale Solar (150 MW); Li-Ion Storage (150 MW); Dist. Solar (10 MW); Nuclear SMR (300 MW); Utility-Scale Solar (96 MW utilizing existing IC); Li-Ion Storage (150 MW utilizing existing IC); Utility-Scale 2:1 S+S (92 MW utilizing existing IC); Utility-Scale 4:1 S+S (96 MW utilizing existing IC)	Dist. Solar (10 MW); Riverton CC H2 Retrofit; Stateline CC H2 Retrofit
2036	Utility-Scale 2:1 S+S (100 MW); Dist. Solar (10 MW)	Li-Ion Storage (50 MW); Dist. Solar (10 MW)	Dist. Solar (10 MW)
2037	Utility-Scale Solar (50 MW); Li-Ion Storage (150 MW); Dist. Solar (10 MW)	Utility-Scale Solar (50 MW); Dist. Solar (10 MW)	Dist. Solar (10 MW)
2038	Dist. Li-Ion Storage (10 MW); Dist. Solar (10 MW)	Utility-Scale Solar (50 MW); Dist. Li-Ion Storage (15 MW); Dist. Solar (10 MW)	Utility-Scale 4:1 S+S (50 MW); Dist. Li-Ion Storage (10 MW); Dist. Solar (10 MW)
2039	Li-Ion Storage (150 MW); Utility-Scale 2:1 S+S (300 MW); Dist. Solar (10 MW); Gravity Storage (50 MW)	Li-Ion Storage (150 MW); Utility-Scale 2:1 S+S (300 MW); Dist. Solar (10 MW)	Utility-Scale Solar (50 MW); Utility-Scale 2:1 S+S (375 MW); Dist. Solar (10 MW)
2040	Utility-Scale 2:1 S+S (60 MW); Dist. Solar (10 MW)	Utility-Scale Solar (50 MW); Utility-Scale 2:1 S+S (60 MW); Dist. Solar (10 MW)	Dist. Solar (10 MW)
2041	Utility-Scale 2:1 S+S (180 MW); Dist. Solar (10 MW); Gravity Storage (150 MW)	Utility-Scale 2:1 S+S (180 MW); Dist. Solar (10 MW); Gravity Storage (150 MW)	Li-Ion Storage (100 MW); Utility-Scale 2:1 S+S (210 MW); Dist. Solar (5 MW)

3.3.15 Schedule of Alternative Resource Plan Retirements

Table 6-10 presents the existing plant retirement assumptions for Liberty-Empire's alternative resource plans. The represented retirement year indicates a retirement as of January 1 of the given year.

Table 6-10 - Alternative Resource Plan Retirement Assumptions

Plan	Empire Energy Center 1 and 2	Riverton 10 and 11	Iatan 1	Riverton 12	StateLine CC
Plan 1	2035	2025	2039	n/a	n/a
Plan 2					
Plan 3					
Plan 4					
Plan 5					
Plan 6					
Plan 7					
Plan 8					
Plan 9					
Plan 10				2045	2050
Plan 11					
Plan 12					
Plan 13				2035	2035
Plan 14					
Plan 15					

Table 6-11 shows the summer and winter UCAP ratings of the existing units assumed to retire during the IRP horizon. The accredited capacity for thermal resources is determined by Southwest Power Pool ("SPP") criteria and is subject to re-rating from time to time.

Table 6-11 – UCAP of Retiring Existing Units

Unit	Summer Accredited Capacity (UCAP MW)	Winter Accredited Capacity (UCAP MW)
Energy Center 1	81	95
Energy Center 2	81	80
Riverton 10	13	15
Riverton 11	16	15
Iatan 1	84	84
Riverton 12	254	283
State Line CC	300	329

3.3.16 Schedule of Expiration of Liberty-Empire PPAs

Table 6-12 provides the sequence and schedule for the summer capacity accreditation of Liberty-Empire's PPA resources. Table 6-13 provides the sequence and schedule for the winter capacity accreditation of Liberty-Empire's PPA resources.

Beginning with the 2023 summer season, the accreditation for wind and solar resources in SPP is expected to be determined using the Effective Load Carrying Capability ("ELCC") methodology. ELCC is defined as the amount of incremental load that a resource can reliably serve while accounting for the probabilistic nature of generation shortfalls and random forced outages. ELCC is an industry-wide accepted methodology used for determining the capacity value of resources.

In February 2021, SPP completed its first informational-only studies for both wind and solar resources using the approved ELCC methodology for future use. The ELCC estimates were included as the accredited capacity value for wind resources beginning in 2023. Prior to 2023, Liberty-Empire utilized the pre-ELCC methodology accredited capacity based on SPP guidance.

Liberty-Empire also included a 78 MW system sale representing the Company's five-year PPA with the Missouri Joint Municipal Utility Commission ("MJMEUC") for capacity and energy beginning June 1, 2020 and ending May 31, 2025. The capacity sale is based on a "slice of Liberty-Empire system" approach, with a total capacity sale of 78 MW during the agreement period.

Table 6-12 - Liberty-Empire Renewable PPAs (Summer UCAP)

	Elk River Wind PPA	Meridian Way Wind PPA	Plum Point PPA	MJMEUC PPA
2022	33	17	50	-78
2023	25.71	13.14	50	-78
2024	25.71	13.14	50	-78
2025	25.71	13.14	50	0
2026	0	13.14	50	0
2027	0	13.14	50	0
2028	0	13.14	50	0
2029	0	0	50	0
2030	0	0	50	0
2031	0	0	50	0
2032	0	0	50	0
2033	0	0	50	0
2034	0	0	50	0
2035	0	0	50	0
2036	0	0	50	0
2037	0	0	50	0
2038	0	0	50	0
2039	0	0	50	0
2040	0	0	50	0
2041	0	0	0	0

Table 6-13 – Liberty-Empire Renewable PPAs (Winter UCAP)

	Elk River Wind PPA	Meridian Way Wind PPA	Plum Point PPA	MJMEUC PPA
2022	26	18	50	-78
2023	21.94	14.59	50	-78
2024	21.94	14.59	50	-78
2025	21.94	14.59	50	0
2026	0	14.59	50	0
2027	0	14.59	50	0
2028	0	14.59	50	0
2029	0	0	50	0
2030	0	0	50	0
2031	0	0	50	0
2032	0	0	50	0
2033	0	0	50	0
2034	0	0	50	0
2035	0	0	50	0
2036	0	0	50	0
2037	0	0	50	0
2038	0	0	50	0
2039	0	0	50	0
2040	0	0	50	0
2041	0	0	0	0

3.3.17 Schedule of Wind Additions

Table 6-14 and Table 6-15 illustrate the capacity accreditation values for Liberty-Empire's owned wind additions. As described in Volume 4, 600 MW of wind resources was added in 2020 and 2021. The ELCC estimates were included as the accredited capacity value for the wind resources beginning in 2023. Prior to 2023, Liberty-Empire used a 5% accreditation rating as allowed by Section 7.1.2 of the SPP Planning Criteria for new wind resources in commercial operation for 3 years or less.

Table 6-14 – Liberty-Empire Renewable Intermittent Resources (Summer UCAP)

	Neosho Wind	North Fork Ridge Wind	Kings Point Wind
2022	15.1	7.5	7.5
2023+	66.89	37.32	37.57

Table 6-15 – Liberty-Empire Renewable Intermittent Resources (Winter UCAP)

	Neosho Wind	North Fork Ridge Wind	Kings Point Wind
2022	15.1	7.5	7.5
2023+	57.80	38.14	38.39

3.3.18 DSM Utilized in Alternative Resource Plans

As part of the process of developing the alternative resource plans, several demand-side programs were evaluated on an equivalent basis as the supply-side resources. The analysis of the DSM programs is described in detail in Volume 5. DSM measures that were screened for inclusion in a DSM program were bundled together and evaluated in the integrated portfolio modeling. A summary of the demand-side program bundles is below:

Table 6-16 – Description of DSM IRP Bundles

DSM	Program Bundle	Description
RAP	Low Cost	Programs with a three-year average $/kWh saved below $0.18 per kWh. Includes: - Retail Lighting - Residential Behavioral - Commercial Custom - SEM - Retrocommissioning
	Mid Cost	Programs with a three-year average $/kWh saved between $0.18 to $0.25 per kWh. Includes: - Residential Prescriptive - Appliance Recycling - Commercial Prescriptive - Midstream Food Service
	High Cost	Programs with a three-year average $/kWh saved above $0.25 per kWh. Includes: - Whole Home Efficiency - SBDI
	Demand Side Rates ("DSR")	DR and DSR programs. Includes: - Time of Use Rate (Res & Non-Res) - Critical Peak Pricing (Res & Non-Res) - DLC Smart Thermostat - Real Time Pricing
MAP	Low Cost	Programs with a three-year average $/kWh saved below $0.18 per kWh. Includes: - Retail Lighting - Residential Behavioral - Commercial Custom - SEM - Retrocommissioning
	Mid Cost	Programs with a three-year average $/kWh saved between $0.18 to $0.25 per kWh. Includes: - Residential Prescriptive - Appliance Recycling - Commercial Prescriptive - Midstream Food Service
	High Cost	Programs with a three-year average $/kWh saved above $0.25 per kWh. Includes: - Whole Home Efficiency - SBDI
	Demand Side Rates ("DSR")	DR and DSR programs. Includes: - Time of Use Rate (Res & Non-Res) - Critical Peak Pricing (Res & Non-Res) - DLC Smart Thermostat - Real Time Pricing

SECTION 4 ANALYSIS OF RESOURCE PLAN

(4) Analysis of Alternative Resource Plans. The utility shall describe and document its assessment of 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 on a year-by-year basis in order to assess the annual and cumulative impacts of alternative resource plans. The analysis shall be based on the assumption that rates will be adjusted annually, in a manner that is consistent with Missouri law. The analysis shall treat supply-side and demand-side resources on a logically-consistent and economically-equivalent basis, such that the same types or categories of costs, benefits, and risks shall be considered and such that these factors shall be quantified at a similar level of detail and precision for all resource types. The utility shall provide the following information:

4.1 Performance Measures of Resource Plans

(A) 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;

The performance of each of the 15 alternative resource plans with respect to the performance measures specified at 20 CSR 4240-22.060(2)(A) is provided in Table 6-17. All results were evaluated under Base Case market conditions. Table 6-18 provides a legend to facilitate the referencing of each alternative resource plan.

Table 6-17 - 20 Year Performance of Alternative Resource Plans

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Table 6-18 - Plan Legend

Plan	Plan Description
1	Baseline – Utility-Scale Gas Only
2	Baseline – Utility-Scale + Distributed Gas Only
3	Baseline – Utility-Scale + Distributed Gas Only
4	Baseline – Utility-Scale Gas/Renew Mix
5	Baseline – Utility-Scale + Distributed Gas/Renew Mix
6	Baseline – Utility-Scale + Distributed Gas/Renew Mix
7	Baseline – Utility-Scale Renewable
8	Baseline – Utility-Scale + Distributed Renewable
9	Baseline – Utility-Scale + Distributed Renewable
10	Net Zero 2050 – Renewable + Storage
11	Net Zero 2050 – Nuclear SMR
12	Net Zero 2050 – Hydrogen
13	Net Zero 2035 – Renewable / Storage
14	Net Zero 2035 – Nuclear SMR
15	Net Zero 2035 – Hydrogen

In addition to PVRRs calculated for the 20-year study horizon (2022-2041) required for the IRP analysis, Liberty-Empire also calculated PVRRs for the 30-year study horizon to properly compare plans that add significant amounts of capital and fixed costs in the longer term and to further

evaluate the performance of the Net Zero by 2050 portfolios (plans 10 through 12). The difference between the 20-year and 30-Year PVRRs does not materially change the ordering of the plans. The PVRR for each of Liberty-Empire's 15 alternative resource plans under the 2022 IRP Base Case conditions over the twenty-year planning period of 2022-2041 is shown in Figure 6-4. The deterministic PVRR for each plan over the thirty-year period of 2022-2051 is shown in Figure 6-5.

Figure 6-4 – Deterministic 20-Year PVRR of All Plans ($ millions)

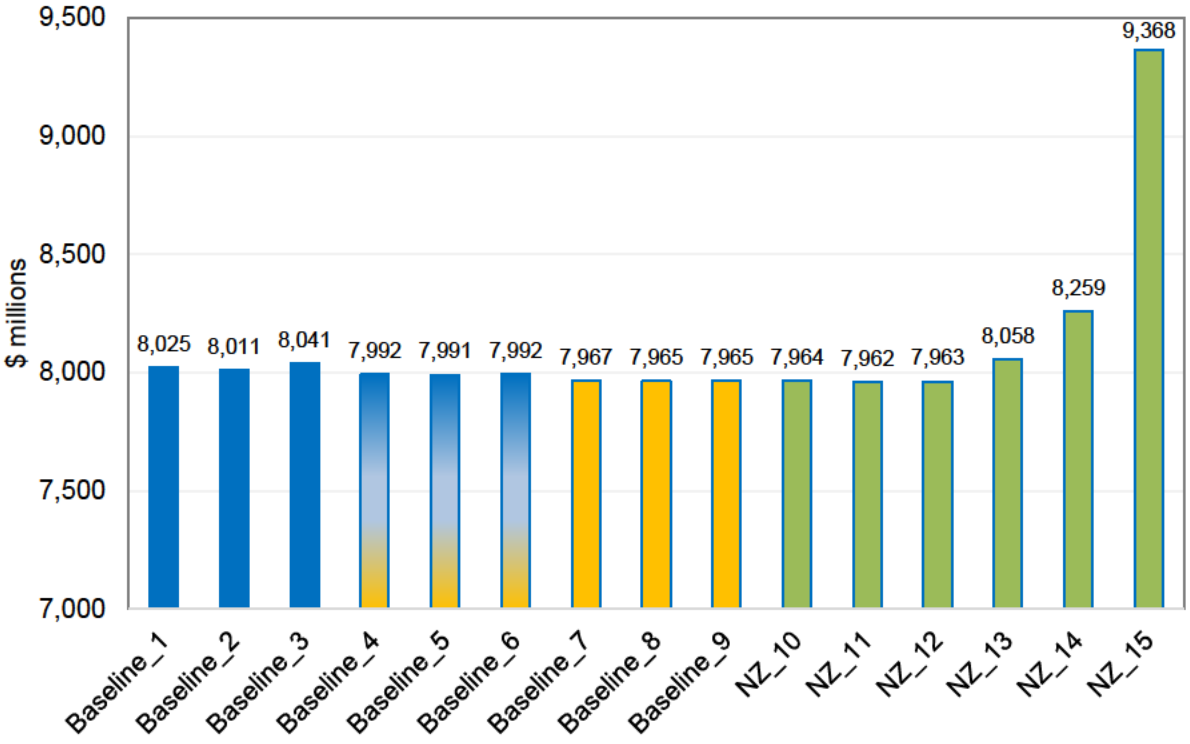
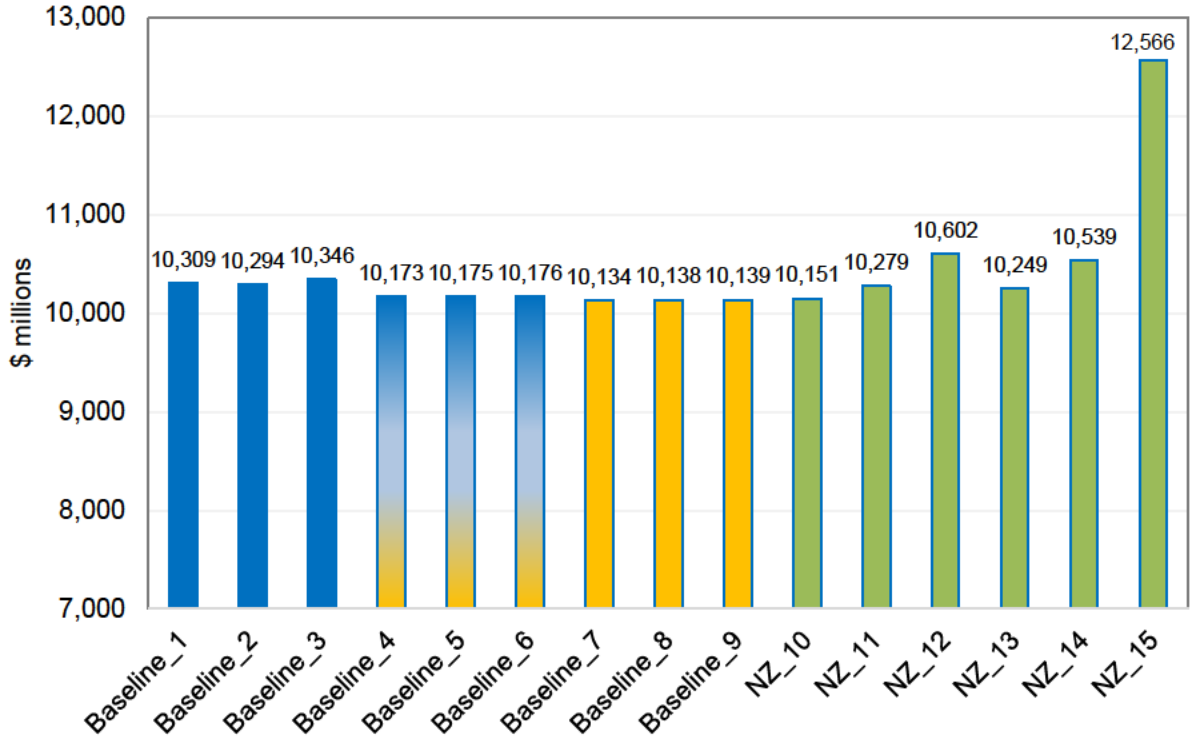


Figure 6-5 – Deterministic 30-Year PVRR of All Plans ($ millions)



As discussed in Section 3.3.1, Liberty-Empire also developed and analyzed an alternative plan that is minimally compliant with legal mandates for demand-side resources, renewable energy resources, and other mandated energy resources. This compliance benchmark plan is known as "Plan 1A," and is identical to Plan 1 except that Plan 1A does not allow any new DSM resources. Given that at least some level of new DSM resources was found to be cost-effective in all other alternative plans, Plan 1A was analyzed under the Base Case primarily for compliance purposes and only under the Base Case. The results of this analysis are shown in Table 6-19. Liberty-Empire found that Plan 1A was approximately $24 million higher cost than Plan 1 on a 20-year PVRR basis.

Table 6-19 – Deterministic 20 Year PVRR for Plan 1A

Plan	20 Year PVRR ($MM)	Probable Enviro Costs (NPV $MM)	DSM Costs (NPV $MM)	Levelized Annual Rates (cents/kWh)	Maximum Rate Increase (%)	Pre-Tax Interest Coverage	Total Debt to Capital	Net Cash Flow to CapEx
1A	8,049	338	0	14.03	9.1%	6.51	47.4%	1.52

4.2 Graphic Analysis of Plans

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

4.2.1 DSM Impact on Peak Demand

1. The combined impact of all demand-side resources on the base-case forecast of summer and winter peak demands;

The combined impact of all demand-side resources on the Base Case forecast of summer and winter peak demands for each of the 15 alternative resource plans is shown in the following figures.

Figure 6-6 – RAP DSM Impact on Load (Low and Mid Cost Bundle)
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Figure 6-7 – MAP DSM Impact on Load (Low Cost Bundle)
****Confidential in its Entirety****

Figure 6-8 – RAP DSM Impact on Load (Low Cost Bundle)
****Confidential in its Entirety****

4.2.2 DSM Program Composition of Plans

2. The composition, by program and demand-side rate, of the capacity provided by demand-side resources;

The composition by program and demand-side rate of the capacity provided by DSM resources for the RAP and MAP bundles selected in the alternative plans is shown in Figure 6-9 and Figure 6-10. The corresponding tables of values for all these figures are provided in Appendix 6C.

Figure 6-9 - DSM Composition of Selected RAP DSM

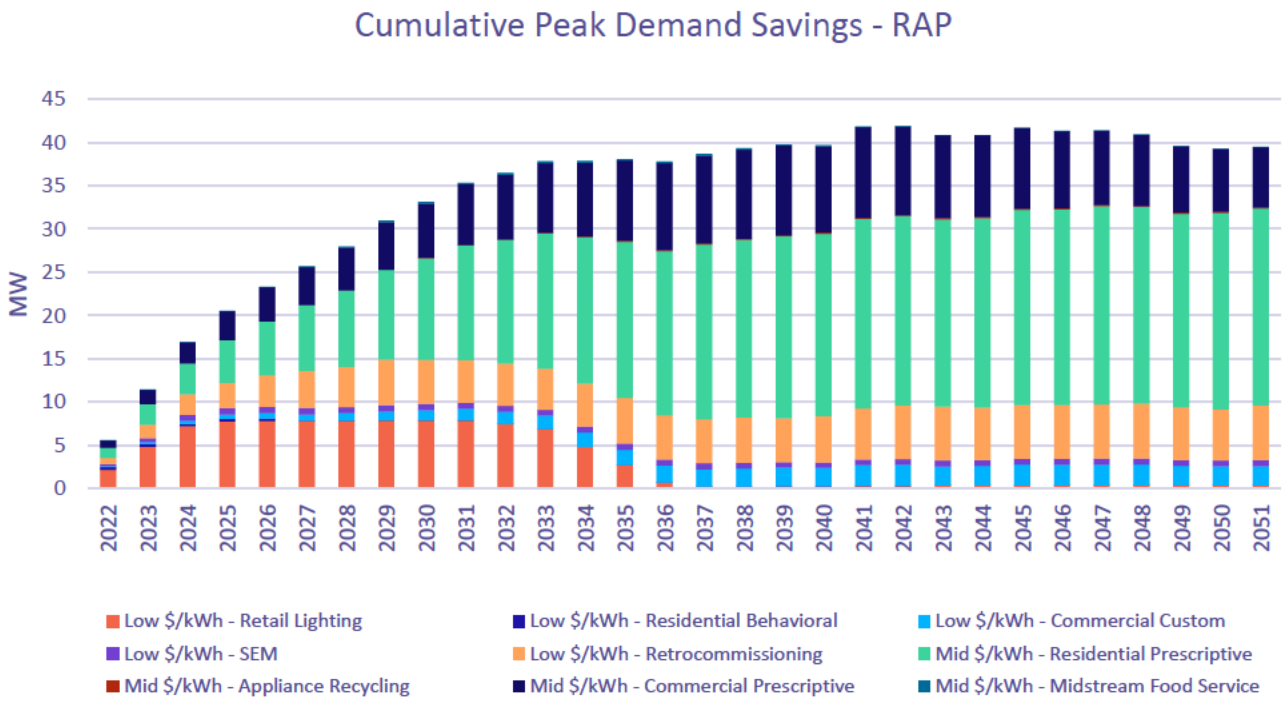
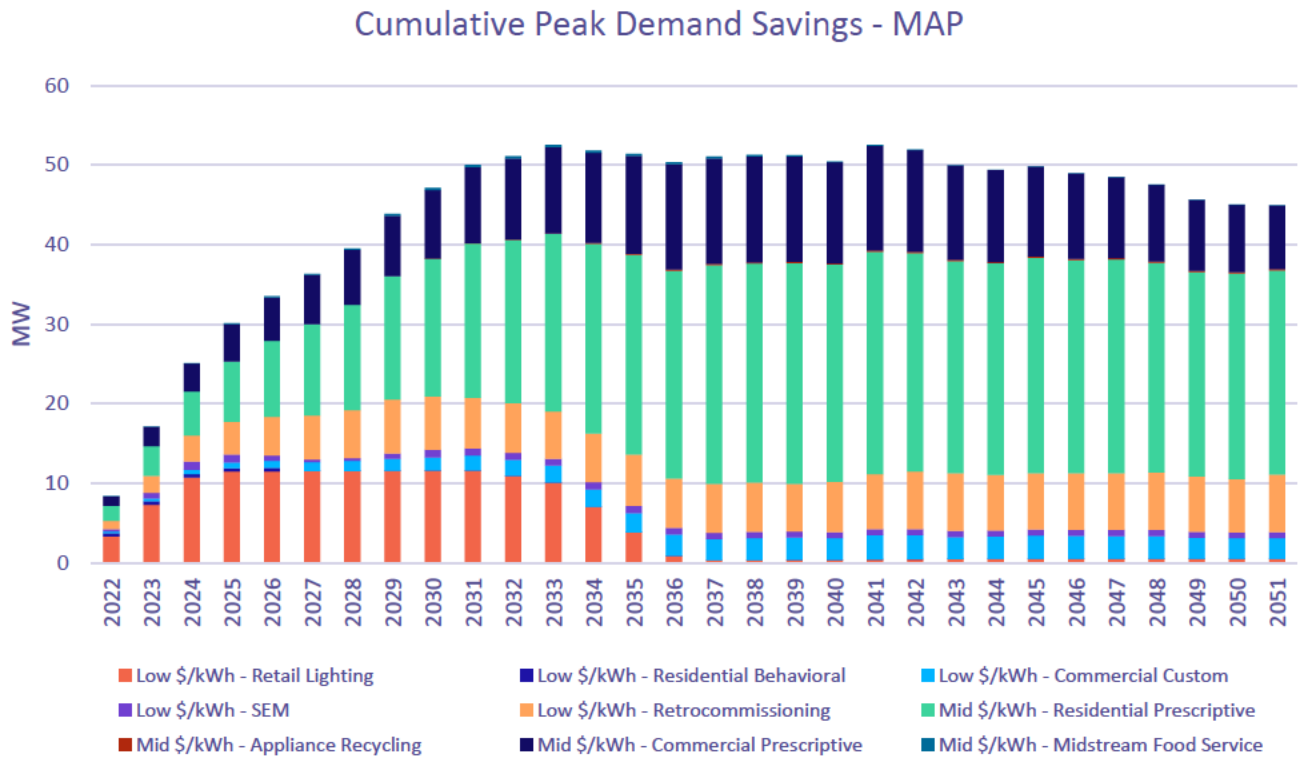


Figure 6-10 - DSM Composition of Selected MAP DSM



4.2.3 Supply-Side Composition of Plans

3. The composition, by supply-side resource, of the capacity supplied to the transmission grid provided by supply-side resources. Existing supply-side resources may be shown as a single resource;

The composition by supply-side resource of Liberty-Empire's capacity supplied by supply-side resources for each resource plan is shown in the following figures. The capacity values are provided in summer UCAP MW.

Figure 6-11 - Supply-Side Resource Composition of Plan 1

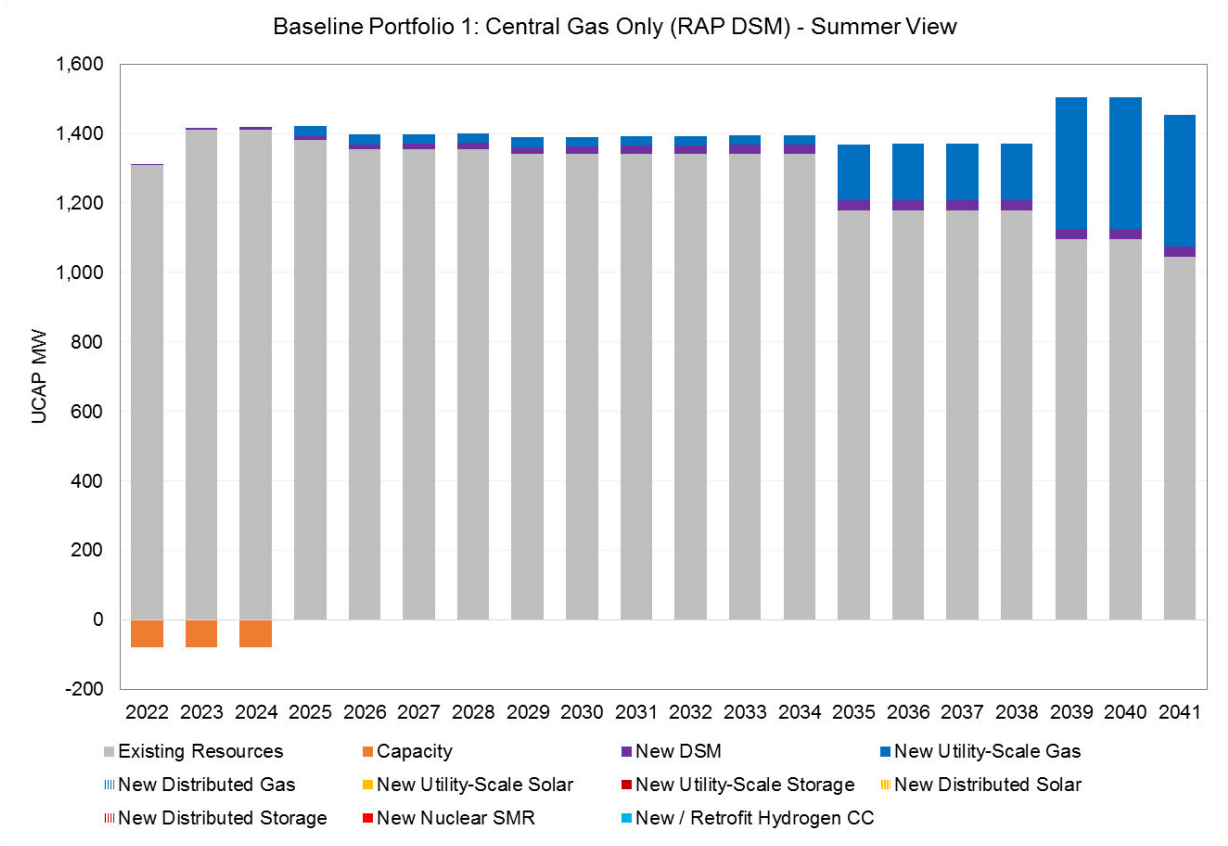


Figure 6-12 - Supply-Side Resource Composition of Plan 1A

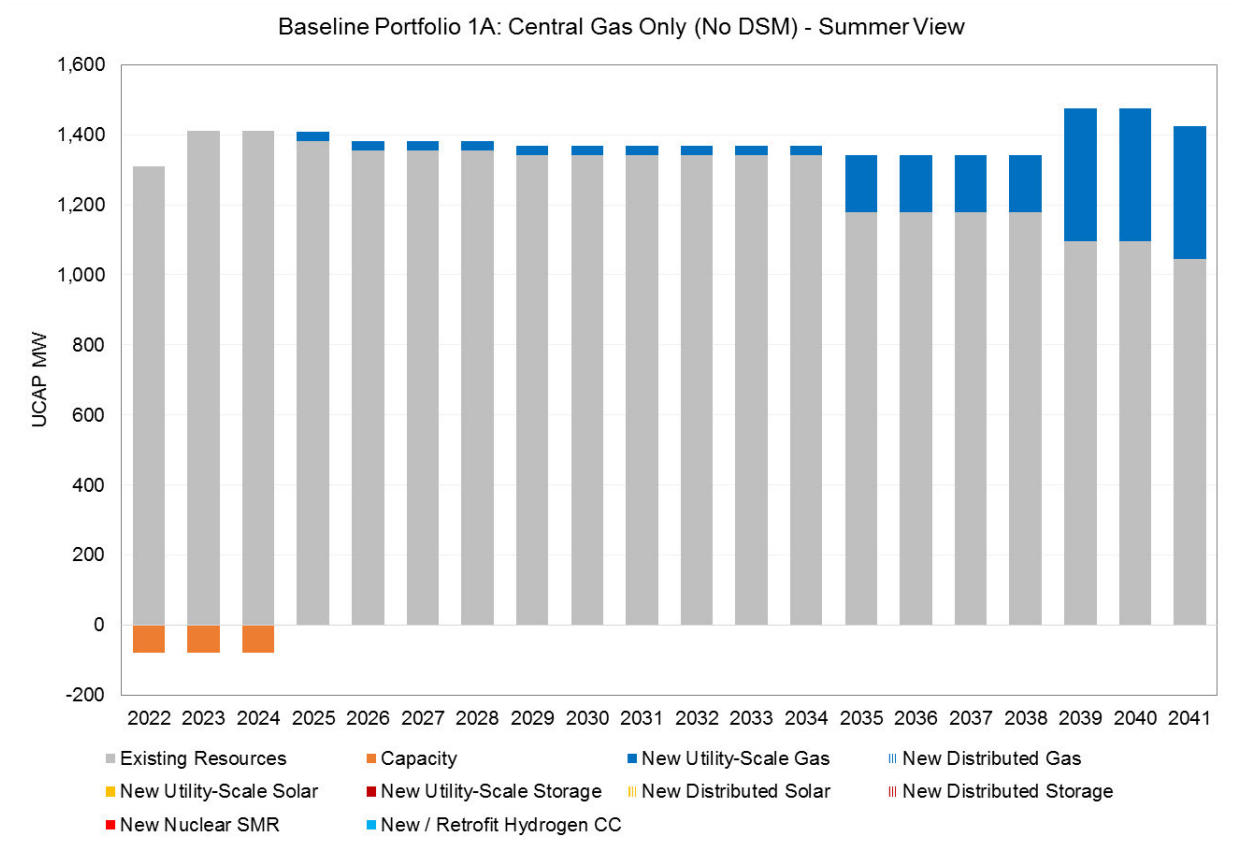


Figure 6-13 - Supply-Side Resource Composition of Plan 2

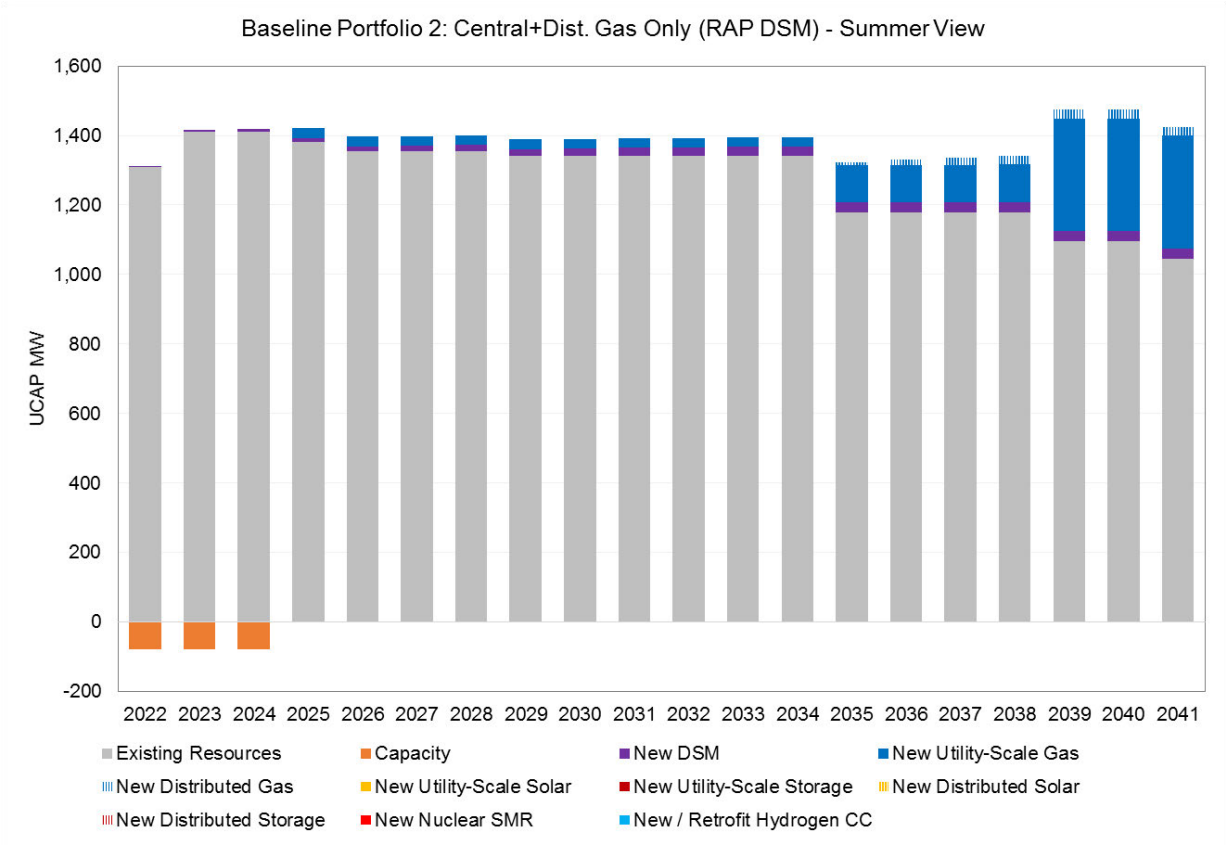


Figure 6-14 - Supply-Side Resource Composition of Plan 3

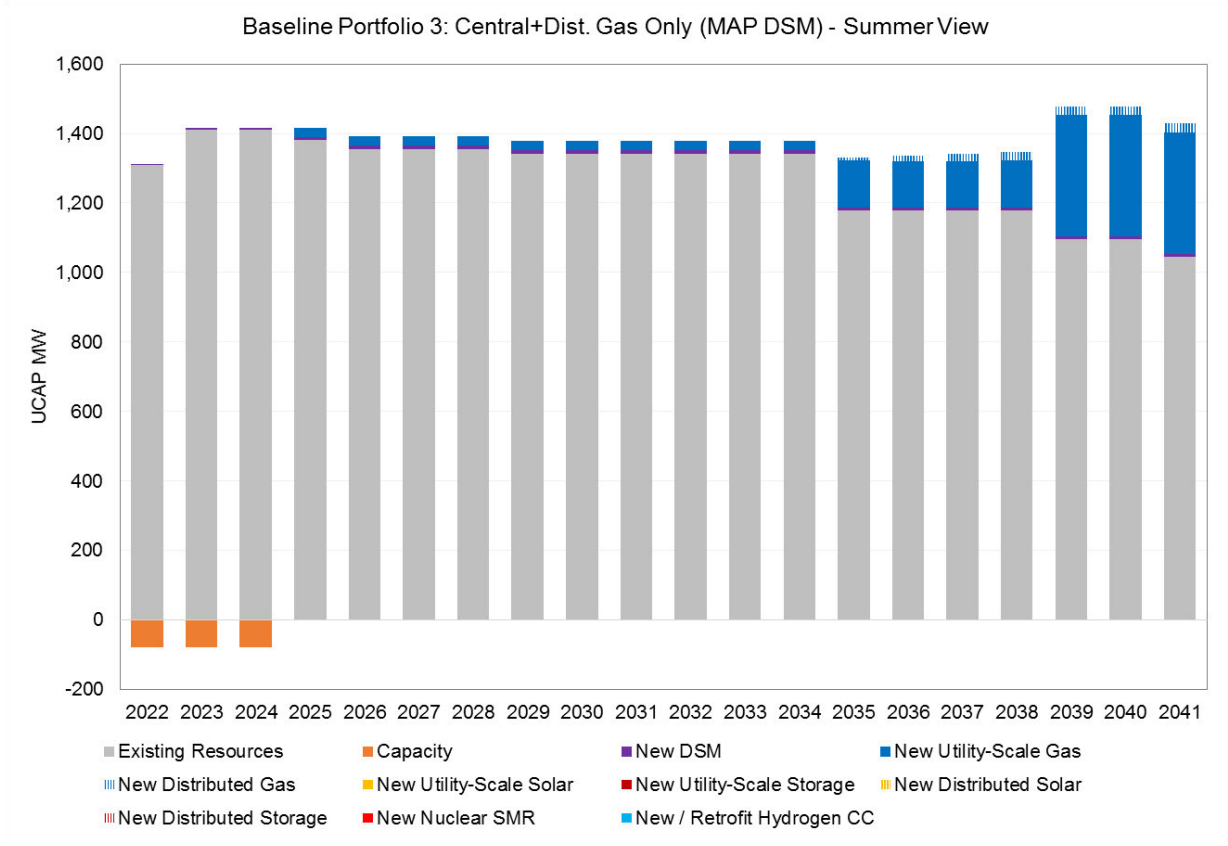


Figure 6-15 - Supply-Side Resource Composition of Plan 4

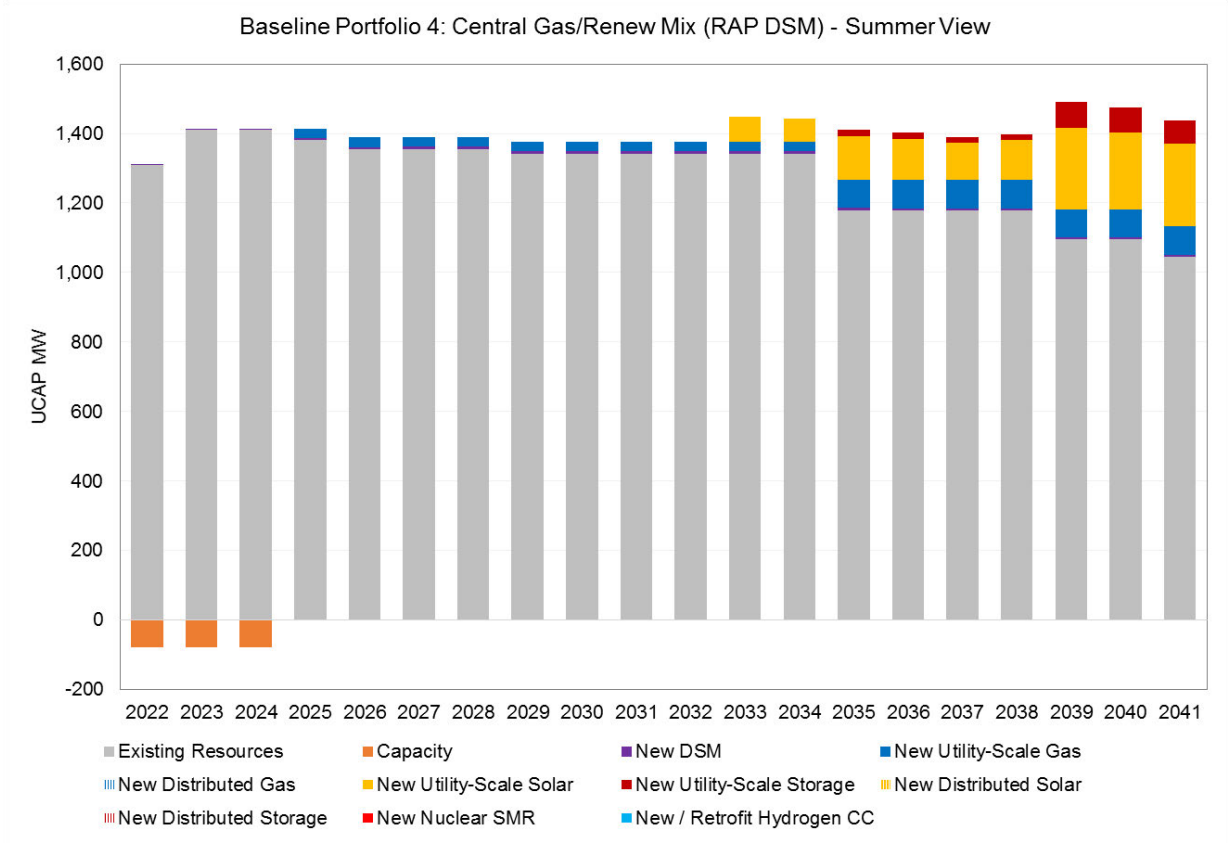


Figure 6-16 - Supply-Side Resource Composition of Plan 5

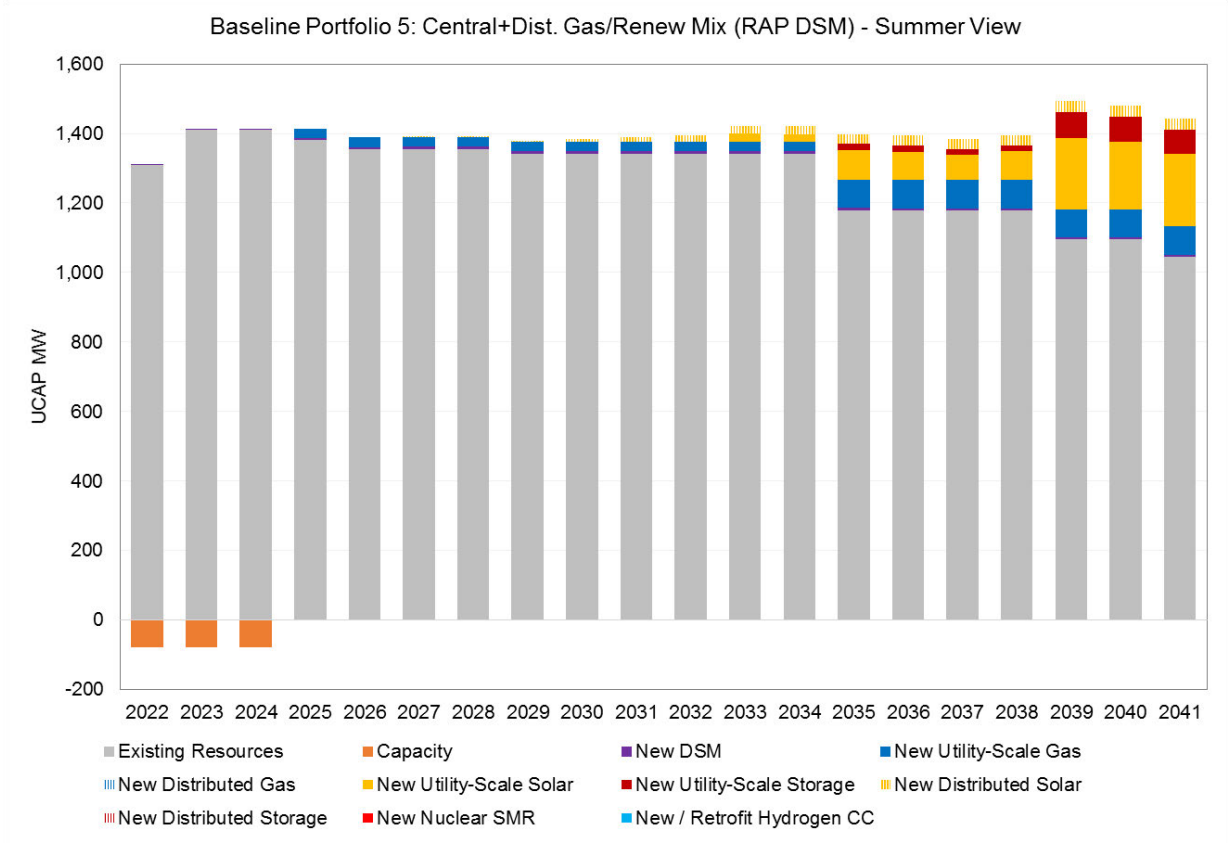


Figure 6-17 - Supply-Side Resource Composition of Plan 6

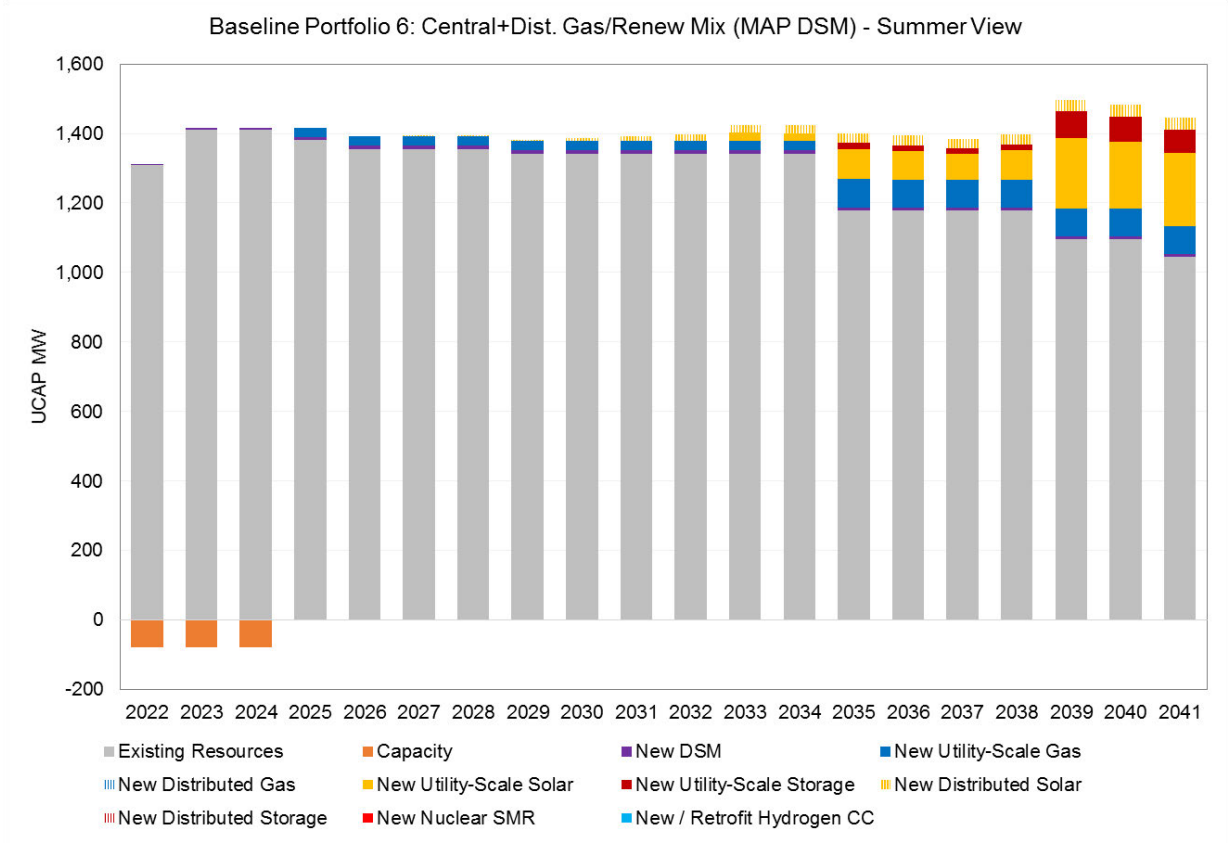


Figure 6-18 - Supply-Side Resource Composition of Plan 7

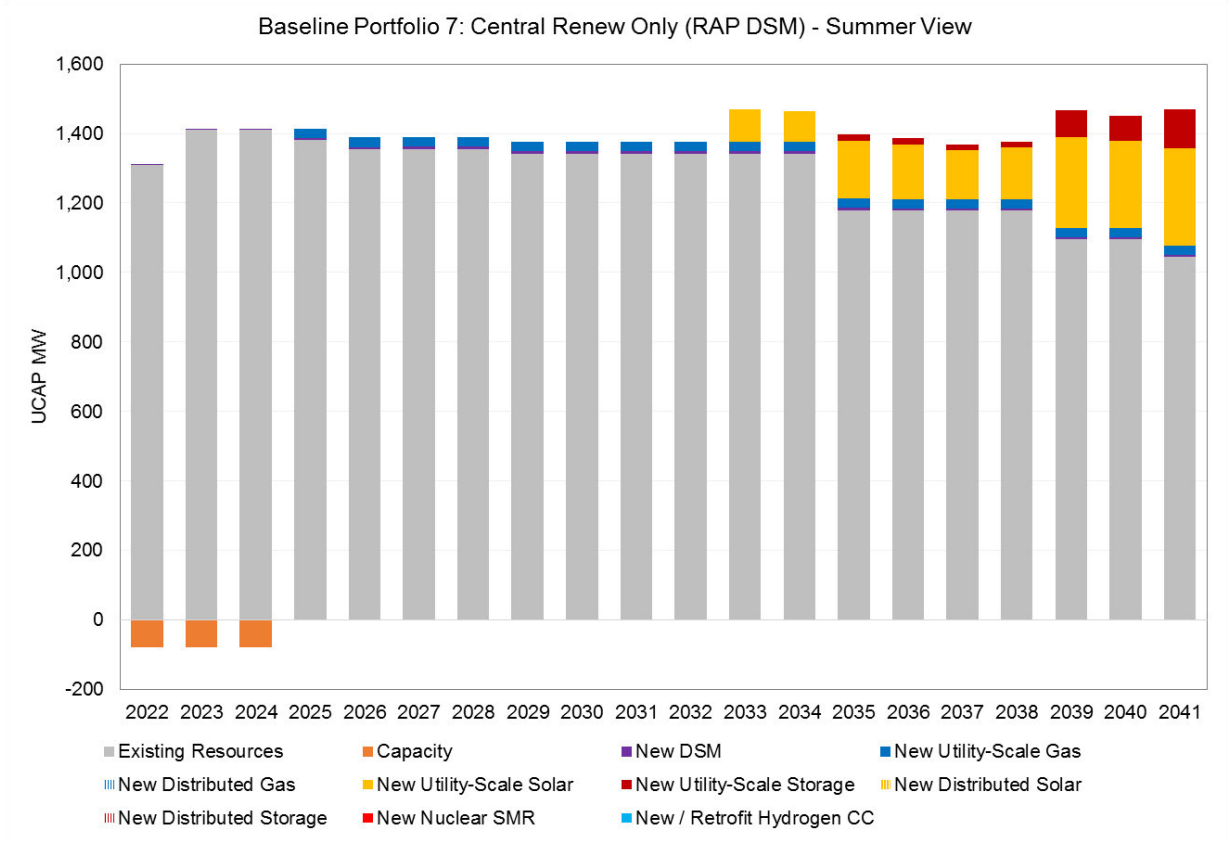


Figure 6-19 - Supply-Side Resource Composition of Plan 8

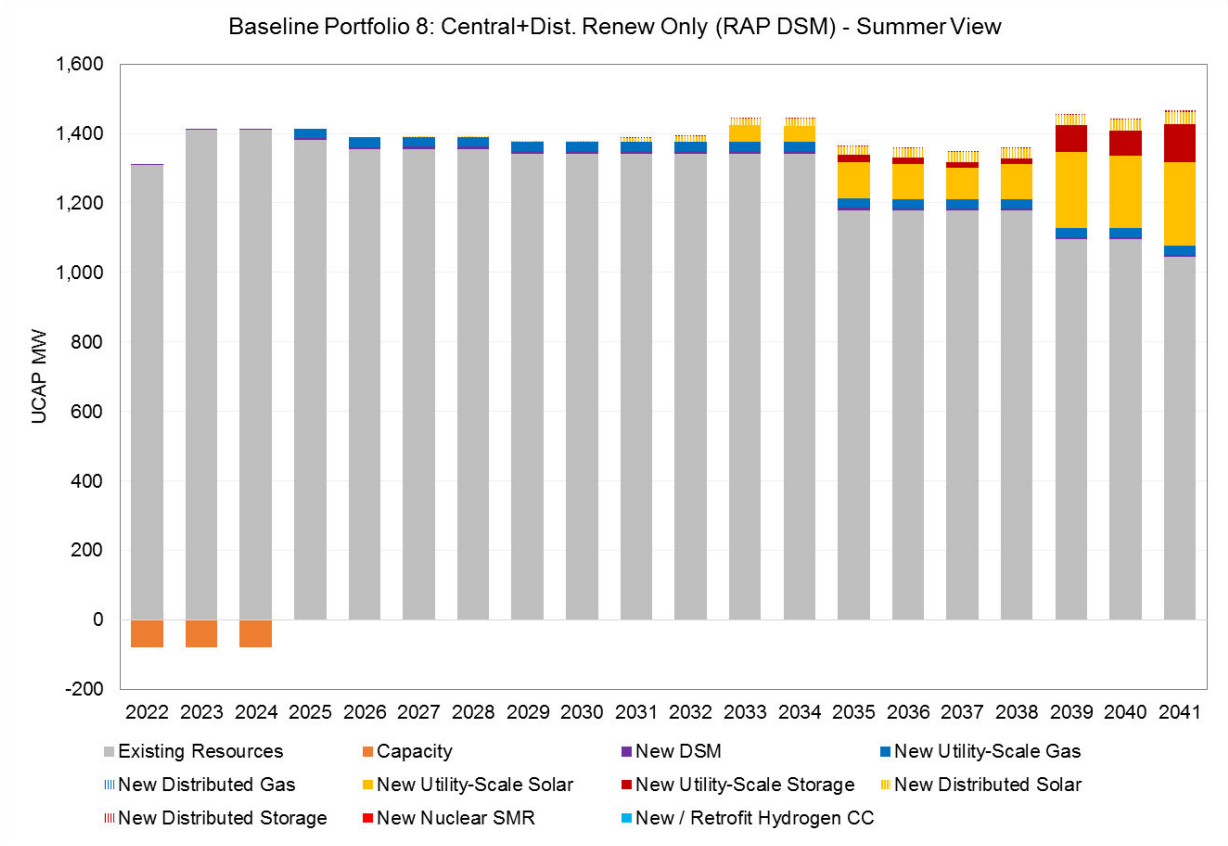


Figure 6-20 - Supply-Side Resource Composition of Plan 9

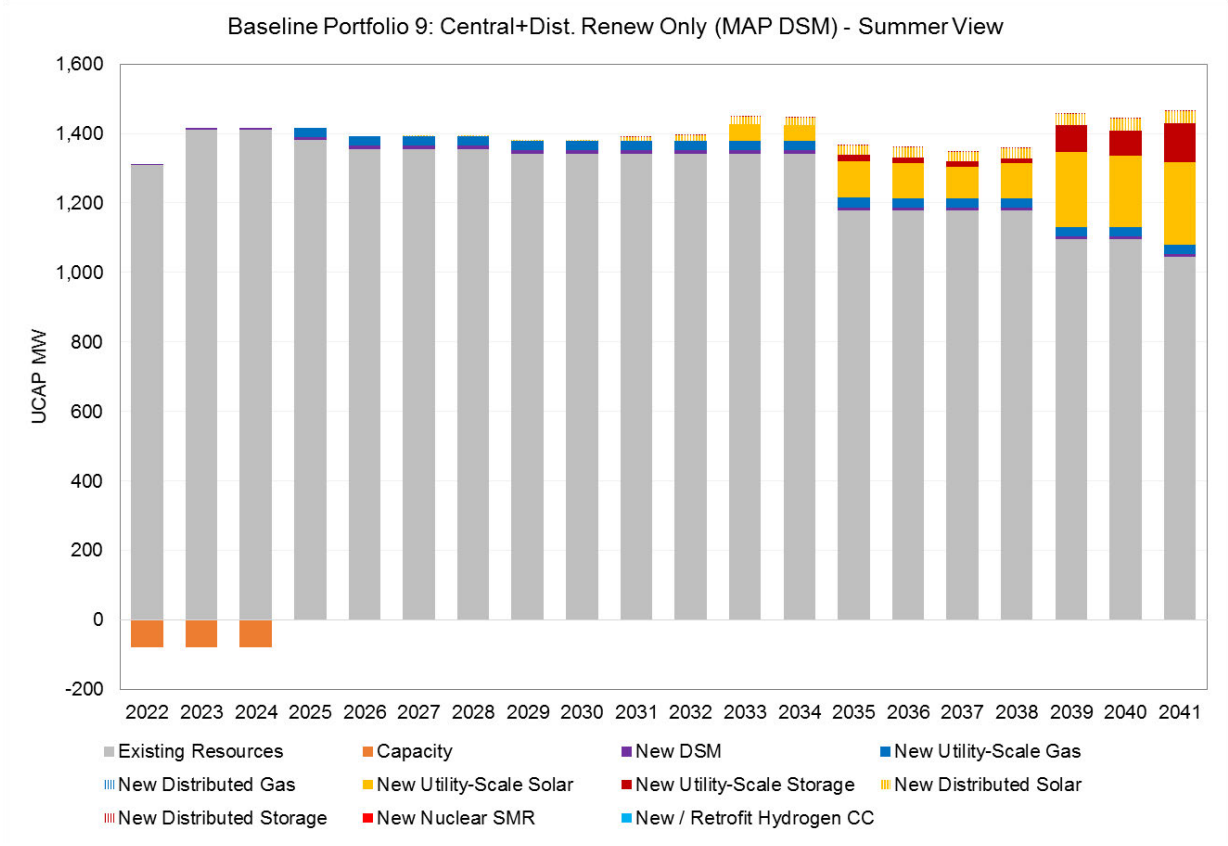


Figure 6-21 - Supply-Side Resource Composition of Plan 10

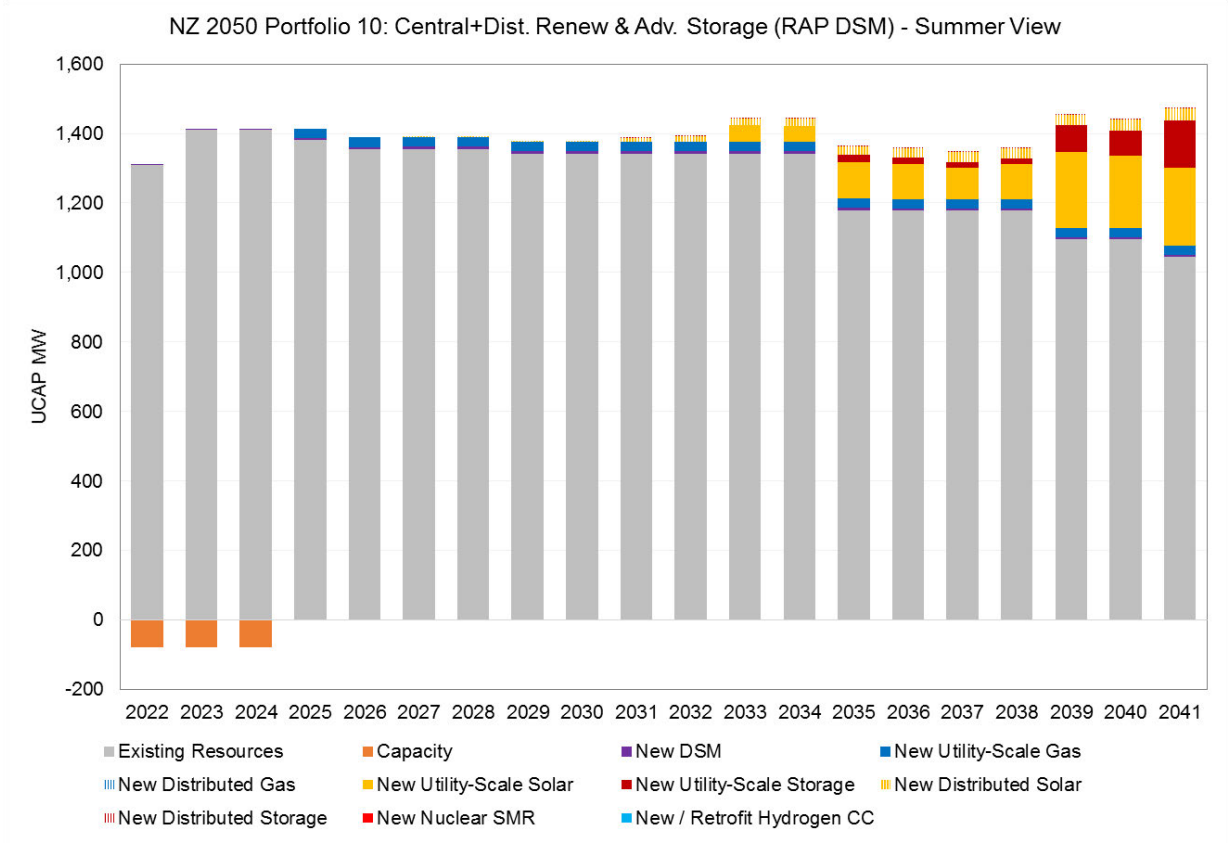


Figure 6-22 - Supply-Side Resource Composition of Plan 11

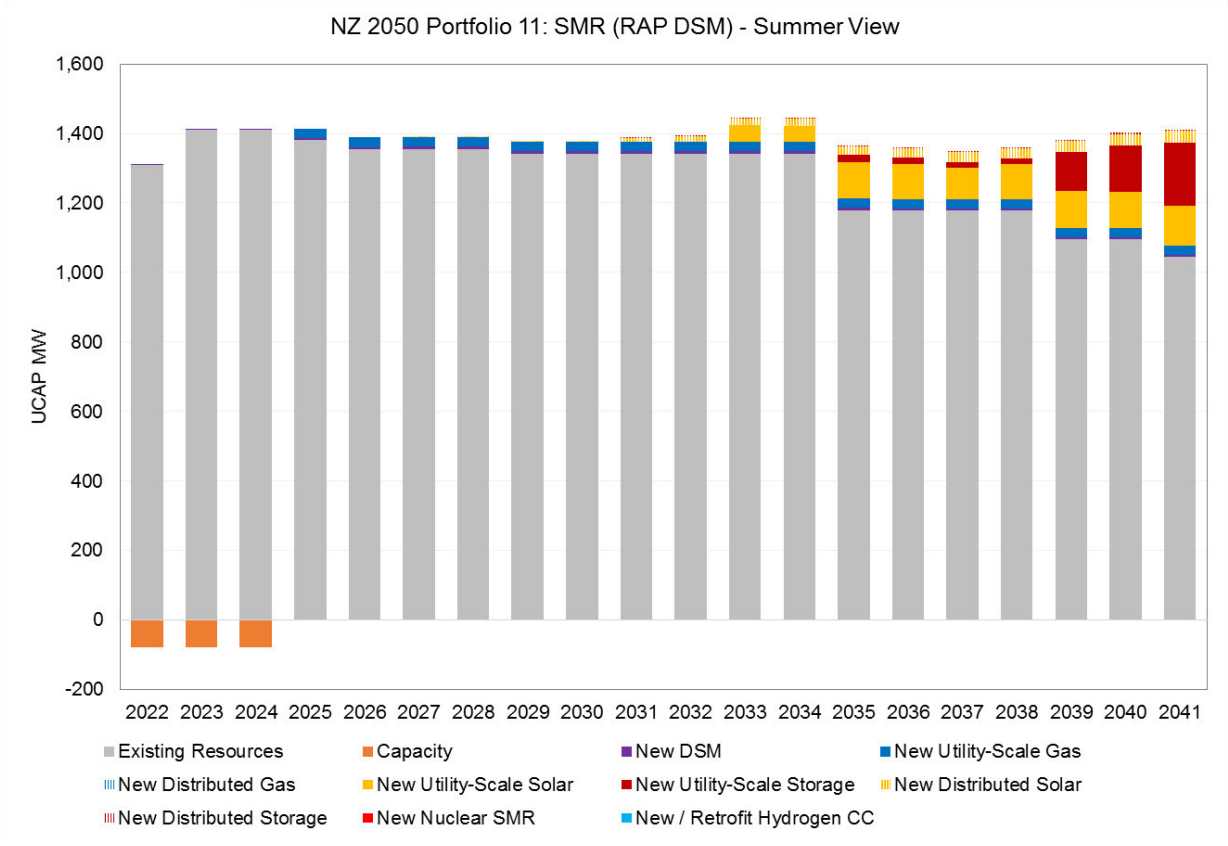


Figure 6-23 - Supply-Side Resource Composition of Plan 12

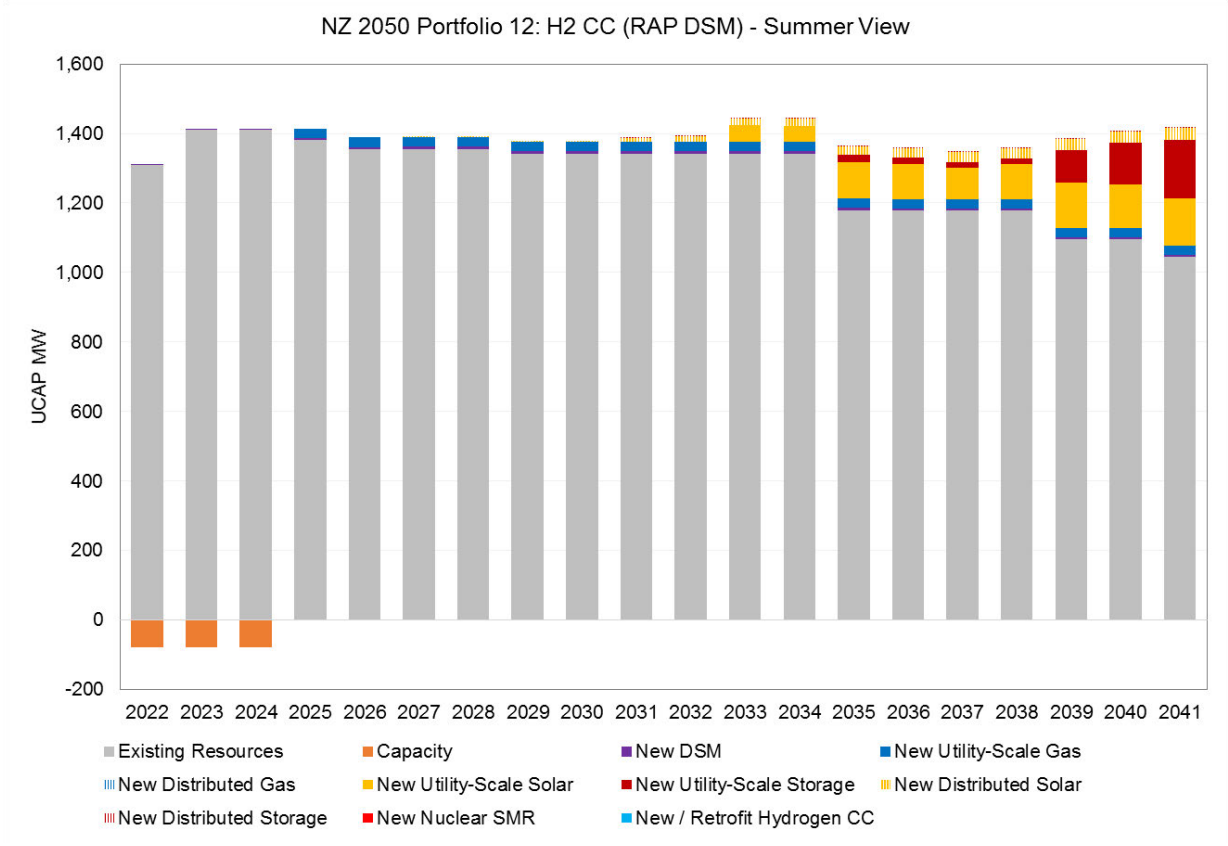


Figure 6-24 - Supply-Side Resource Composition of Plan 13

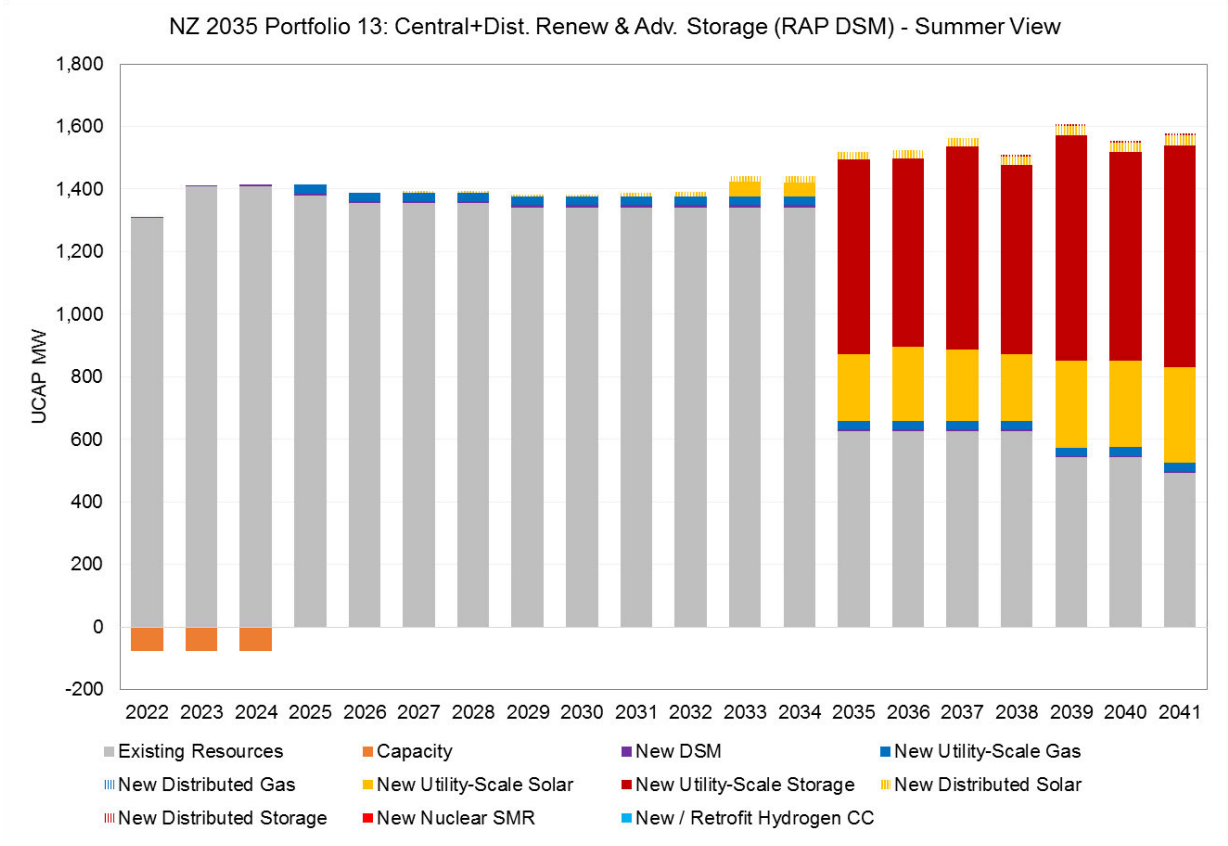


Figure 6-25 - Supply-Side Resource Composition of Plan 14

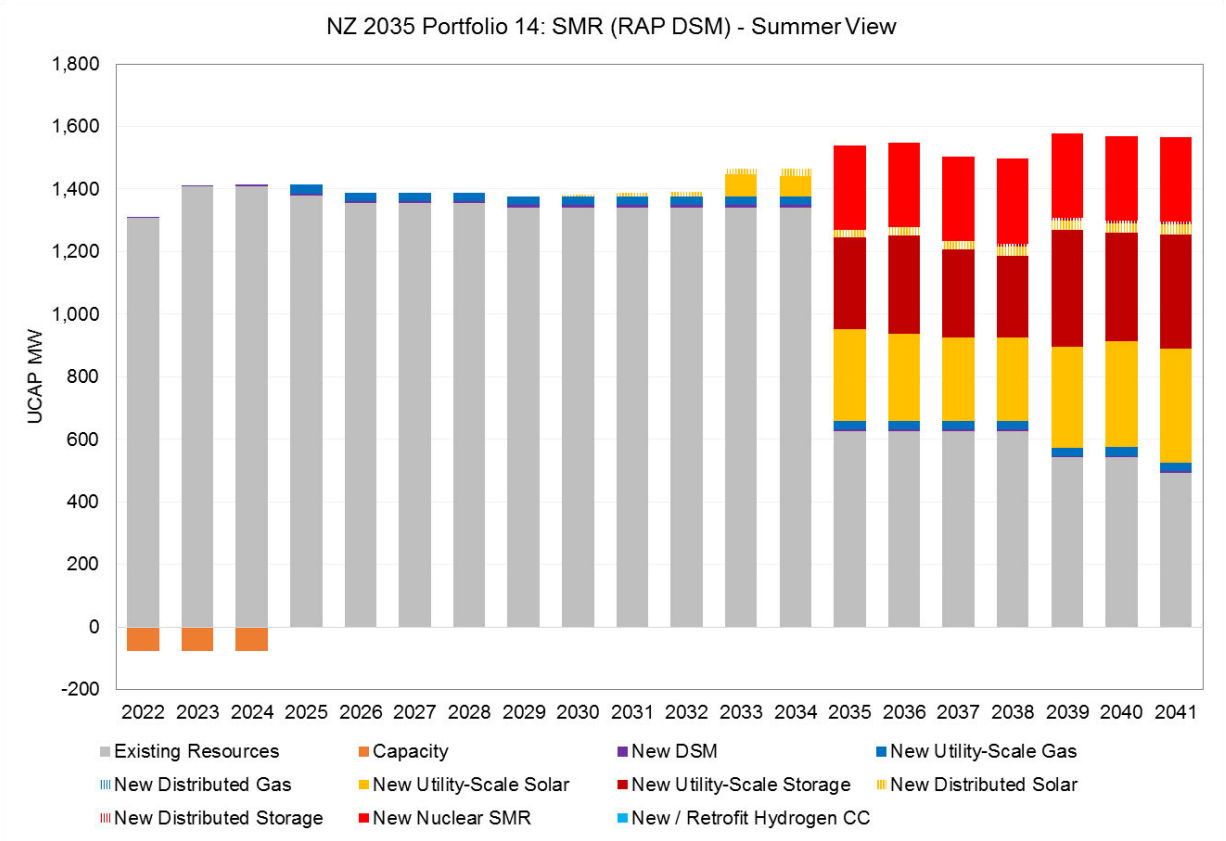
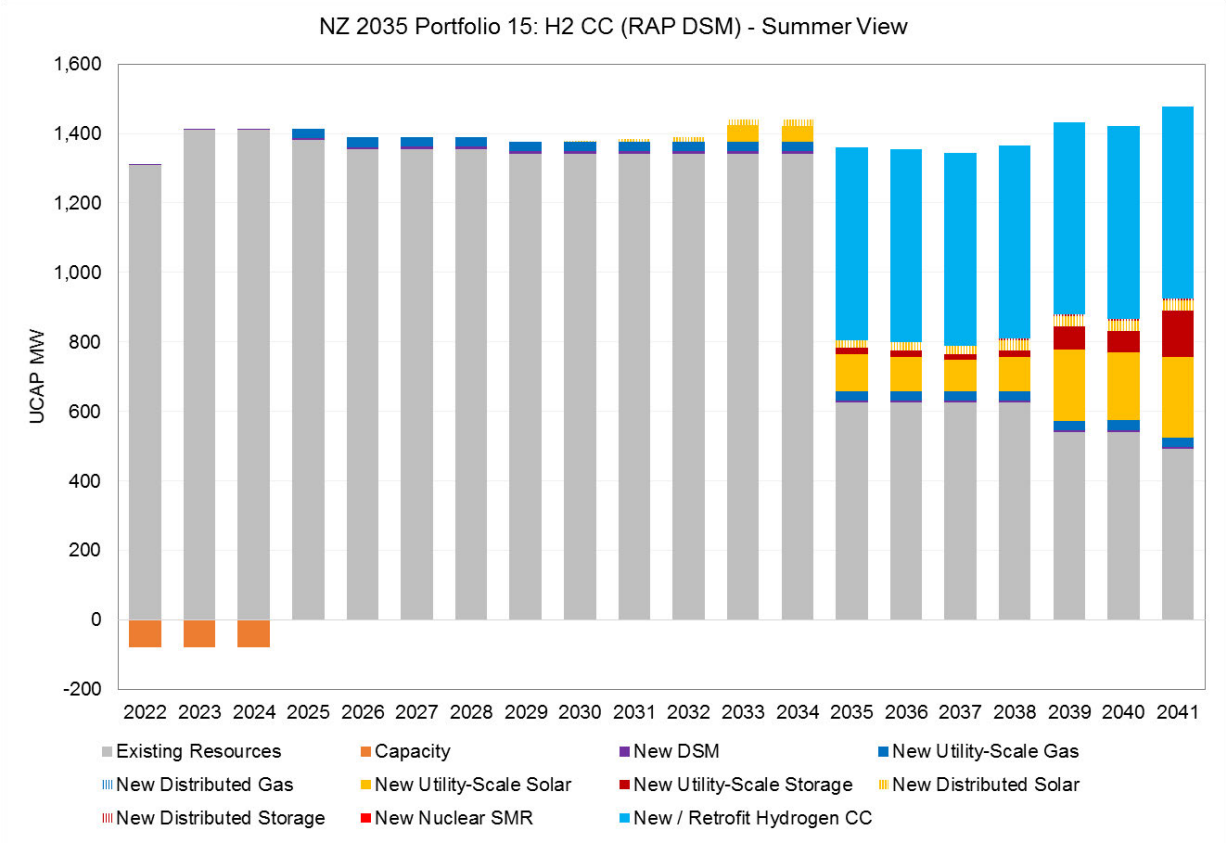


Figure 6-26 - Supply-Side Resource Composition of Plan 15



4.2.4 DSM Impacts on Annual Energy

4. The combined impact of all demand-side resources on the base-case forecast of annual energy requirements;

The combined impact of all demand-side resources on the base annual load forecast of annual energy requirements for each alternative resource plan is shown in Figure 6-27 through Figure 6-29.

Figure 6-27 - Impact of RAP DSM on Annual Energy Requirements (Low- and Mid-Cost Bundle)
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Figure 6-28 - Impact of MAP DSM on Annual Energy Requirements (Low-Cost Bundle)
****Confidential in its Entirety****

Figure 6-29 - Impact of RAP DSM on Annual Energy Requirements (Low-Cost Bundle)
****Confidential in its Entirety****

4.2.5 Composition of DSM to Annual Energy

5. The composition, by program and demand-side rate, of the annual energy provided by demand-side resources;

The composition by program and demand-side rate of the annual energy provided by demand-side resources for RAP and MAP DSM is shown in Figure 6-30 and Figure 6-31. The corresponding tables of values for all these figures are provided in Appendix 6F.

Figure 6-30 - Composition of DSM Energy of Selected RAP DSM

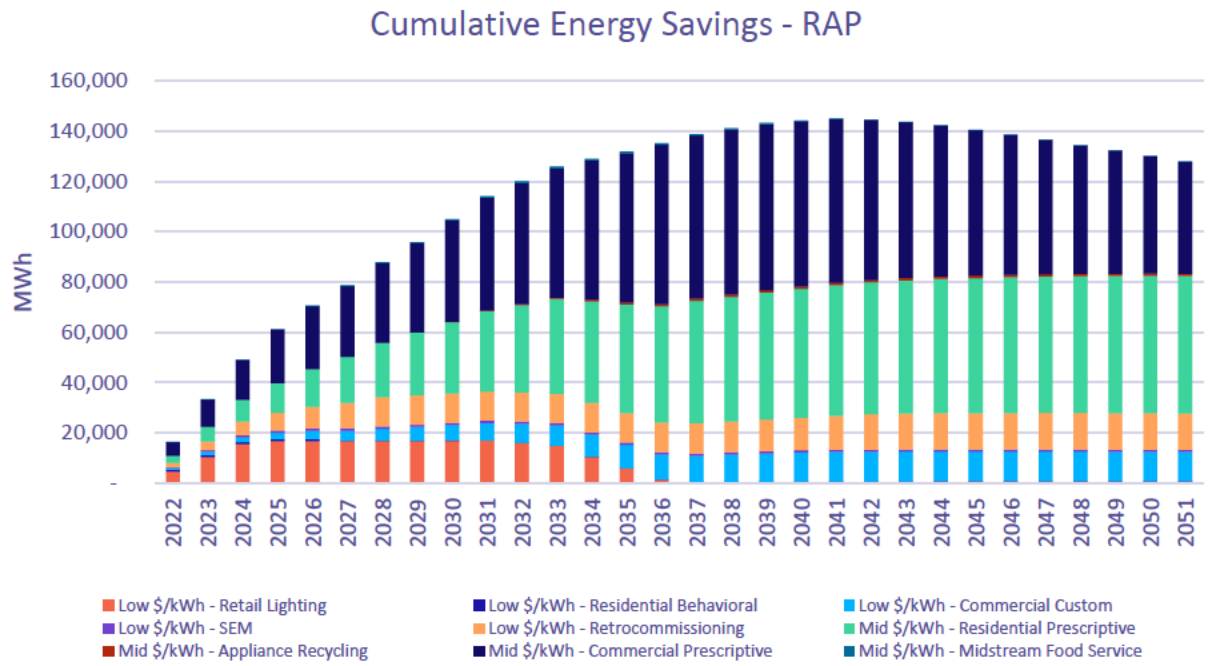
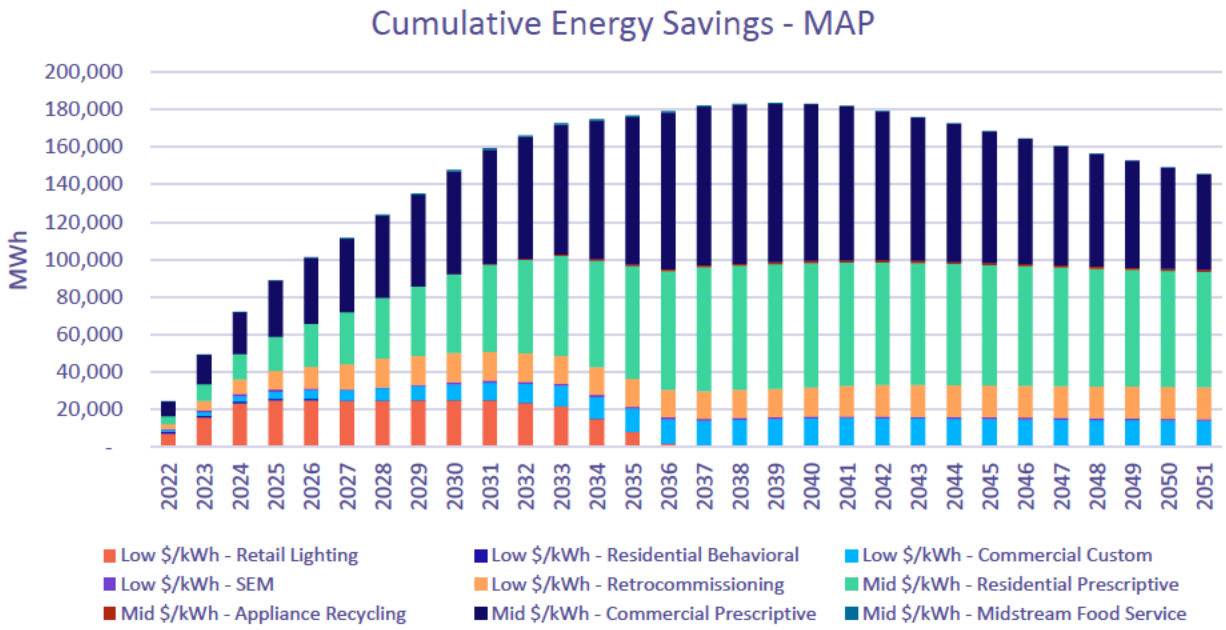


Figure 6-31 - Composition of DSM Energy of Selected MAP DSM



4.2.6 Supply-Side Resource Contribution to Energy

6. The composition, by supply-side resource, of the annual energy supplied to the transmission grid, less losses, provided by supply-side resources. Existing supply-side resources may be shown as a single resource;

The composition by supply-side resources of the annual energy supplied to the transmission grid by supply-side resources is provided for each alternative resource plan in Figure 6-32 through Figure 6-47. All energy profiles assume Base Case market conditions.

Figure 6-32 - Composition of Supply-Side Energy for Plan 1

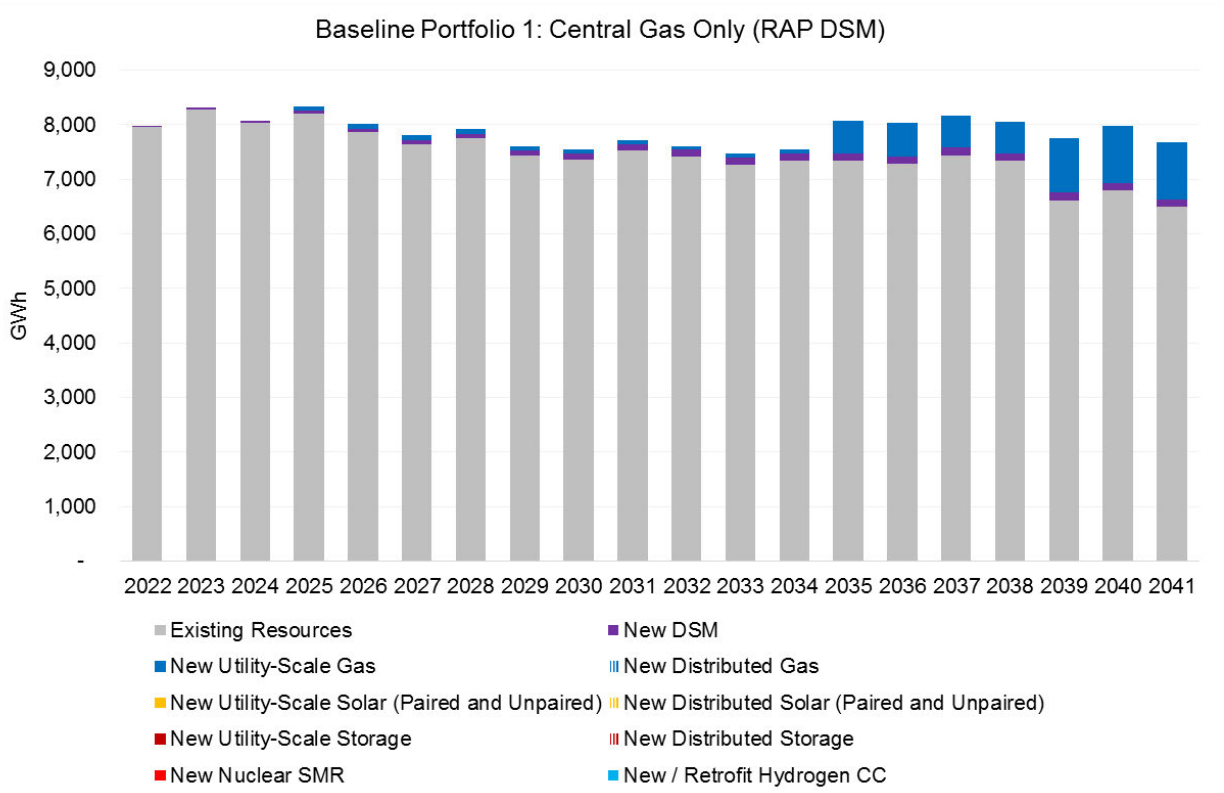


Figure 6-33 - Composition of Supply-Side Energy for Plan 1A

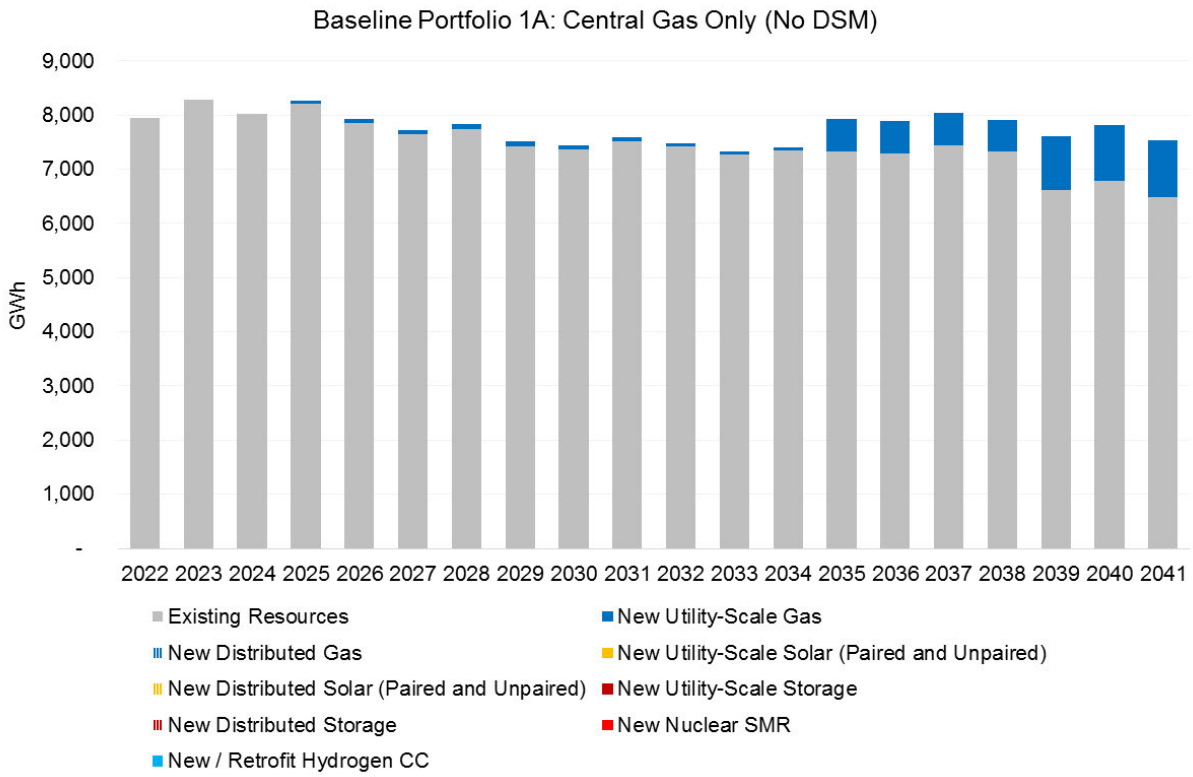


Figure 6-34 - Composition of Supply-Side Energy for Plan 2

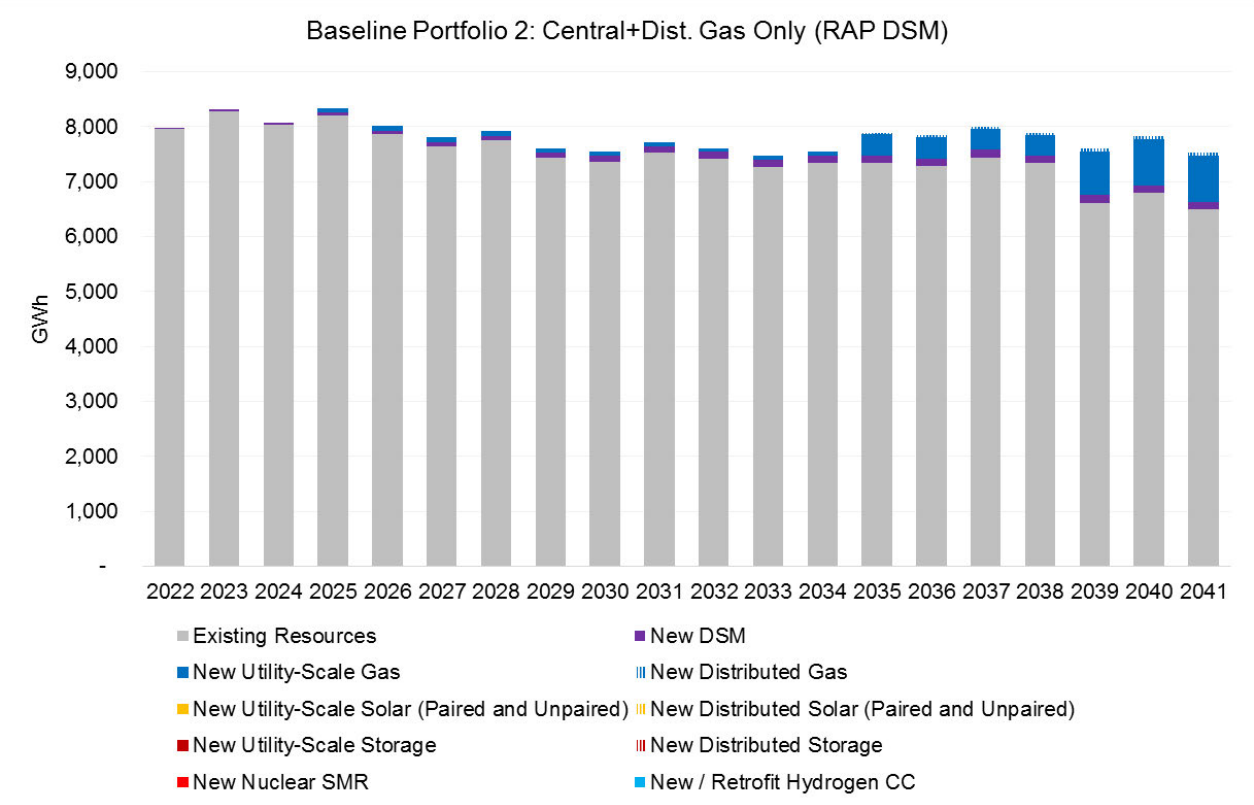


Figure 6-35 - Composition of Supply-Side Energy for Plan 3

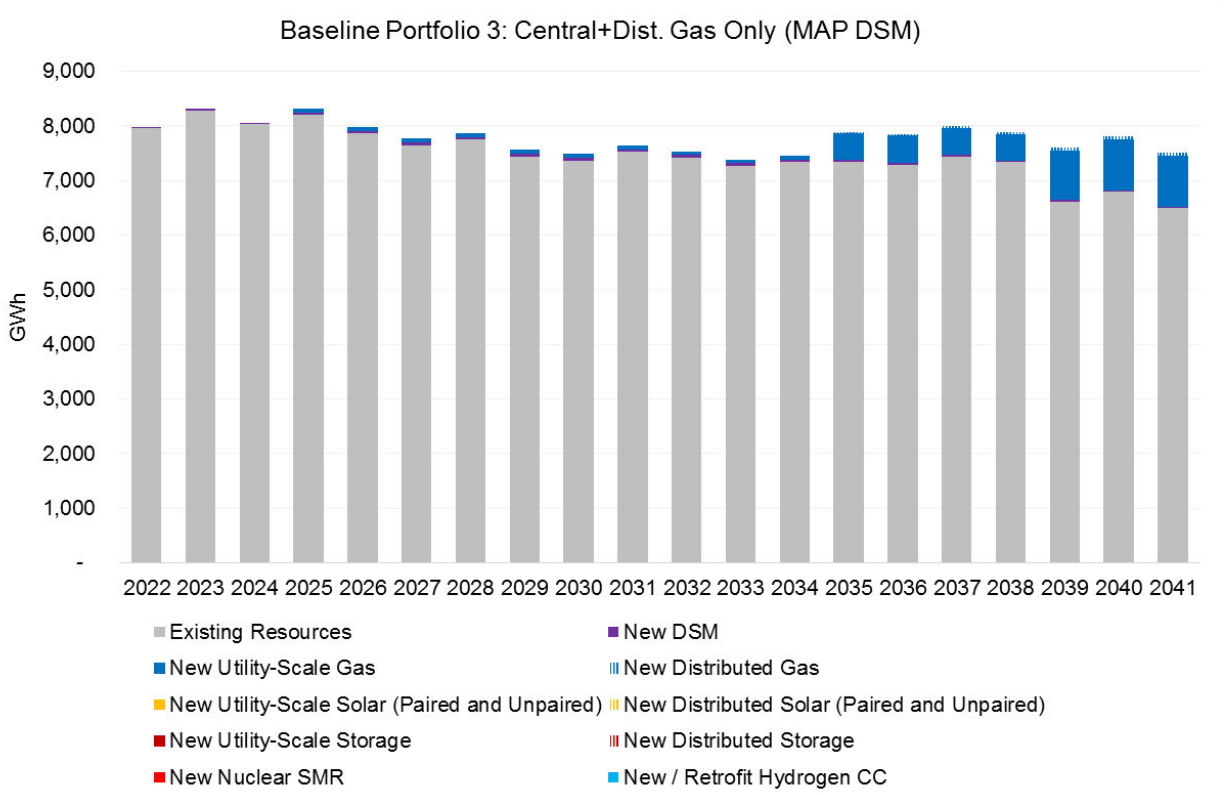


Figure 6-36 - Composition of Supply-Side Energy for Plan 4

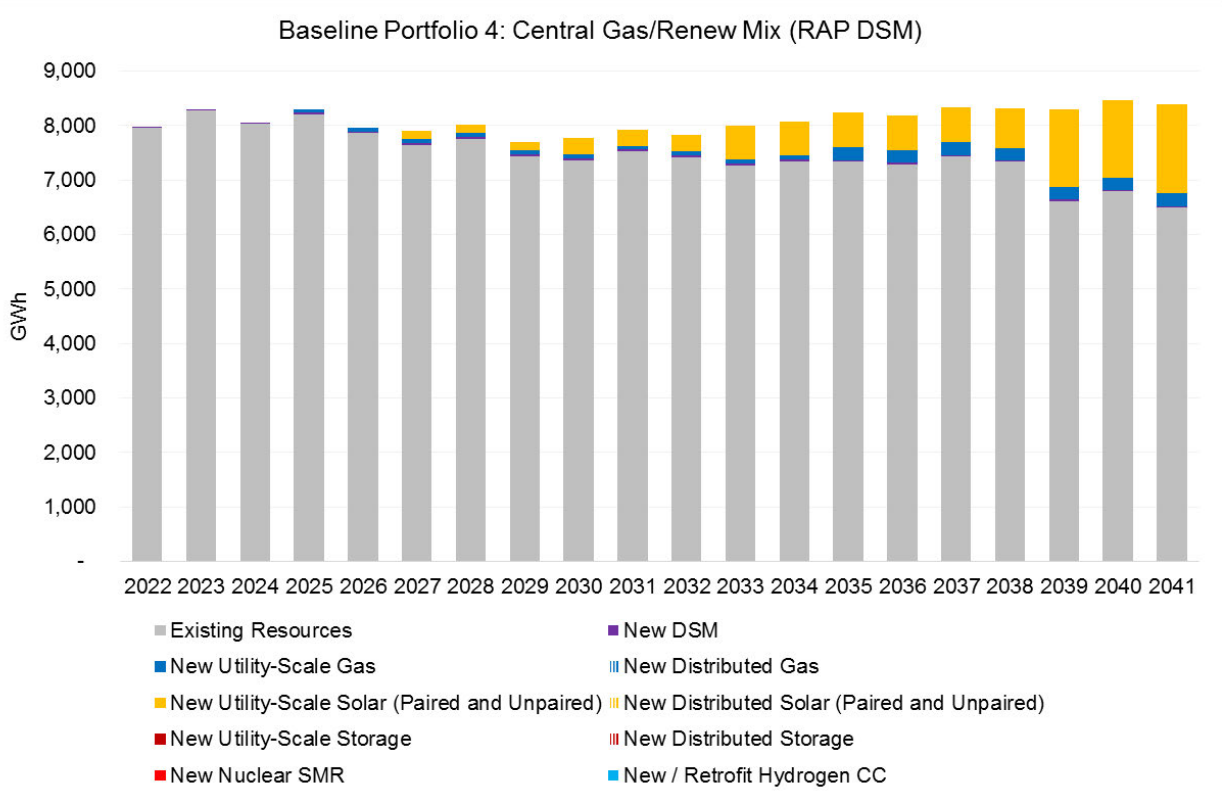


Figure 6-37 - Composition of Supply-Side Energy for Plan 5

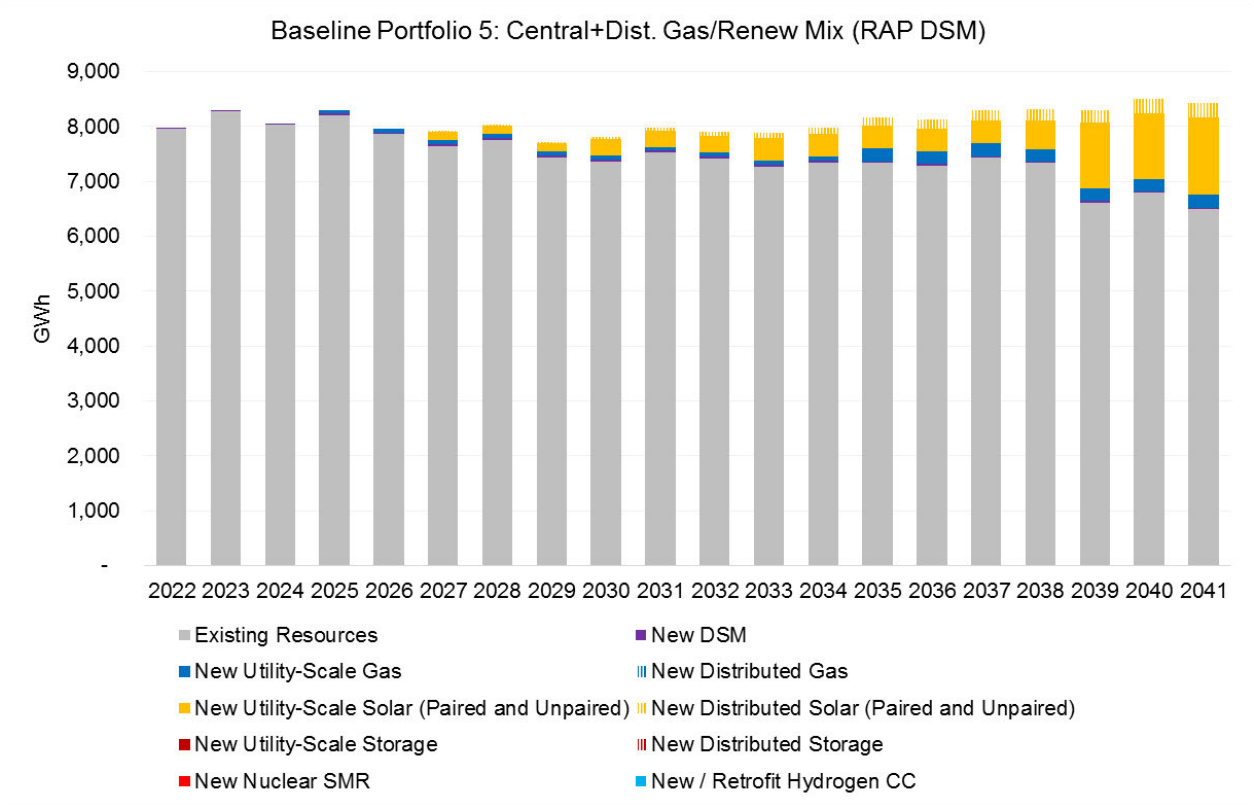


Figure 6-38 - Composition of Supply-Side Energy for Plan 6

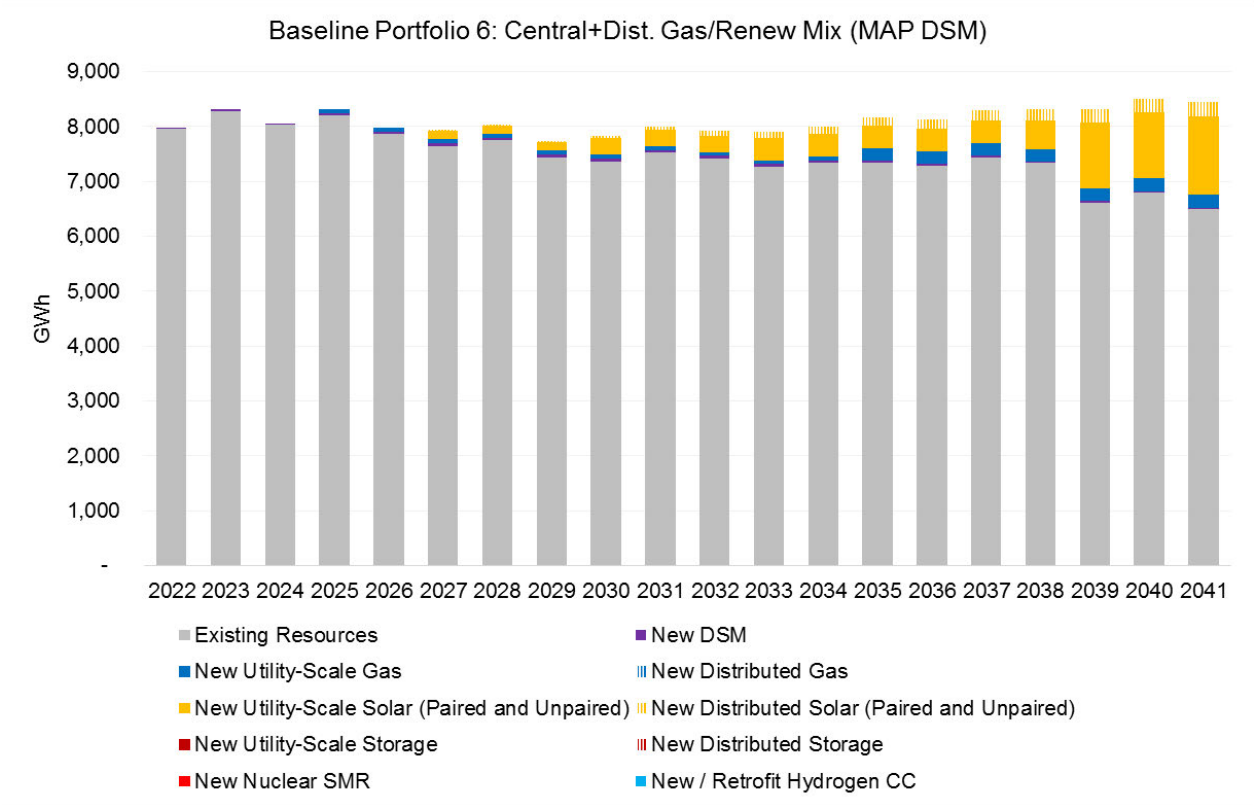


Figure 6-39 - Composition of Supply-Side Energy for Plan 7

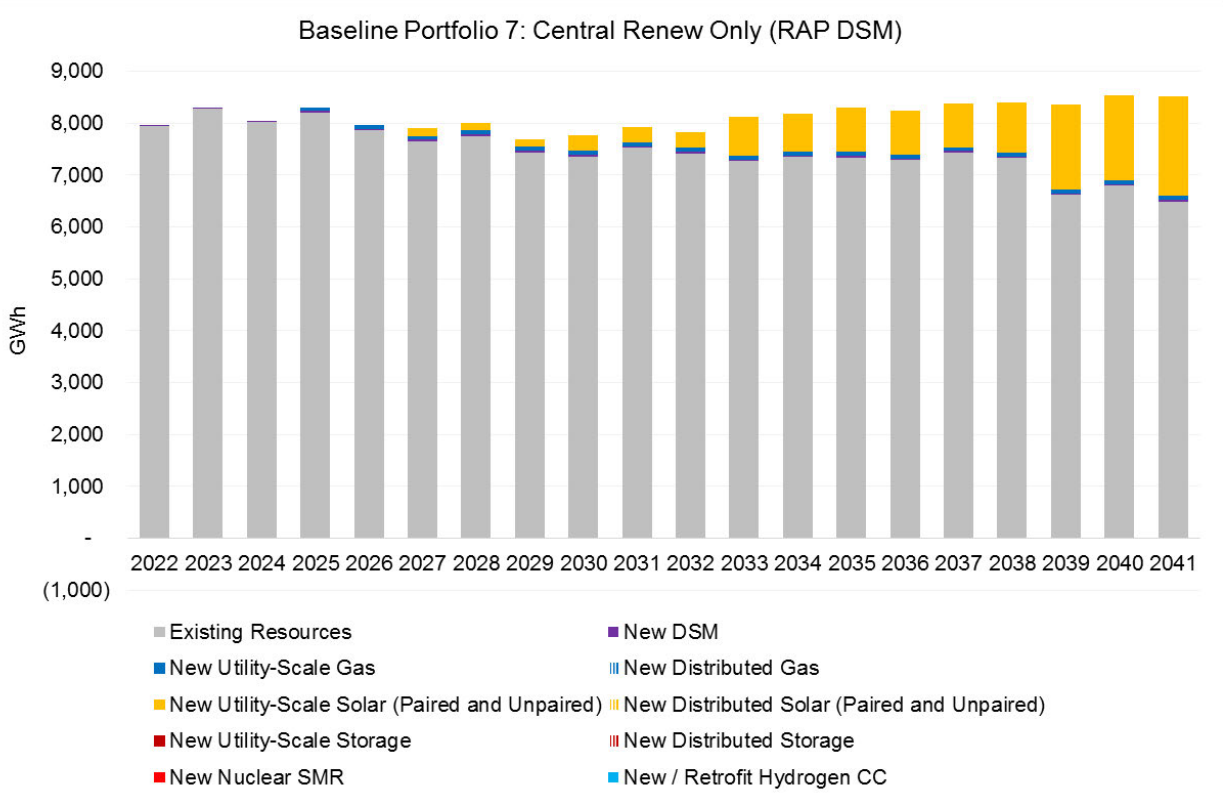


Figure 6-40 - Composition of Supply-Side Energy for Plan 8

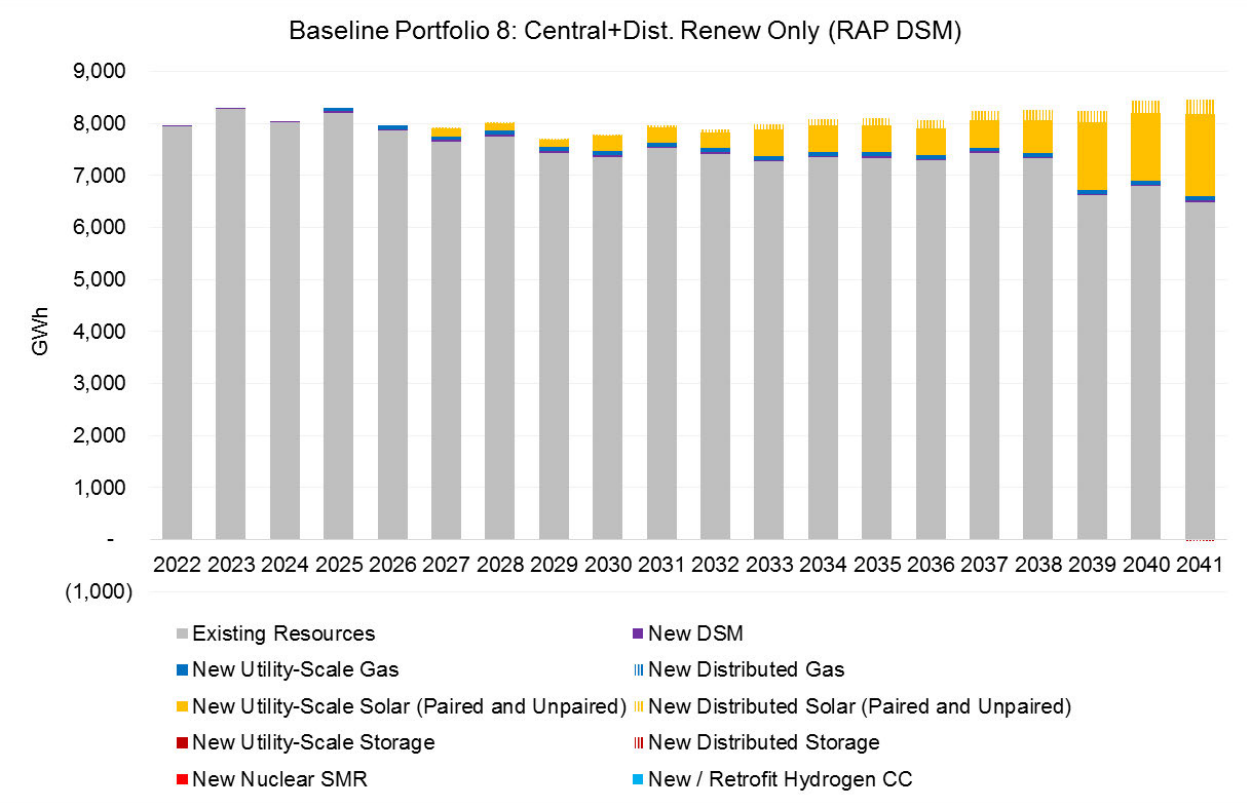


Figure 6-41 - Composition of Supply-Side Energy for Plan 9

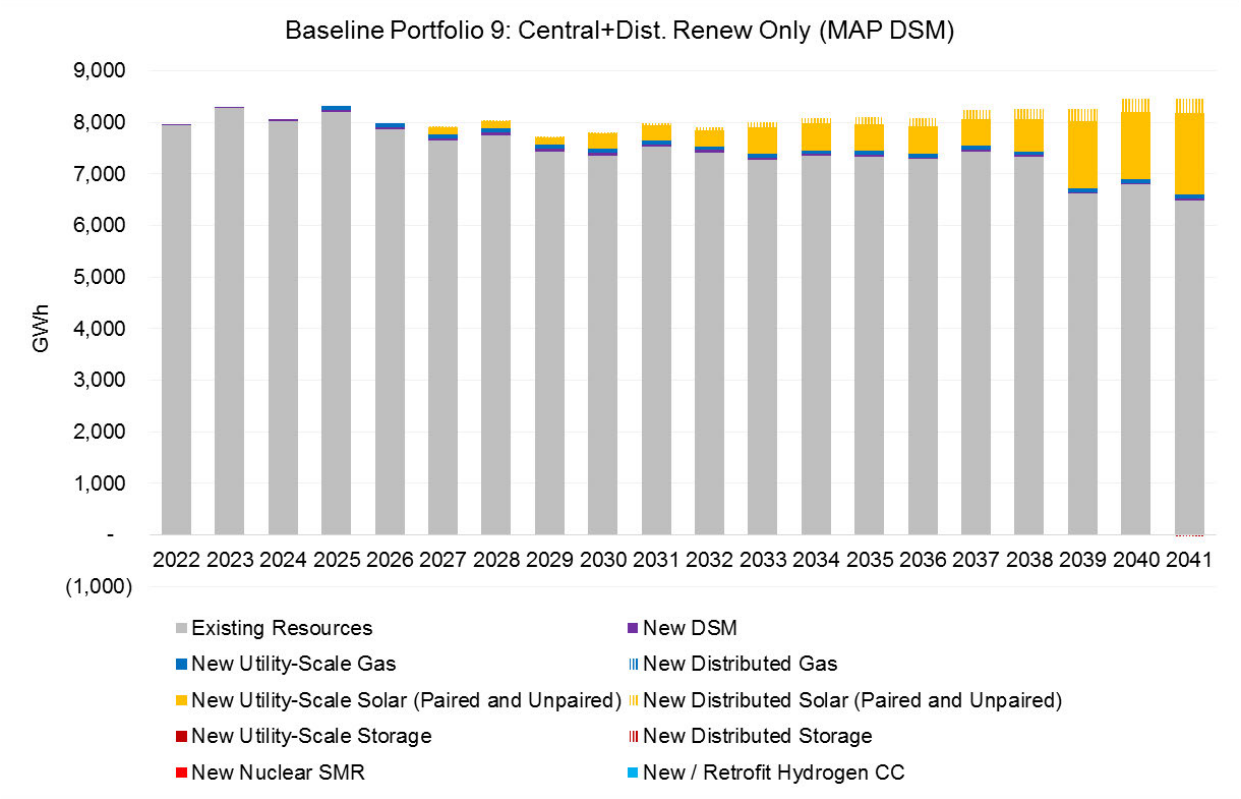


Figure 6-42 - Composition of Supply-Side Energy for Plan 10

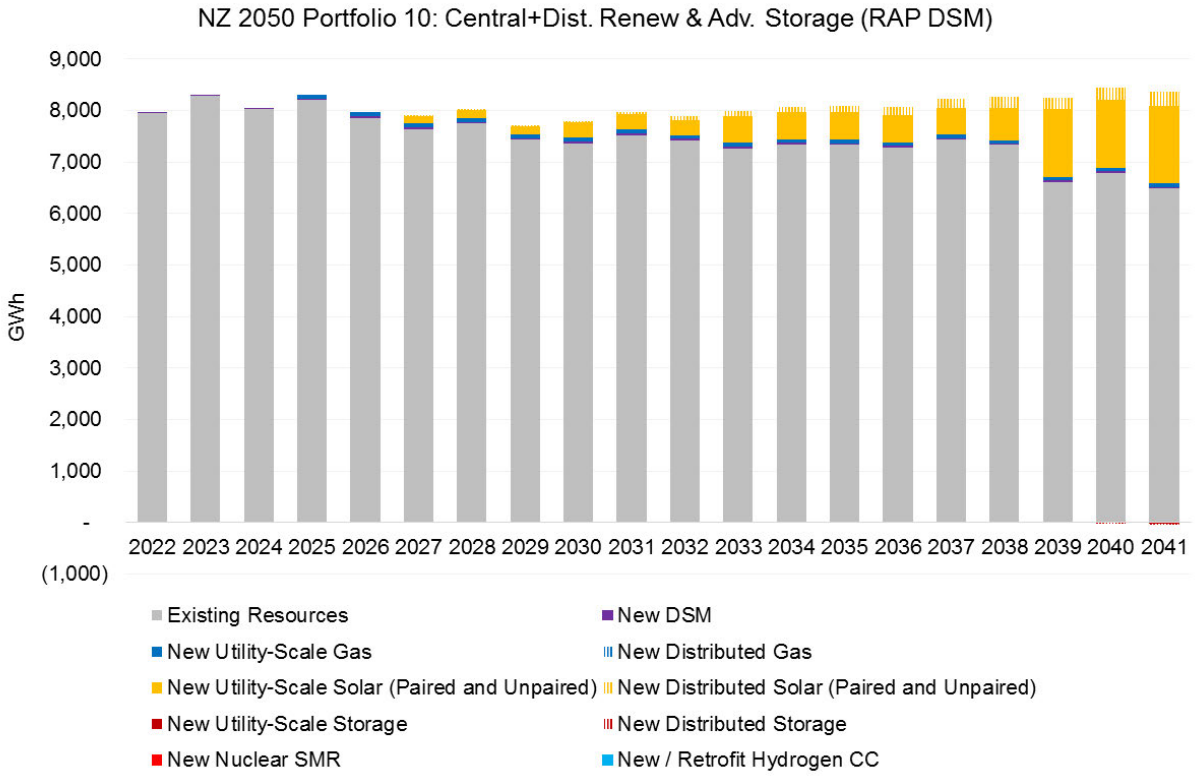


Figure 6-43 - Composition of Supply-Side Energy for Plan 11

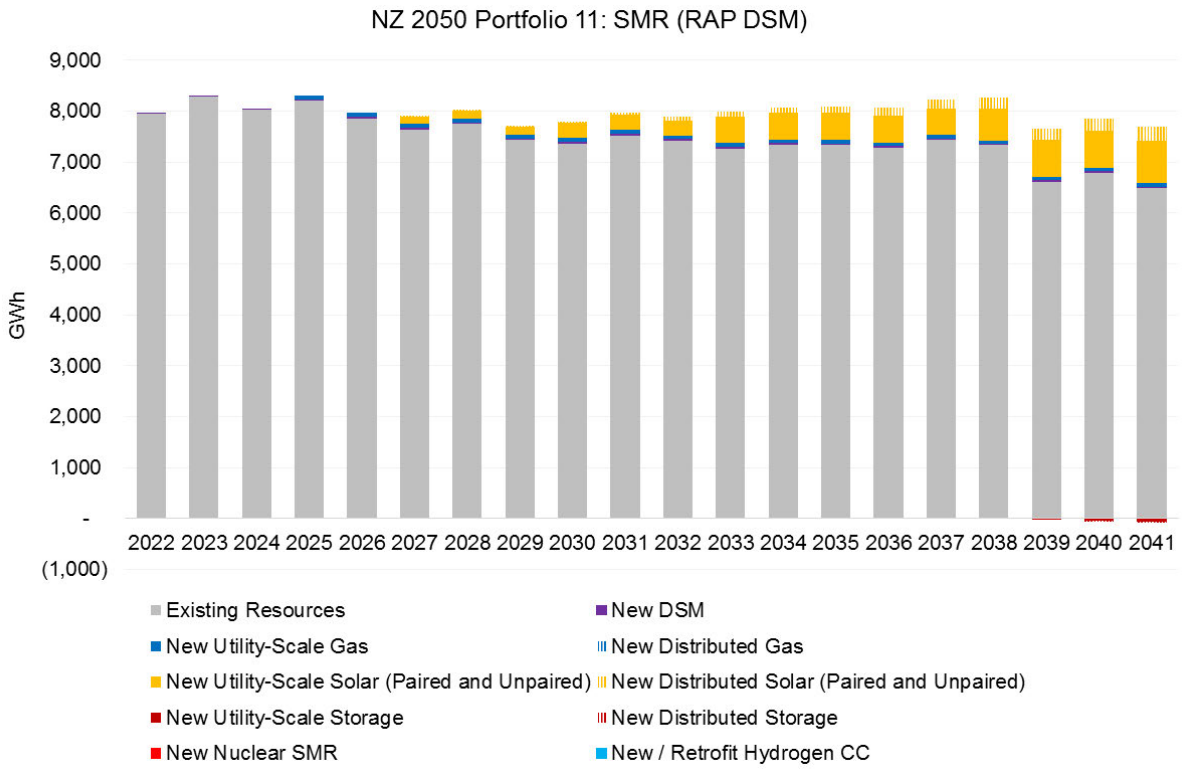


Figure 6-44 - Composition of Supply-Side Energy for Plan 12

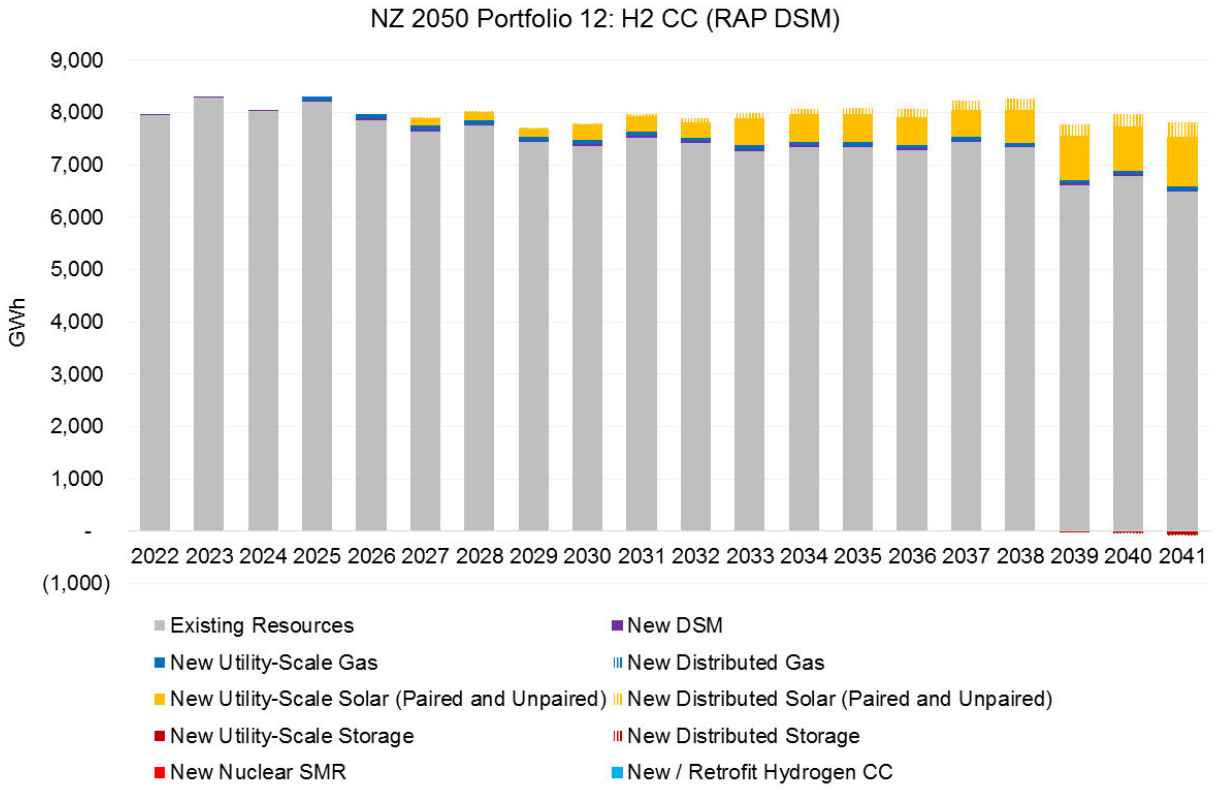


Figure 6-45 - Composition of Supply-Side Energy for Plan 13

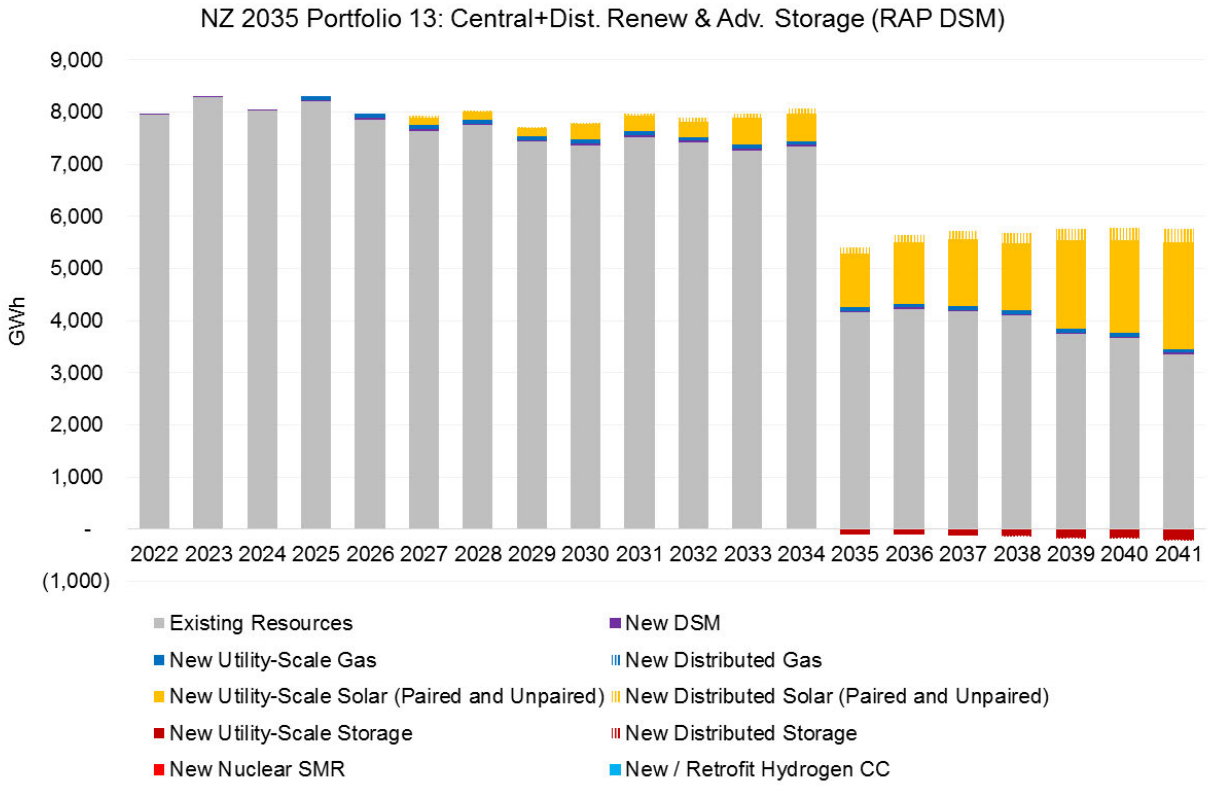


Figure 6-46 - Composition of Supply-Side Energy for Plan 13

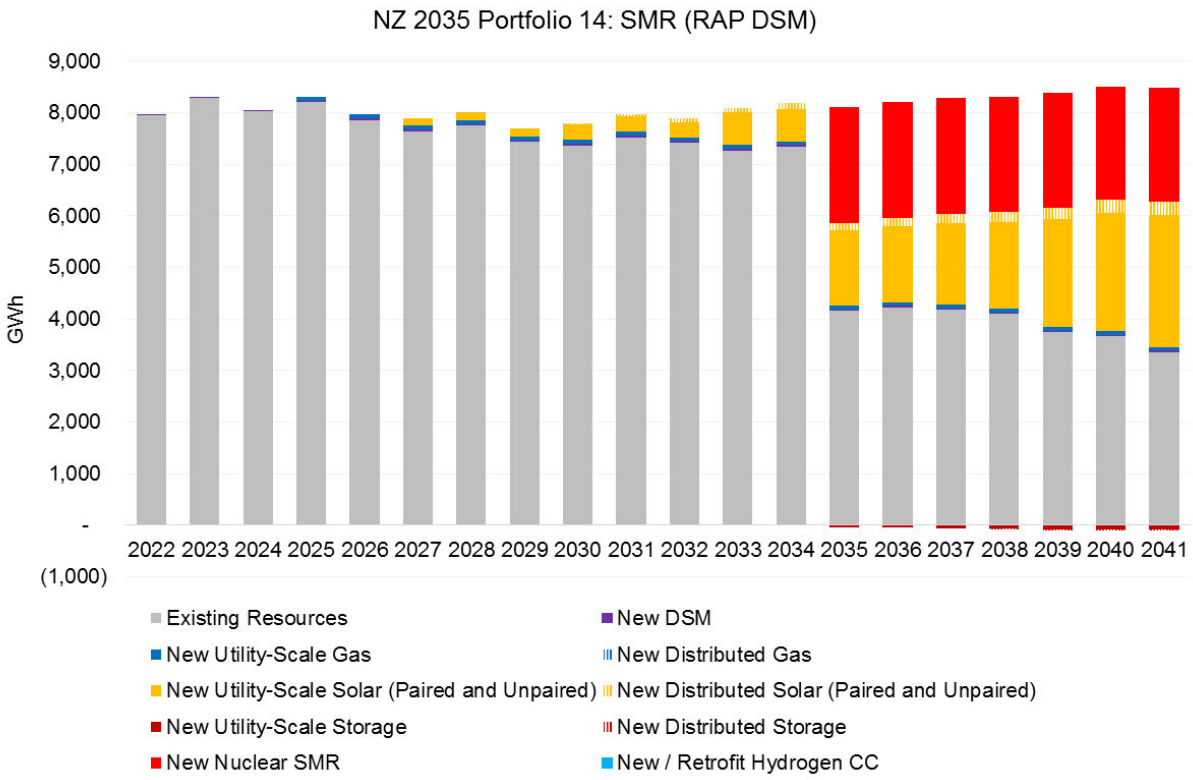
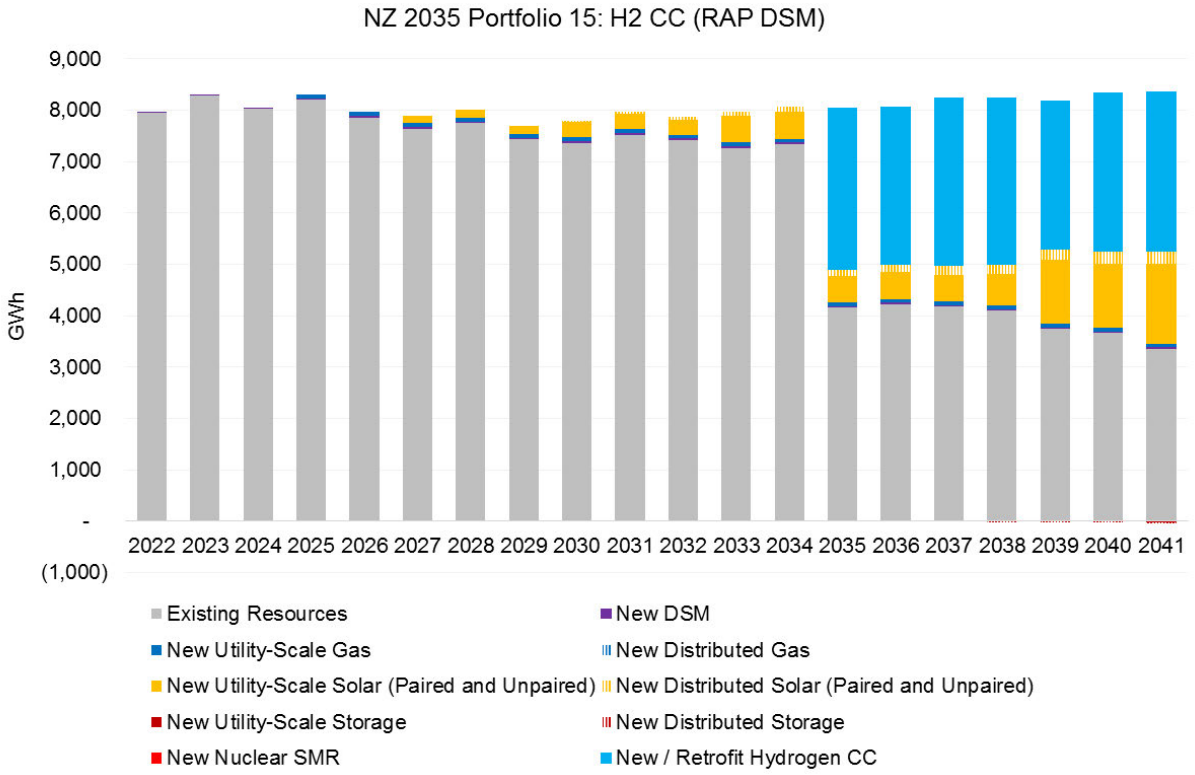


Figure 6-47 - Composition of Supply-Side Energy for Plan 13



4.2.7 Annual Emissions of Plans by Pollutant

7. Annual emissions of each environmental pollutant identified pursuant to 4 CSR 240-22.040(2)(B);

The annual emissions for CO_2, NOx, and SO2 for each alternative resource plan are provided in Figure 6-48 through Figure 6-51. Figure 6-48 represents scope 1, 2, and 3 CO2 emissions, while Figure 6-49 represents scope 1 and 2 CO2 emissions only. For Liberty-Empire, all emissions except those associated with the owned portion of Plum Point and Iatan 1 and 2 are scope 1 and 2 emissions and are counted against Liberty-Empire's net zero goals. Scope 3 emissions are subject to environmental costs but do not count against Liberty-Empire's net zero emissions accounting.

Figure 6-48 - Annual CO2 Emissions (Scope 1, 2, and 3)

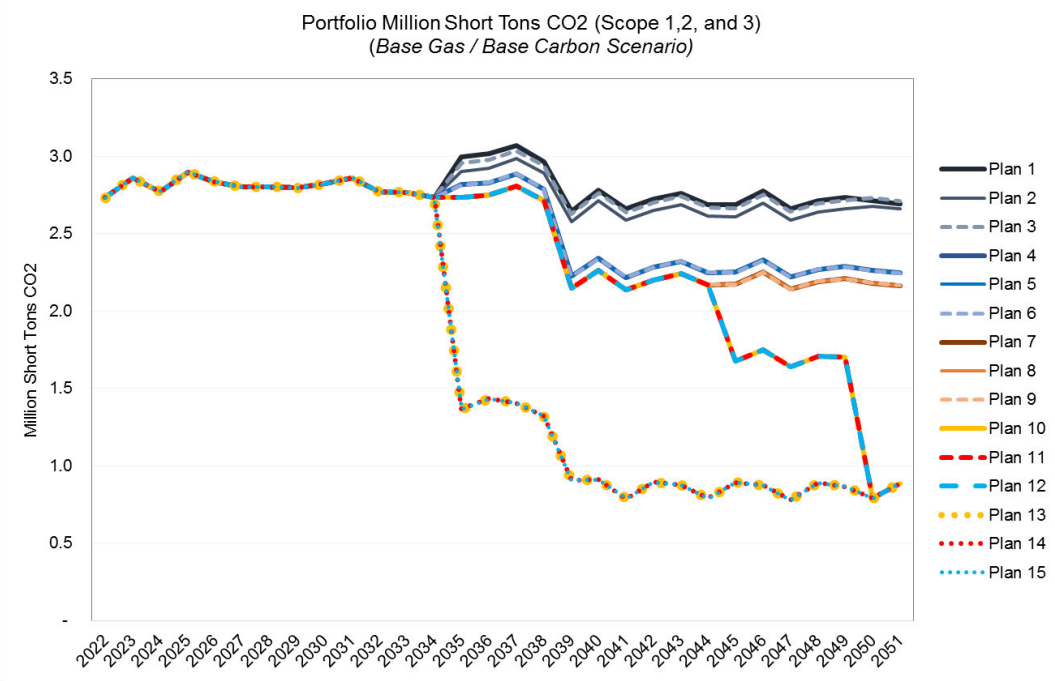


Figure 6-49 - Annual CO2 Emissions (Scope 1 and 2 only)

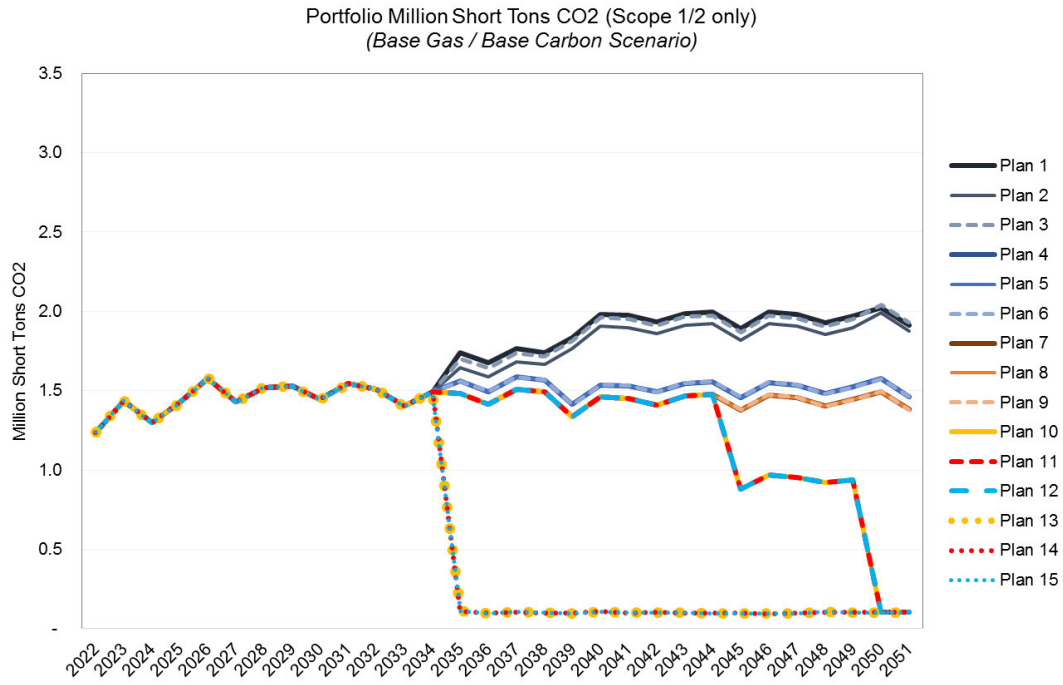


Figure 6-50 - Annual NOx Emissions

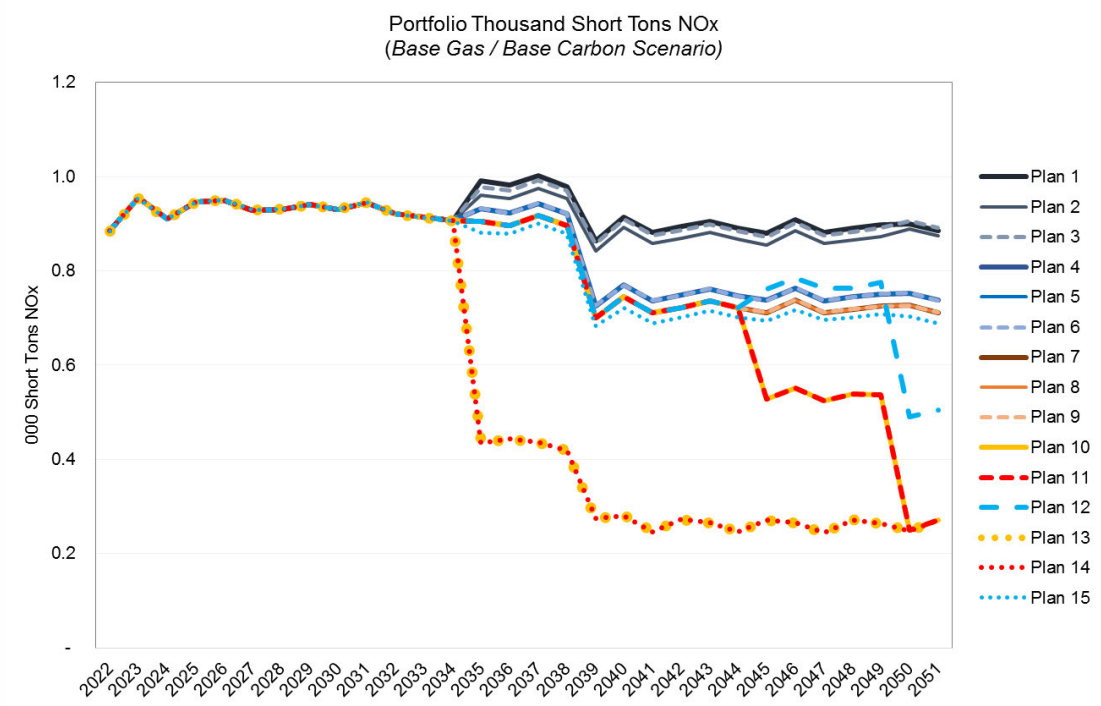
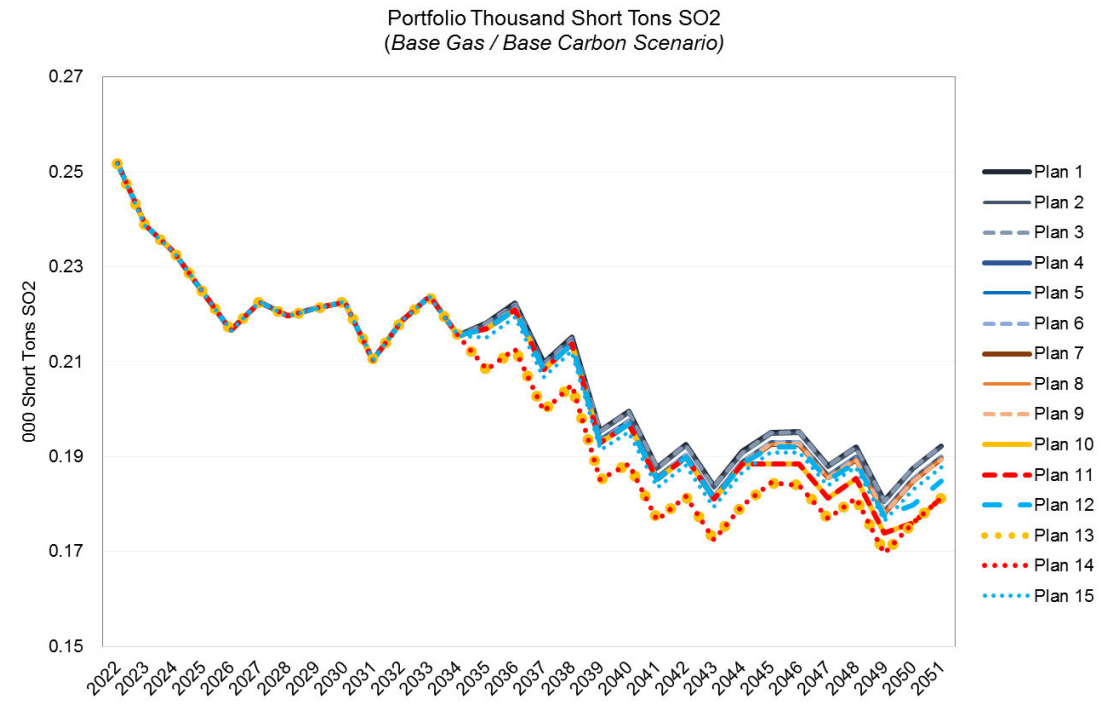


Figure 6-51 - Annual SO2 Emissions

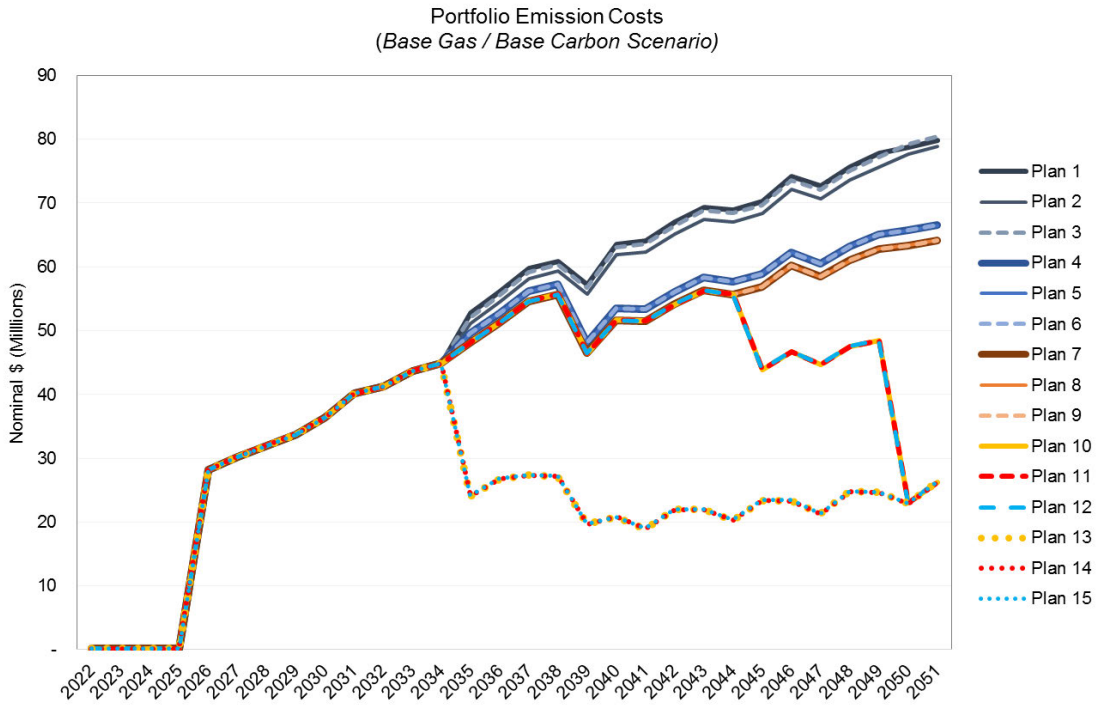


4.2.8 Annual Probable Environmental Cost for Each Plan

8. Annual probable environmental costs; and

The total annual probable environmental costs for each alternative resource plan are shown in Figure 6-52.

Figure 6-52 - Annual Probable CO2 Costs for Each Alternative Resource Plan



4.2.9 Forecast of Capacity Balance Tables

9. Public and highly-confidential forms of the capacity balance spreadsheets completed in the specified format;

The capacity balance forecast for each alternative resource plan for both summer and winter are provided in the following tables.

Table 6-20 – Summer Forecast of Capacity Balance for Plan 1
****Confidential in its Entirety****

Table 6-21 – Winter Forecast of Capacity Balance for Plan 1
****Confidential in its Entirety****

NP

Table 6-22 – Summer Forecast of Capacity Balance for Plan 1A
****Confidential in its Entirety****

NP

Table 6-23 – Winter Forecast of Capacity Balance for Plan 1A
****Confidential in its Entirety****

Table 6-24 – Summer Forecast of Capacity Balance for Plan 2
****Confidential in its Entirety****

Table 6-25 – Winter Forecast of Capacity Balance for Plan 2
****Confidential in its Entirety****

Table 6-26 – Summer Forecast of Capacity Balance for Plan 3
****Confidential In Its Entirety****

Table 6-27 – Winter Forecast of Capacity Balance for Plan 3
****Confidential In Its Entirety****

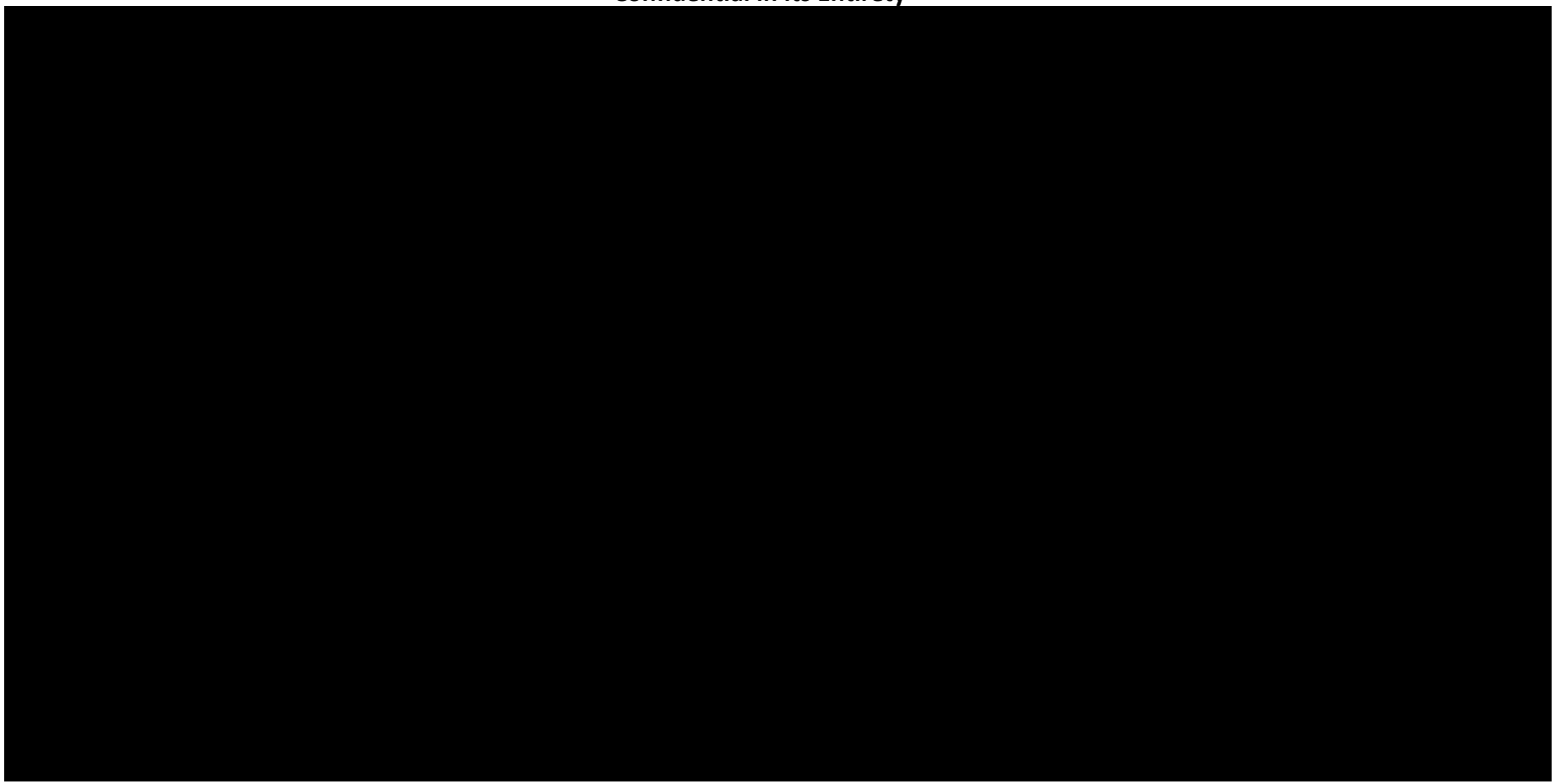
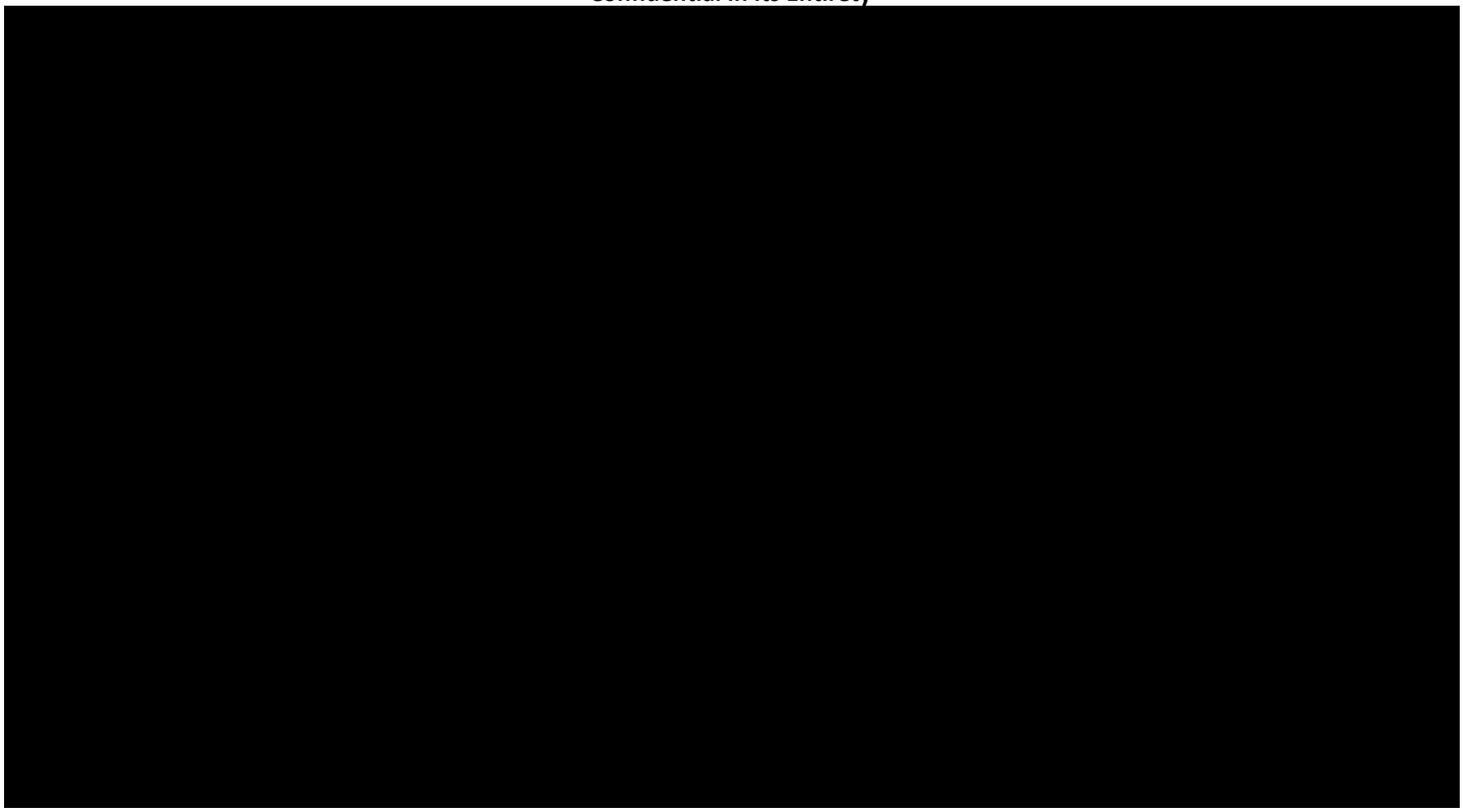


Table 6-28 – Summer Forecast of Capacity Balance for Plan 4
****Confidential In Its Entirety****

Table 6-29 – Winter Forecast of Capacity Balance for Plan 4
****Confidential In Its Entirety****



NP

Table 6-30 – Summer Forecast of Capacity Balance for Plan 5
****Confidential In Its Entirety****

Table 6-31 – Winter Forecast of Capacity Balance for Plan 5
****Confidential In Its Entirety****

NP

Table 6-32 – Summer Forecast of Capacity Balance for Plan 6
****Confidential In Its Entirety****

NP

Table 6-33 – Winter Forecast of Capacity Balance for Plan 6
****Confidential In Its Entirety****

NP

Table 6-34 – Summer Forecast of Capacity Balance for Plan 7
****Confidential In Its Entirety****

Table 6-35 – Winter Forecast of Capacity Balance for Plan 7
****Confidential In Its Entirety****

Table 6-36 – Summer Forecast of Capacity Balance for Plan 8
****Confidential In Its Entirety****

Table 6-37 – Winter Forecast of Capacity Balance for Plan 8
****Confidential In Its Entirety****

Table 6-38 – Summer Forecast of Capacity Balance for Plan 9
****Confidential In Its Entirety****

NP

Table 6-39 – Winter Forecast of Capacity Balance for Plan 9
****Confidential In Its Entirety****

NP

Table 6-40 - Summary Forecast of Capacity Balance for Plan 10
****Confidential In Its Entirety****

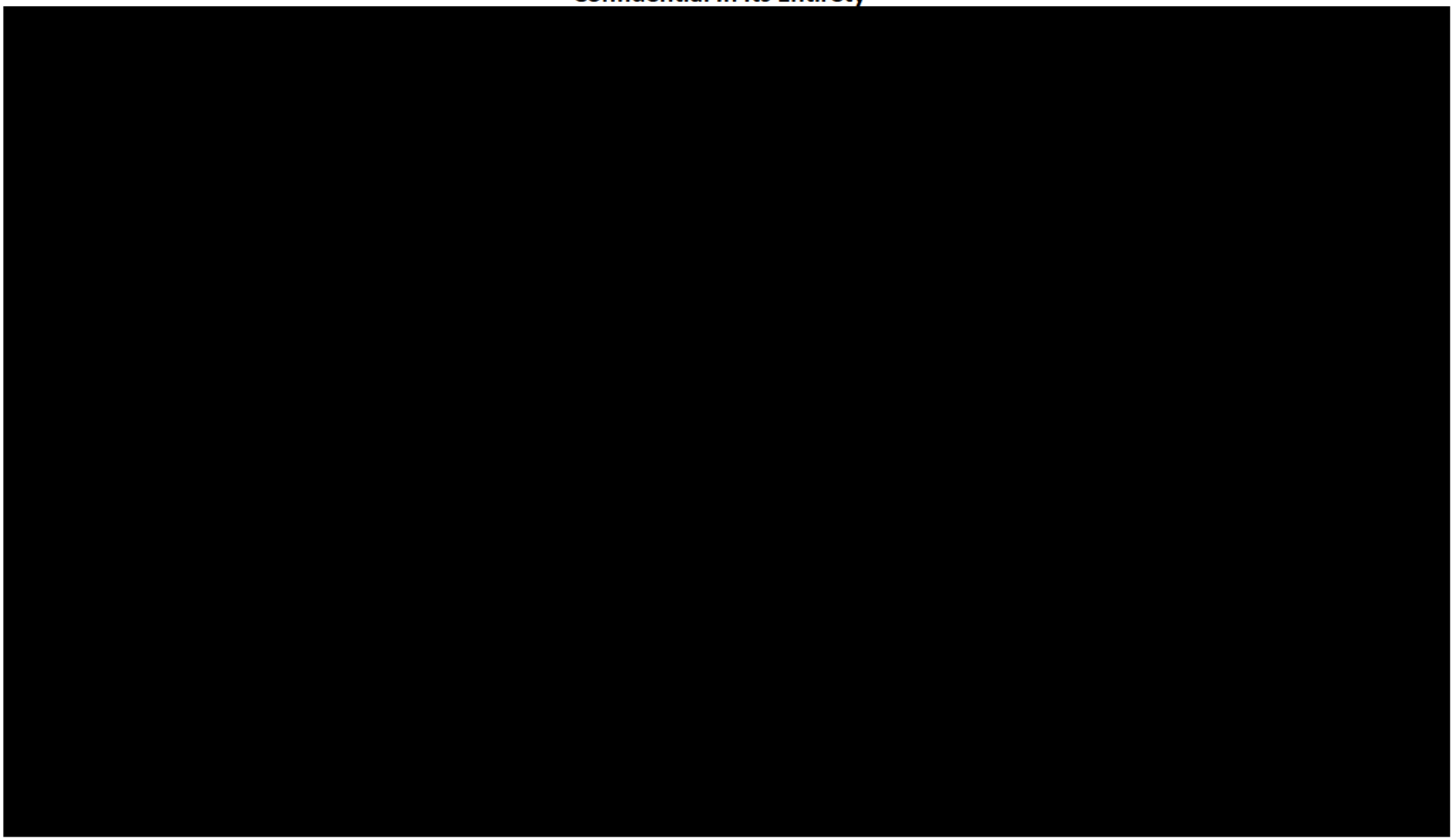
Table 6-41 – Winter Forecast of Capacity Balance for Plan 10
****Confidential In Its Entirety****

Table 6-42 - Summer Forecast of Capacity Balance for Plan 11
****Confidential In Its Entirety****

Table 6-43 – Winter Forecast of Capacity Balance for Plan 11
****Confidential In Its Entirety****

NP

Table 6-44 – Summer Forecast of Capacity Balance for Plan 12
****Confidential In Its Entirety****



NP

Table 6-45 – Winter Forecast of Capacity Balance for Plan 12
****Confidential In Its Entirety****

NP

Table 6-46 – Summer Forecast of Capacity Balance for Plan 13
****Confidential In Its Entirety****

NP

Table 6-47 – Winter Forecast of Capacity Balance for Plan 13
****Confidential In Its Entirety****

Table 6-48 – Summer Forecast of Capacity Balance for Plan 14
****Confidential In Its Entirety****

NP

Table 6-49 – Winter Forecast of Capacity Balance for Plan 14
****Confidential In Its Entirety****

NP

Table 6-50 – Summer Forecast of Capacity Balance for Plan 15
****Confidential In Its Entirety****

NP

Table 6-51 – Winter Forecast of Capacity Balance for Plan 15
****Confidential In Its Entirety****

4.2.10 Performance Measure Results for Each Plan

(C) The analysis of economic impact of alternative resource plans, calculated with and without utility financial incentives for demand-side resources, shall provide comparative estimates for each year of the planning horizon—

1. For the following performance measures for each year:

A. Estimated annual revenue requirement;

B. Estimated annual average rates and percentage increase in the average rate from the prior year; and

C. Estimated company financial ratios and credit metrics; and

The following tables provide the performance measures of each alternative resource plan.

Table 6-52 - Plan 1 Performance
****Confidential in its Entirety****
Calculated without Utility Financial Incentives for DSM

****Confidential in its Entirety****
Calculated with Utility Financial Incentives for DSM

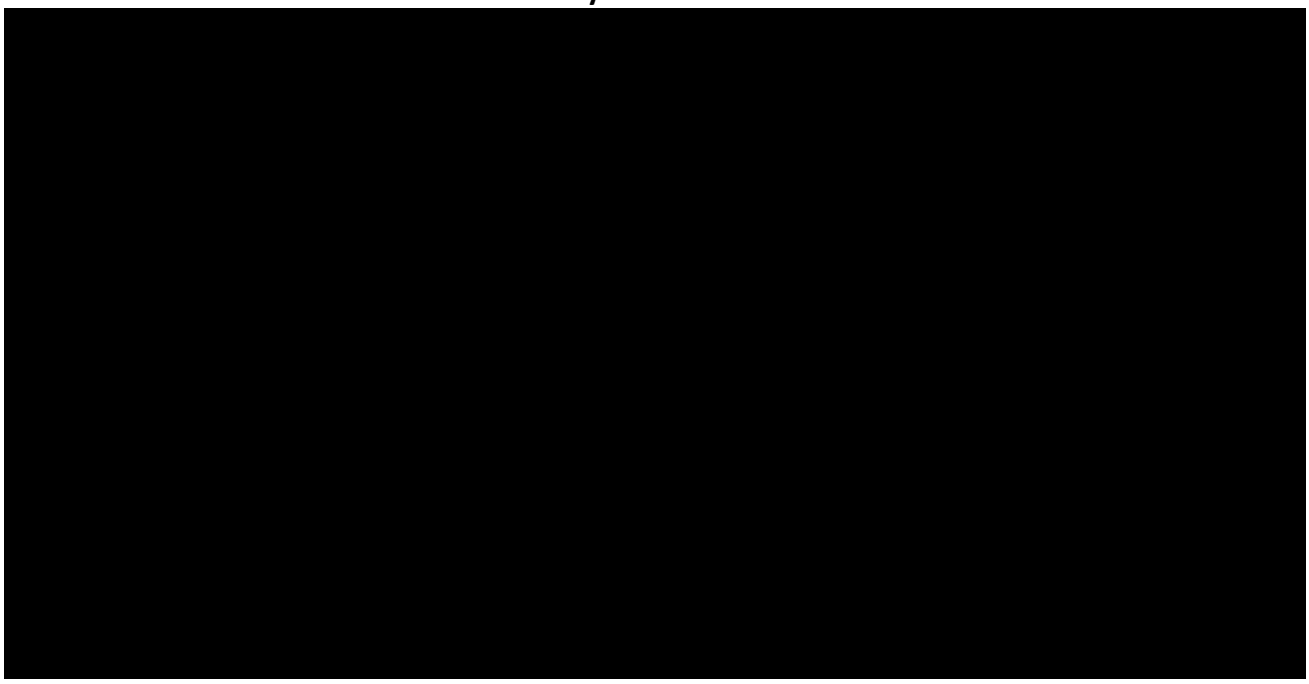
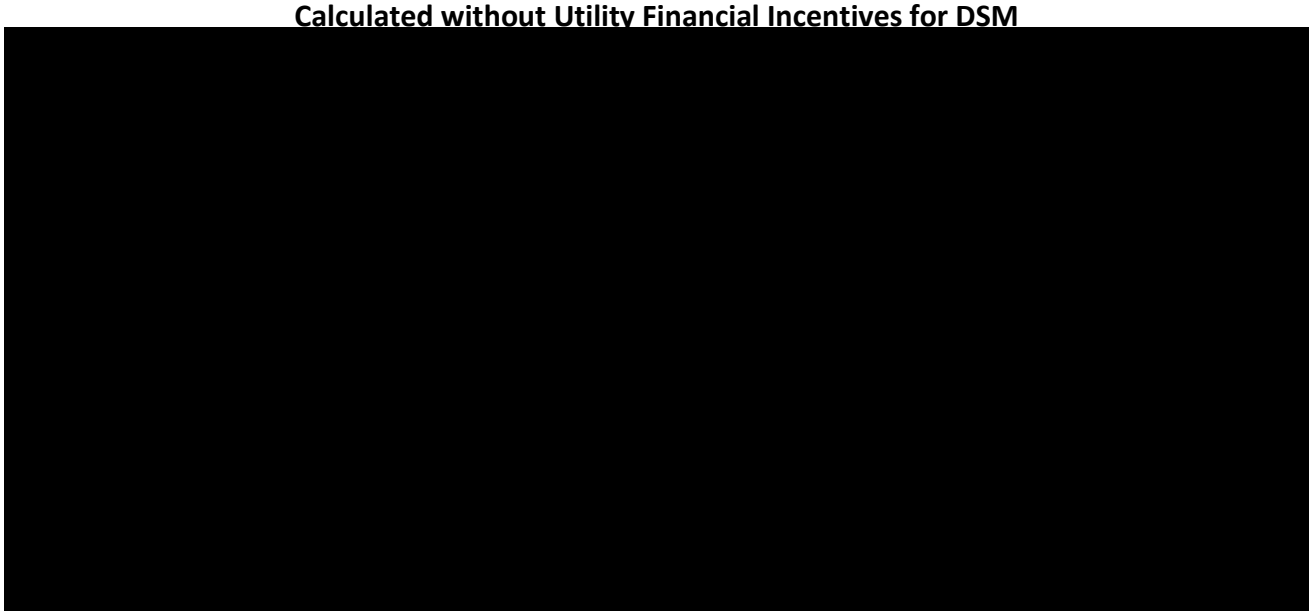
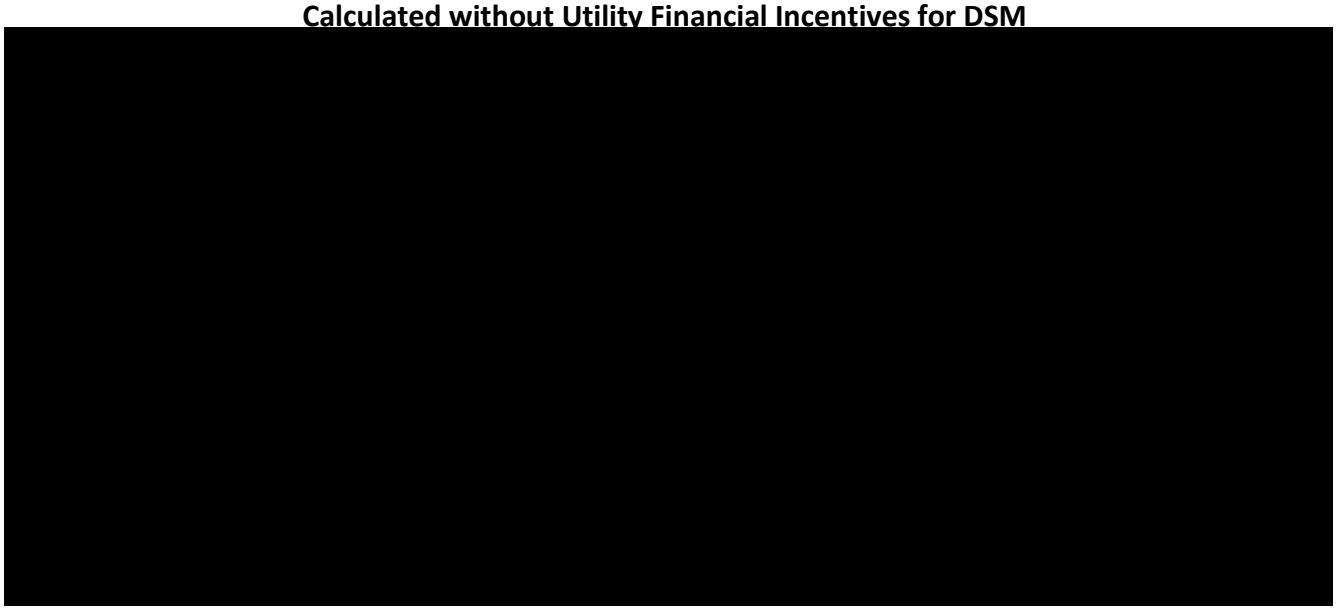


Table 6-53 - Plan 1A Performance
****Confidential in its Entirety****
Calculated without Utility Financial Incentives for DSM



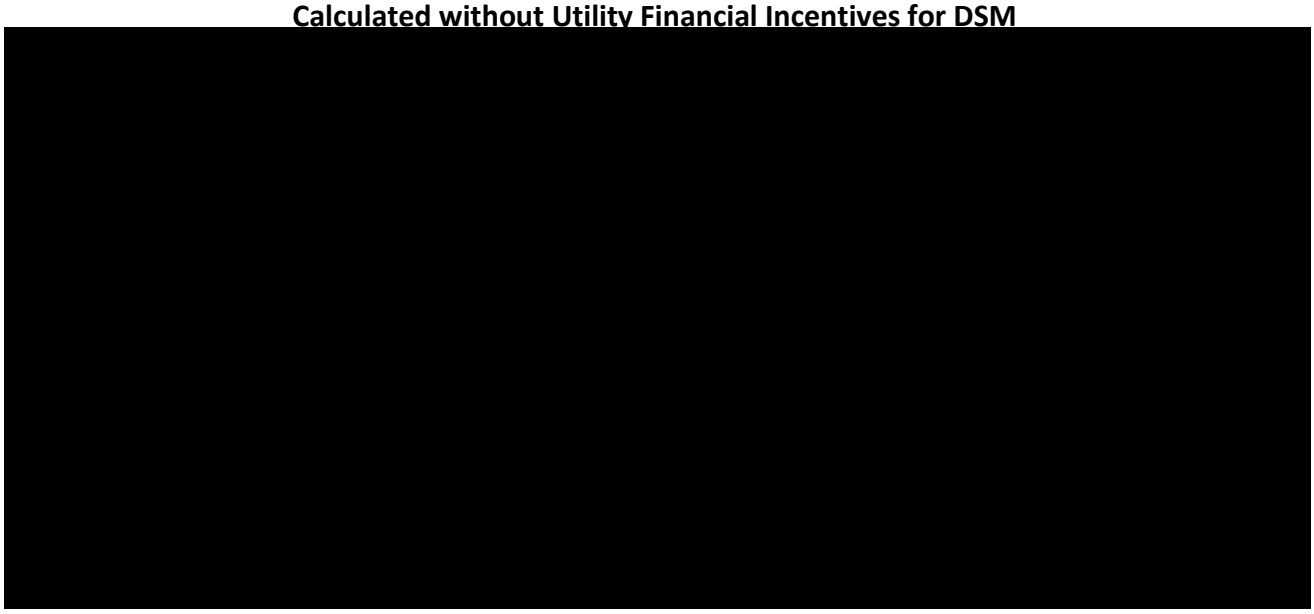
****Confidential in its Entirety****
Calculated with Utility Financial Incentives for DSM

Table 6-54 - Plan 2 Performance
****Confidential in its Entirety****
Calculated without Utility Financial Incentives for DSM



****Confidential in its Entirety****
Calculated with Utility Financial Incentives for DSM

Table 6-55 - Plan 3 Performance
****Confidential in its Entirety****
Calculated without Utility Financial Incentives for DSM



****Confidential in its Entirety****
Calculated with Utility Financial Incentives for DSM

Table 6-56 - Plan 4 Performance
****Confidential in its Entirety****
Calculated without Utility Financial Incentives for DSM

****Confidential in its Entirety****
Calculated with Utility Financial Incentives for DSM

Table 6-57 - Plan 5 Performance
****Confidential in its Entirety****
Calculated without Utility Financial Incentives for DSM

****Confidential in its Entirety****
Calculated with Utility Financial Incentives for DSM

Table 6-58 - Plan 6 Performance
****Confidential in its Entirety****
Calculated without Utility Financial Incentives for DSM

****Confidential in its Entirety****
Calculated with Utility Financial Incentives for DSM

Table 6-59 - Plan 7 Performance
****Confidential in its Entirety****
Calculated without Utility Financial Incentives for DSM

****Confidential in its Entirety****
Calculated with Utility Financial Incentives for DSM

Table 6-60 - Plan 8 Performance
****Confidential in its Entirety****
Calculated without Utility Financial Incentives for DSM

****Confidential in its Entirety****
Calculated with Utility Financial Incentives for DSM

Table 6-61 - Plan 9 Performance
****Confidential in its Entirety****
Calculated without Utility Financial Incentives for DSM

****Confidential in its Entirety****
Calculated with Utility Financial Incentives for DSM

Table 6-62 - Plan 10 Performance
****Confidential in its Entirety****
Calculated without Utility Financial Incentives for DSM

****Confidential in its Entirety****
Calculated with Utility Financial Incentives for DSM

Table 6-63 - Plan 11 Performance
****Confidential in its Entirety****
Calculated without Utility Financial Incentives for DSM

****Confidential in its Entirety****
Calculated with Utility Financial Incentives for DSM

Table 6-64 - Plan 12 Performance
****Confidential in its Entirety****
Calculated without Utility Financial Incentives for DSM

****Confidential in its Entirety****
Calculated with Utility Financial Incentives for DSM

Table 6-65 - Plan 13 Performance
****Confidential in its Entirety****
Calculated without Utility Financial Incentives for DSM

****Confidential in its Entirety****
Calculated with Utility Financial Incentives for DSM

Table 6-66 - Plan 14 Performance
****Confidential in its Entirety****
Calculated without Utility Financial Incentives for DSM

****Confidential in its Entirety****
Calculated with Utility Financial Incentives for DSM

Table 6-67 - Plan 15 Performance
****Confidential in its Entirety****
Calculated without Utility Financial Incentives for DSM

****Confidential in its Entirety****
Calculated with Utility Financial Incentives for DSM

2. If the estimated company financial ratios in subparagraph (4)(C)1.C. are below investment grade in any year of the planning horizon, a description of any changes in legal mandates and cost recovery mechanisms necessary for the utility to maintain an investment grade credit rating in each year of the planning horizon and the resulting performance measures in subparagraphs (4)(C)1.A.-(4)(C)1.C. of the alternative resource plans that are associated with the necessary changes in legal mandates and cost recovery mechanisms.

Liberty-Empire does not anticipate below investment grade financial ratios based on the alternative plans presented.

4.2.11 Rate Change Modeling Methodology

(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;

Liberty-Empire included price in the residential, small commercial, large commercial, and municipal models. These models employ Statistically Adjusted End-Use (SAE) variables. The SAE models include the following price elasticities:

- In the residential model and municipal models, the price elasticity used is -0.10.
- In the commercial models, the price elasticity used is -0.15.

Liberty-Empire shows that price is included as a variable in the class model descriptions located in Volume 3 Sections 6.1.2.1, 6.1.2.2, and 6.1.2.3. Volume 3 Figure 3-4 shows the historical and forecast prices indices. The forecast uses historical prices and price elasticities help to explain historical sales and assumes a "flat" price forecast. The flat price forecast assumes price remain constant in real dollars.

4.2.12 Incremental Costs of Increasing Renewable Resources

(E) A discussion of the incremental costs of implementing more renewable energy resources than required to comply with renewable energy legal mandates;

Many of the alternative resource plans build renewable energy resources above what is required for Liberty-Empire to meet the Missouri RES standard. Liberty-Empire found that adding renewables to its portfolio provides significant cost savings for customers relative to meeting customer obligations with thermal resources. Additionally, as demonstrated by the results of the alternative resource plan analysis, plans that add utility-scale and distributed solar are lower-cost than plans that do not.

4.2.13 Incremental Costs of Increased DSM

(F) A discussion of the incremental costs of implementing more energy efficiency resources than required to comply with energy efficiency legal mandates;

No target for energy efficiency currently exists.

4.2.14 Incremental Costs of Implementing Excess Resources

(G) A discussion of the incremental costs of implementing more energy resources than required to comply with any other energy resource legal mandates; and

No other legal mandates currently exist.

4.2.15 IRP Analysis Software

(H) A description of the computer models used in the analysis of alternative resource plans.

Liberty-Empire used a combination of multiple modeling tools to analyze the alternative resource plans. These models included:

- CRA's integrated energy market models (including the Aurora market model and the Natural Gas Fundamentals model), which develop fuel and electric power price projections.
- CRA's suite of resource planning models (including the Aurora market model and CRA's PERFORM model), which perform hourly dispatch simulation, production cost analysis, and financial revenue requirement projections.

CRA Market Models

Liberty-Empire relied on the following models to develop inputs for natural gas, coal, and SPP power prices:

- CRA's Natural Gas Fundamentals ("NGF") model, which provides a bottom-up forecast of North American gas production and prices with a focus on shale gas supply and other unconventional resources. Key NGF outputs include a long-term price forecast for domestic natural gas, as well as breakeven costs and production data for major gas basins across the United States. NGF is a national model, useful for macroeconomic scenarios. CRA also licenses the GPCM model for regional basis analysis.
- The Aurora model, which CRA licenses, performs regional long-term capacity expansion analysis and produces hourly SPP market prices at a zonal level based on a fundamental dispatch of the market. Market inputs for the Aurora model include fuel prices, emission prices, regional load forecasts, existing resource parameters and announced regional capacity additions and retirements, and costs and operational parameters for new technology resource options.

Aurora is recognized in the industry for its flexibility and breadth of technical capability, incorporating extensive details in generating unit operating characteristics and constraints, transmission constraints, generation analysis, unit commitment/operating conditions, and market system operations. The Aurora model considers:

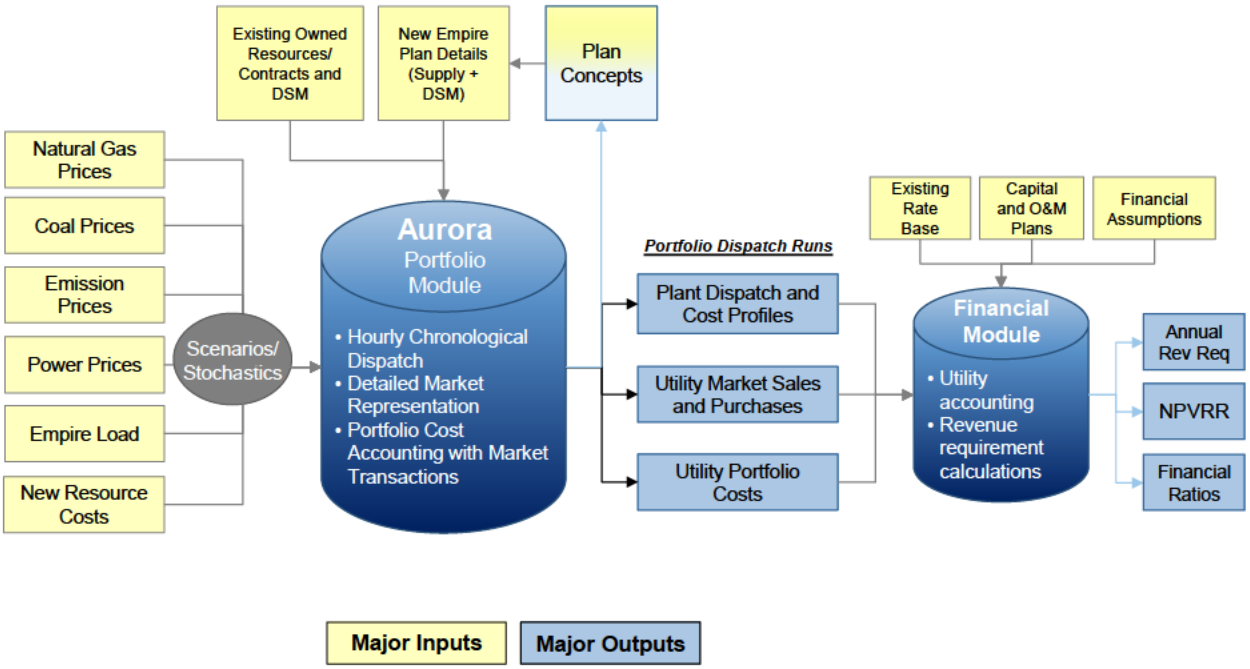
- Individual power plant characteristics, including heat rates, start-up costs, ramp rates, and other technical characteristics of plants;
- Transmission line interconnections, ratings, losses, and wheeling rates;
- Forecasts of resource additions and fuel costs over time;
- Forecasts of loads for each utility or load serving entity in the region; and
- The cost and availability of fuels that supply the plants.

The heart of Aurora is an hourly chronological dispatch algorithm that minimizes costs (or bids) while simultaneously adhering to a wide variety of operating constraints, including generating unit characteristics, transmission limits, and customer demand. Aurora performs an hourly commitment and dispatch recognizing these constraints to forecast hourly energy prices, unit generation, revenues and fuel consumption, and transmission flows.

CRA Resource Planning Models

CRA's resource planning models include a combination of licensed and proprietary tools that evaluate portfolio options and calculate unit-specific generation and cost profiles, market purchases and sales in the SPP market, Liberty-Empire portfolio costs, and revenue requirements. An overview of the modeling process is provided in Figure 6-53, with additional detail on each component provided below.

Figure 6-53 – CRA Resource Planning Model Overview



CRA's resource planning tools comprise:

- The Aurora portfolio tool, which performs portfolio optimization and portfolio cost accounting, and

- CRA's proprietary financial module ("PERFORM"), which performs utility accounting and revenue requirement calculations.

Aurora

The Aurora model was used in Liberty-Empire's IRP to develop and evaluate alternative resource plans. Aurora takes as inputs key assumptions and drivers of the resource portfolio decision. As shown in Figure 6-53, these inputs include fuel prices, emission prices, SPP power prices, Liberty-Empire's load growth forecasts, and costs for new resource parameters, as described in detail in Volume 040. The model also requires information regarding Liberty-Empire's existing portfolio resources and contracts, such as capacity, operational characteristics, and costs.

After defining all of these input assumptions, portfolio optimization analysis was conducted with the Aurora model's portfolio optimization tool to develop least-cost portfolio concepts under a variety of planning and resource acquisition strategy constraints. These constraints defined which resource options were available as well as the minimum and maximum reserve margin and block size for candidate resources. Both supply-side and demand-side resources were evaluated in the portfolio optimization framework. The portfolio optimization algorithm in Aurora seeks to minimize the present value of portfolio costs through selection of candidate resource options.

After the specific portfolio plans were constructed, each plan was evaluated through a full chronological dispatch analysis for the base case and all stochastic input combinations of Critical Uncertain Factors in Aurora's portfolio module. This exercise performs an hourly, chronological dispatch of Liberty-Empire's portfolio within the SPP power market, accounting for all variable costs of operation, all contracts or PPAs, and all economic purchases and sales with the surrounding market. Aurora produces projections of asset-level dispatch and the total variable costs associated with serving load. It also produces estimates for other key metrics, such as carbon dioxide emissions over time and capacity and generation by fuel type, as summarized earlier in this volume.

Financial Module / PERFORM

The Aurora output is used by CRA's proprietary financial module to build a full annual revenue requirement, inclusive of capital investments, fixed operating and maintenance costs, and financial accounting of depreciation, taxes, and utility return on investment. The model requires a series of inputs, including book and tax values for existing generation assets, depreciation schedules, fixed operations and maintenance costs and major maintenance capital expenditures, debt and equity costs, tax rates, and a discount rate. The model produces annual and present value estimates of revenue requirements. The full set of portfolio modeling is undertaken for all portfolio options for the base case and all stochastic input combinations.

Additional Models

Due to the importance of additional revenue streams associated with storage resources (see Volume 4 for a discussion on storage resource value), Liberty-Empire also used CRA's Energy Storage Operations ("ESOP") model to evaluate real-time energy and ancillary services value for flexible resources prior to inclusion in the portfolio optimization analysis. ESOP considers the operation of flexible assets at five-minute granularity. Based on exogenously-specified energy and ancillary services prices, the model optimizes the dispatch of resources to maximize revenue while taking into account detailed operational constraints such as efficiency, battery life cycle, maximum charge/discharge ratings, and storage capacity.

SECTION 5 UNCERTAIN FACTORS

(5) The utility shall describe and document its selection of the uncertain factors that are critical to the performance of the alternative resource plans. The utility shall consider at least the following uncertain factors:

Pursuant to 20 CSR 4240-22.060(5), Liberty-Empire developed a list of potential uncertain factors to use to evaluate the resilience to risk of the alternative plans, including but not limited to those prescribed by the IRP rule. Liberty-Empire compiled information concerning the uncertain factors listed in the rule from subject matter experts within the company and from its consultants. The subject matter experts and consultants developed wide but reasonable scenario ranges for each of the identified factors. Some of the uncertain factor scenarios were grouped together into a single uncertain factor for purposes of simplifying the analysis. Figure 6-54 lists the uncertain factors and factor groupings developed by Liberty-Empire.

Figure 6-54 – List of Uncertain Factors

Uncertain Factor	Scenarios	Group
Load	3	"Load"
Capital Cost Trajectories	3	"Cost of New Builds" (Capital Cost Interest Rate Interconnection Cost Tax Credits FOM CF)
Interest Rates	3	
Interconnection Costs	3	
Tax Credits	3	
FOM	3	
Renewable Capacity Factor	3	
Carbon Prices	3	"Carbon / Emission"
SO2, NOX Prices	3	
NG Prices	3	"NG Price"
Forced Outage Rates	3	"FOR"
Power / Capacity Prices	9 (based on market modeling)	"Power / A/S / ELCC" (Carbon / Emission & NG Price permutations)
Solar and Storage ELCC	9 (based on market modeling)	
A/S Value	9 (based on market modeling)	

To determine whether an uncertain factor was critical, Liberty-Empire tested the impact of changing one uncertain factor at a time on the PVRR rankings of a subset of thematically distinct replacement portfolios. If the PVRR rankings changed relative to the rankings under the Base Case (defined as the market scenario assuming the "base" scenario for all uncertain factors)

because of the impact of a given uncertain factor, then that uncertain factor was deemed "critical." An illustration of the uncertain factor scenarios that were tested for critical impact on PVRR rankings is shown in Figure 6-55. Note that the variables related to the power market outcomes (i.e., power prices, ELCC, and ancillary service value) are dependent on the underlying market carbon price and natural gas fuel price scenario and were tested within the scenarios for those factors.

Figure 6-55 – Uncertain Factor Testing Approach

Case	CO2, NOX, SO2	NG	Load	FOR	Capital	Interest Rate	IC	Tax Policy	FOM	Renew CF
0 – Base	**Base**	**Base**	**Base**	**Base**	**Base**	**Base**	**Base**	**Base**	**Base**	**Base**
1 – Low Emission Price	Low	Base	Base	Base	Base	Base	Base	Base	Base	Base
2 – High Emission Price	High	Base	Base	Base	Base	Base	Base	Base	Base	Base
3 – Low Gas Price	Base	Low	Base	Base	Base	Base	Base	Base	Base	Base
4 – High Gas Price	Base	High	Base	Base	Base	Base	Base	Base	Base	Base
5 – Low Load	Base	Base	Low	Base	Base	Base	Base	Base	Base	Base
6 – High Load	Base	Base	High	Base	Base	Base	Base	Base	Base	Base
7 – Low FOR	Base	Base	Base	Low	Base	Base	Base	Base	Base	Base
8 – High FOR	Base	Base	Base	High	Base	Base	Base	Base	Base	Base
9 – Low Cap Cost	Base	Base	Base	Base	Low	Base	Base	Base	Base	Base
10 – High Cap Cost	Base	Base	Base	Base	High	Base	Base	Base	Base	Base
11 – Low Interest Rate	Base	Base	Base	Base	Base	Low	Base	Base	Base	Base
12 – High Interest Rate	Base	Base	Base	Base	Base	High	Base	Base	Base	Base
13 – Low IC Cost	Base	Base	Base	Base	Base	Base	Low	Base	Base	Base
14 – High IC Cost	Base	Base	Base	Base	Base	Base	High	Base	Base	Base
15 – Low Tax Credit	Base	Base	Base	Base	Base	Base	Base	Low	Base	Base
16 – High Tax Credit	Base	Base	Base	Base	Base	Base	Base	High	Base	Base
17 – Low FOM	Base	Base	Base	Base	Base	Base	Base	Base	Low	Base
18 – High FOM	Base	Base	Base	Base	Base	Base	Base	Base	High	Base
19 – Low Renew CF	Base	Base	Base	Base	Base	Base	Base	Base	Base	Low
20 – High Renew CF	Base	Base	Base	Base	Base	Base	Base	Base	Base	High

Based on the analysis described above, Table 6-68 summarizes the uncertain factors that were individually tested and deemed critical, as well as the final groupings used in the risk analysis described in Section 6.

Table 6-68 – Uncertain Factor Evaluation Results

Uncertain Factor	Include in CUF Analysis?	Final CUF Grouping
Load	Yes	"Load"
Capital Cost Trajectories	Yes	"Cost of New Builds"
Interest Rates	Yes	
Interconnection Costs	Yes	
Tax Credits	Yes	
FOM	No	
Renewable Capacity Factor	Yes	
Carbon Prices	Yes	"Emissions"
SO2, NOX Prices		
NG Prices	Yes	"NG Price"
Forced Outage Rates	No	"FOR"
Power / Capacity Prices	Yes	"Power / A/S / ELCC" (dependent on Emissions and NG Prices)
Solar and Storage ELCC		
A/S Value		

5.1 Load Growth

(A) The range of future load growth represented by the low-case and high-case load forecasts;

As specified at 20 CSR 4240-22.030(7) and 20 CSR 4240-22.030(8), the development of the base, high, and low load growth scenarios is described in more detail in Volume 3. While load did *not* change the PVRR rankings of the portfolios, load growth was included as a critical uncertain factor because it could significantly change the portfolio requirements over time and the total expected costs of different portfolios.

5.2 Interest Rate Levels

(B) Future interest rate levels and other credit market conditions that can affect the utility's cost of capital and access to capital;

Future interest rate scenarios were based on an analysis of historical 10-year treasury rates. When interest rates were tested in the modeling, the high interest rate scenario was found to change plan ranking. Thus, interest rates were deemed to be a critical uncertain factor and were included in the risk analysis.

5.3 Legal Mandates

(C) Future changes in legal mandates;

Potential changes to legal mandates were modeled as various carbon regulation scenarios. Additional detail on the carbon regulation scenarios can be found in Volume 4 Section 5.4.1. Carbon regulation was found to change PVRR rankings and was deemed a critical uncertain factor and included in the risk analysis. Liberty-Empire does not believe that any changes in RPS or any other foreseeable legal mandates would affect the alternative resource plans modeled.

5.4 Fuel Prices

(D) Relative real fuel prices;

Additional detail on the natural gas price scenarios can be found in Volume 4 Section 5.1. Natural gas prices were found to change PVRR rankings and were deemed a critical uncertain factor.

5.5 Siting and Permitting Costs

(E) Siting and permitting costs and schedules for new generation and generation-related transmission facilities for the utility, for a regional transmission organization, and/or other transmission systems;

Siting and permitting costs were incorporated into the high, base, and low capital cost / cost of new build scenarios. Capital costs were found to change PVRR rankings and were deemed a critical uncertain factor.

5.6 Construction Costs

(F) Construction costs and schedules for new generation and generation-related transmission facilities for the utility, for a regional transmission organization, and/or other transmission systems;

Construction costs were incorporated into the high, base, and low capital cost / cost of new build scenarios. Capital costs were found to change PVRR rankings and were deemed a critical uncertain factor.

5.7 Purchased Power Availability

(G) Purchased power availability, terms, cost, optionality, and other benefits;

Because Liberty-Empire is a member of SPP, the availability of purchased power was not considered a risk. However, the *cost* of purchased power was modeled in the development of nine potential power market outcomes that represented permutations of the three carbon regulation scenarios (high, base and low) and the three natural gas price scenarios (high, base and low).

5.8 Emission Allowance Prices

(H) Price of emission allowances, including at a minimum sulfur dioxide, carbon dioxide, and nitrogen oxides;

Additional detail on the emission price scenarios can be found in Volume 4 Section 5.4. Emission prices were found to change PVRR rankings and were found to be a critical uncertain factor and were included in the risk analysis.

5.9 Fixed O&M

Fixed operation and maintenance costs for new and existing generation facilities;

Fixed O&M scenarios did not change PVRR rankings and were excluded from the risk analysis.

5.10 Forced Outage

(J) Equivalent or full- and partial-forced outage rates for new and existing generation facilities;

Forced outage rate scenarios did not change PVRR rankings and were excluded from the risk analysis.

5.11 Future Load Impacts of DSM

(K) Future load impacts of demand-side programs and demand-side rates;

Uncertainty around DSM costs and potential is captured through the analysis for RAP and MAP portfolios during the portfolio optimization process.

5.12 Future Costs for DSM

(L) Utility marketing and delivery costs for demand-side programs and demand-side rates; and

Uncertainty around DSM costs and potential is captured through the analysis for RAP and MAP portfolios during the portfolio optimization process.

5.13 Other Uncertain Factors

(M) Any other uncertain factors that the utility determines may be critical to the performance of alternative resource plans.

In addition to the uncertain factors described previously in this section, Liberty-Empire also included interconnection costs, federal tax credit policy, and variables associated with the nine modeled power market outcomes (representing permutations of the three carbon regulation scenarios (high, base and low) and the three natural gas price scenarios (high, base and low)) as uncertain factors. All three factors or groupings of factors were found to change PVRR rankings and were deemed to be critical.

SECTION 6 CRITICAL UNCERTAIN FACTORS ASSESSMENT

(6) The utility shall describe and document its assessment of the impacts and interrelationships of critical uncertain factors on the expected performance of each of the alternative resource plans developed pursuant to 4 CSR 240-22.060(3) and analyze the risks associated with alternative resource plans. This assessment shall explicitly describe and document the probabilities that utility decision-makers assign to each critical uncertain factor.

As described in Section 5, the uncertain factors determined to impact the expected performance of the alternative resource plans included: load growth, carbon prices, gas prices, and a grouping of factors related to the cost of new builds. These uncertain factors were found to have the greatest potential influence on the selection of the preferred plan and were deemed to be the critical uncertain factors.

Each critical uncertain factor was evaluated for its impact on the PVRR of each alternative plan, illustrated by "tornado diagrams."[7] Tornado diagrams provide an effective means to depict the influence of these driving factors on the PVRR, thereby providing insight into where a risk aversion strategy should be focused. The major driver of PVRR uncertainty for all plans is capital cost uncertainty, followed by environmental cost uncertainty. The following figures illustrate the cumulative probability of the influence of critical uncertain factors on each of the alternative resource plans in terms of 20-year PVRR values.

[7] Tornado diagrams are useful for deterministic sensitivity analysis, comparing the relative importance of uncertain variables. Each variable considered is estimated for what the low, base, and high outcomes would be. The sensitivity variable is modeled as an uncertain value while all other variables are held at baseline values.

Figure 6-56 – Plan 1 Tornado Diagram ($ millions)

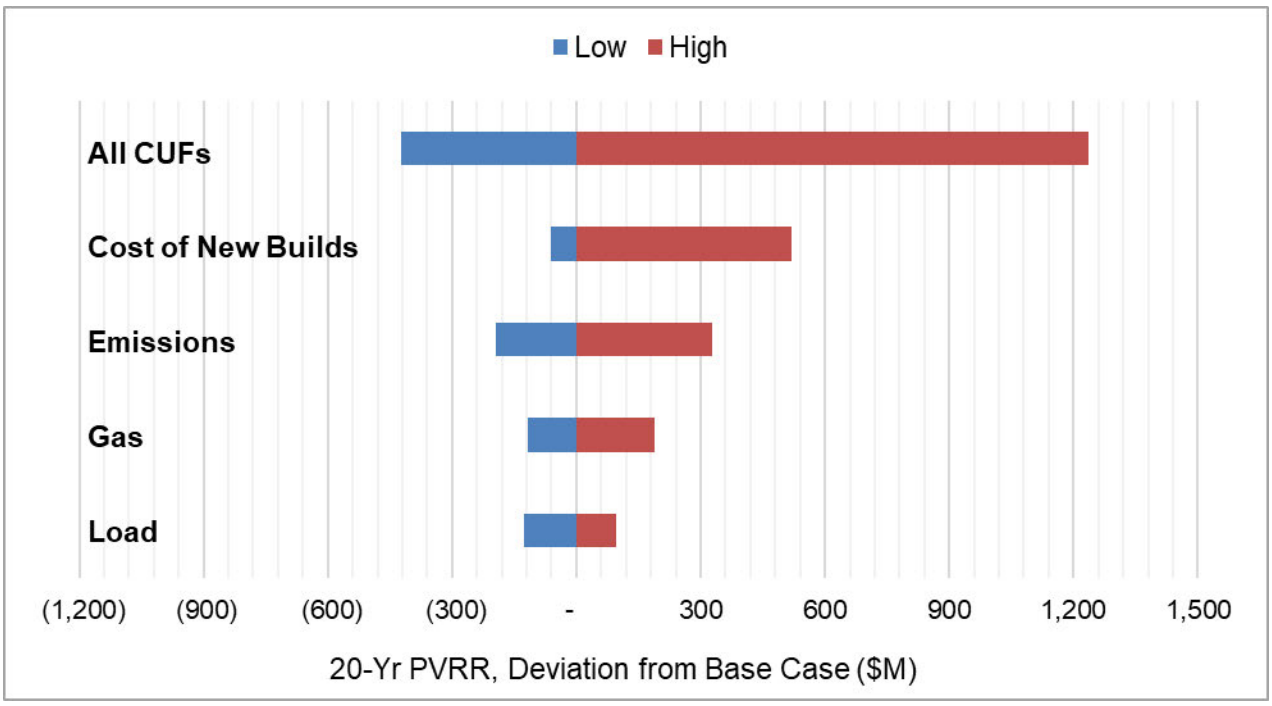


Figure 6-57 - Plan 2 Tornado Diagram ($ millions)

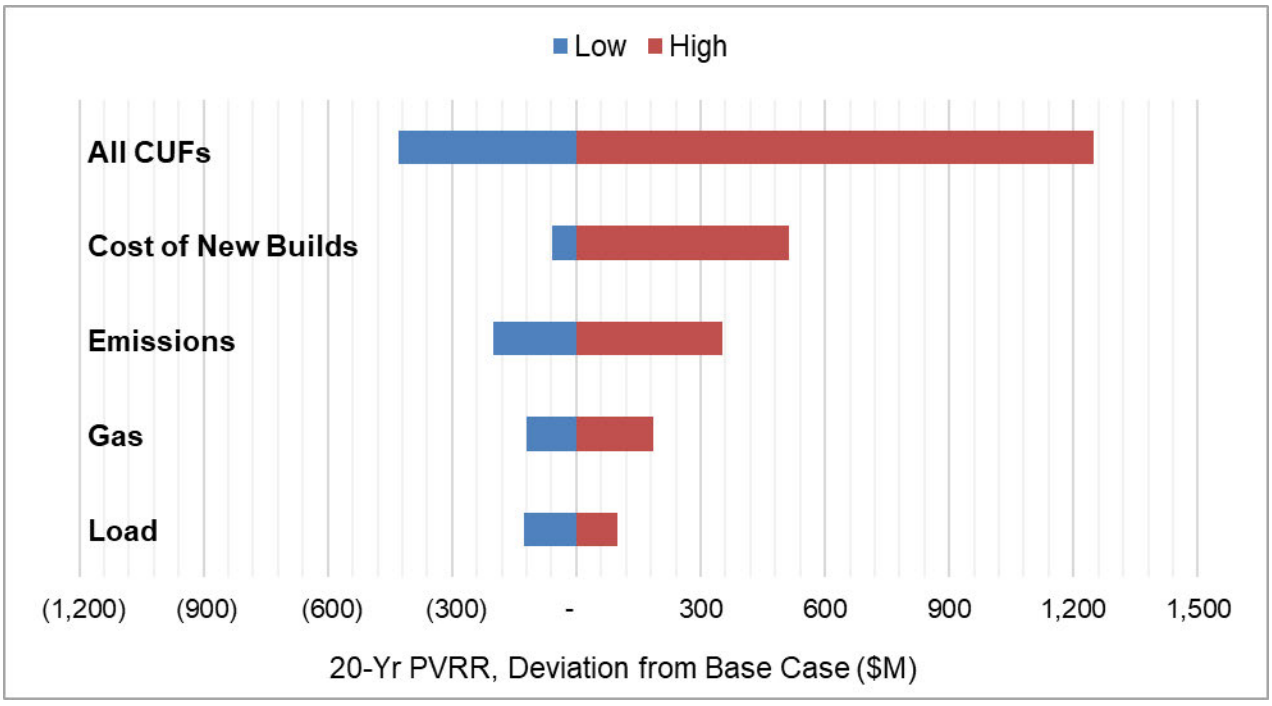


Figure 6-58 - Plan 3 Tornado Diagram ($ millions)

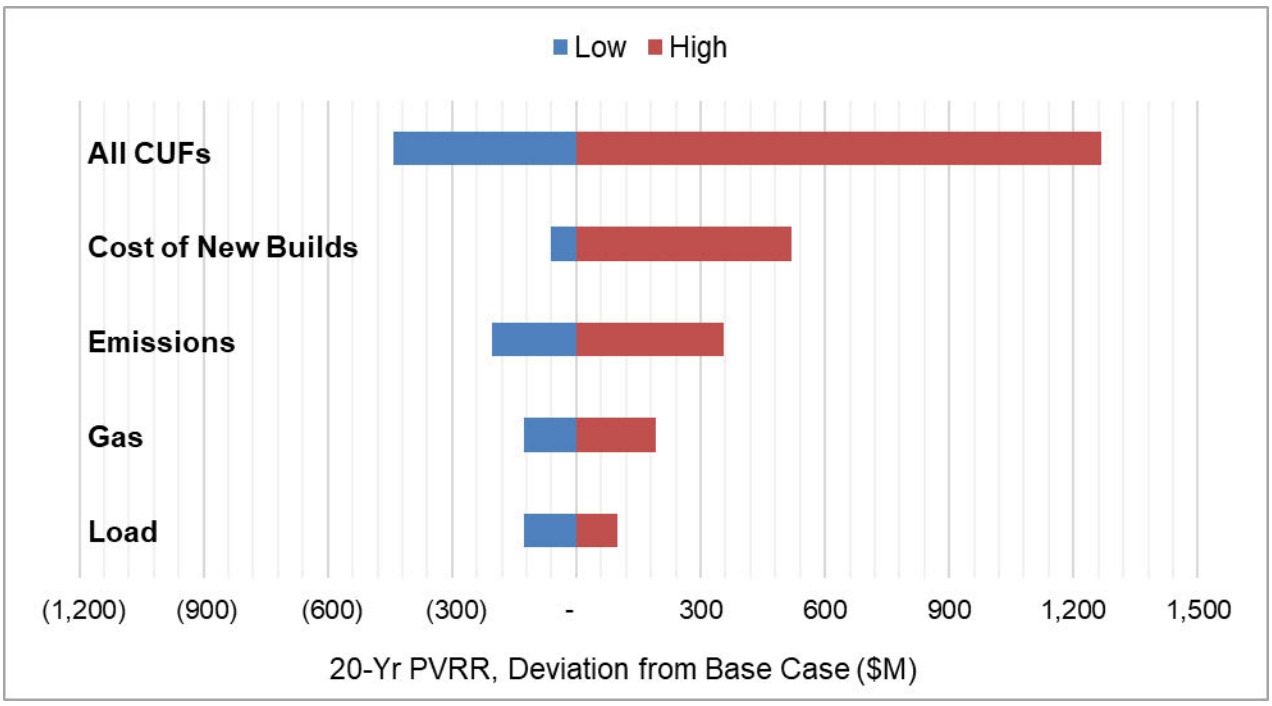


Figure 6-59 - Plan 4 Tornado Diagram ($ millions)

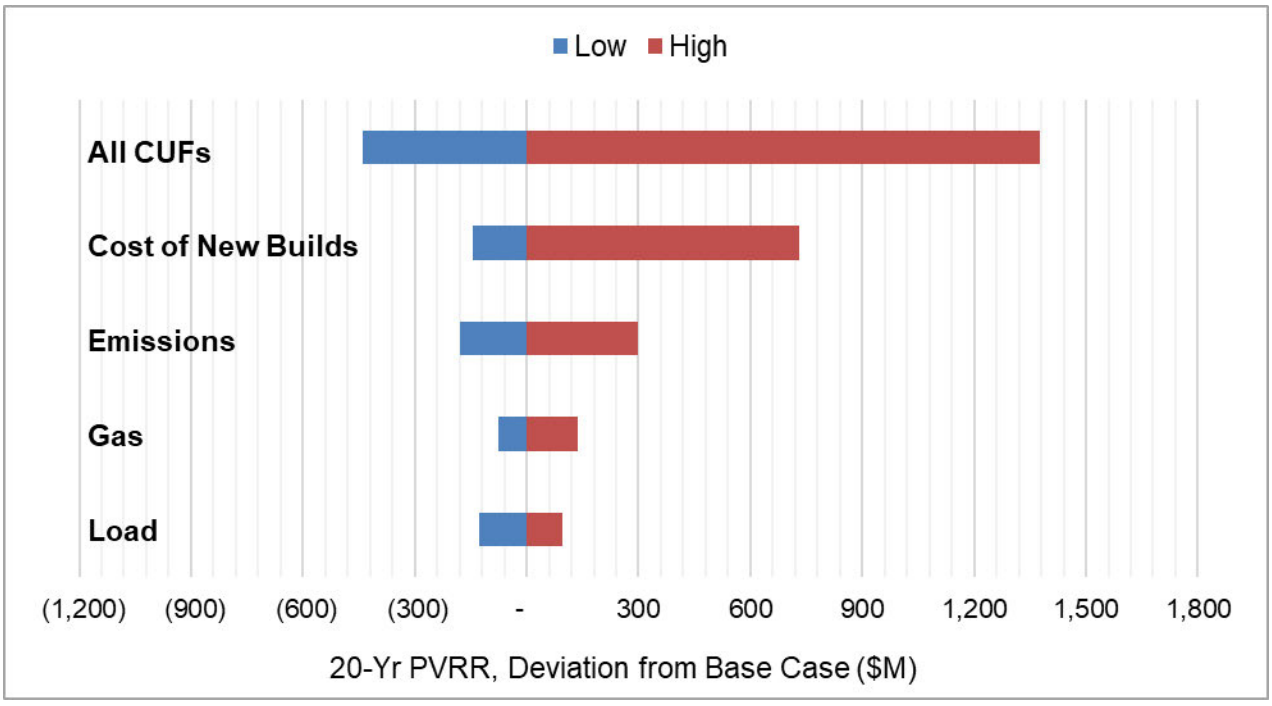


Figure 6-60 - Plan 5 Tornado Diagram ($ millions)

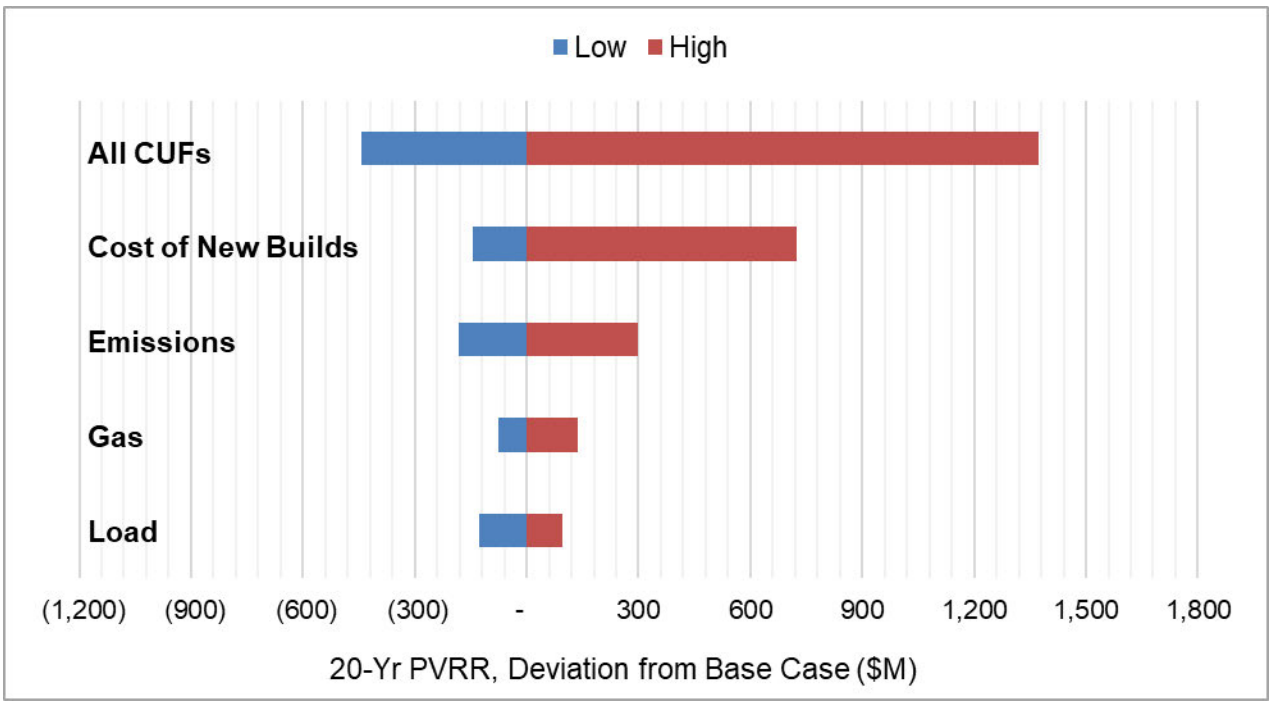


Figure 6-61 - Plan 6 Tornado Diagram ($ millions)

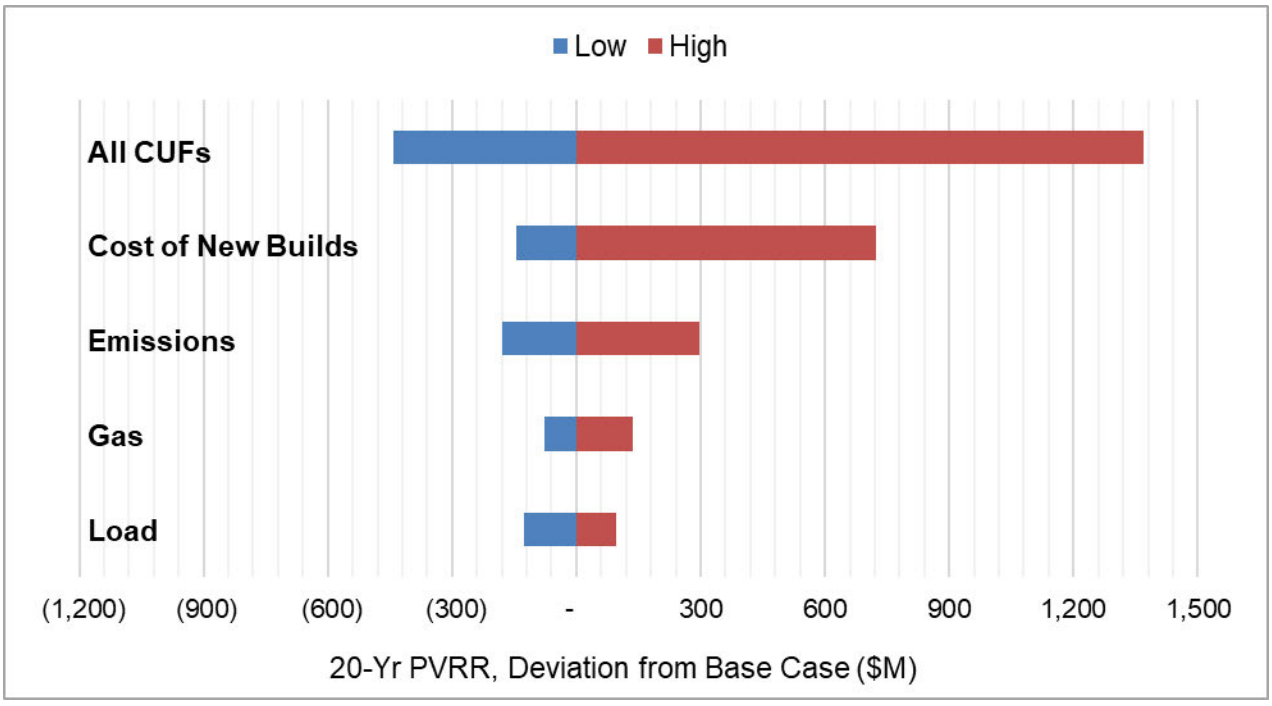


Figure 6-62 - Plan 7 Tornado Diagram ($ millions)

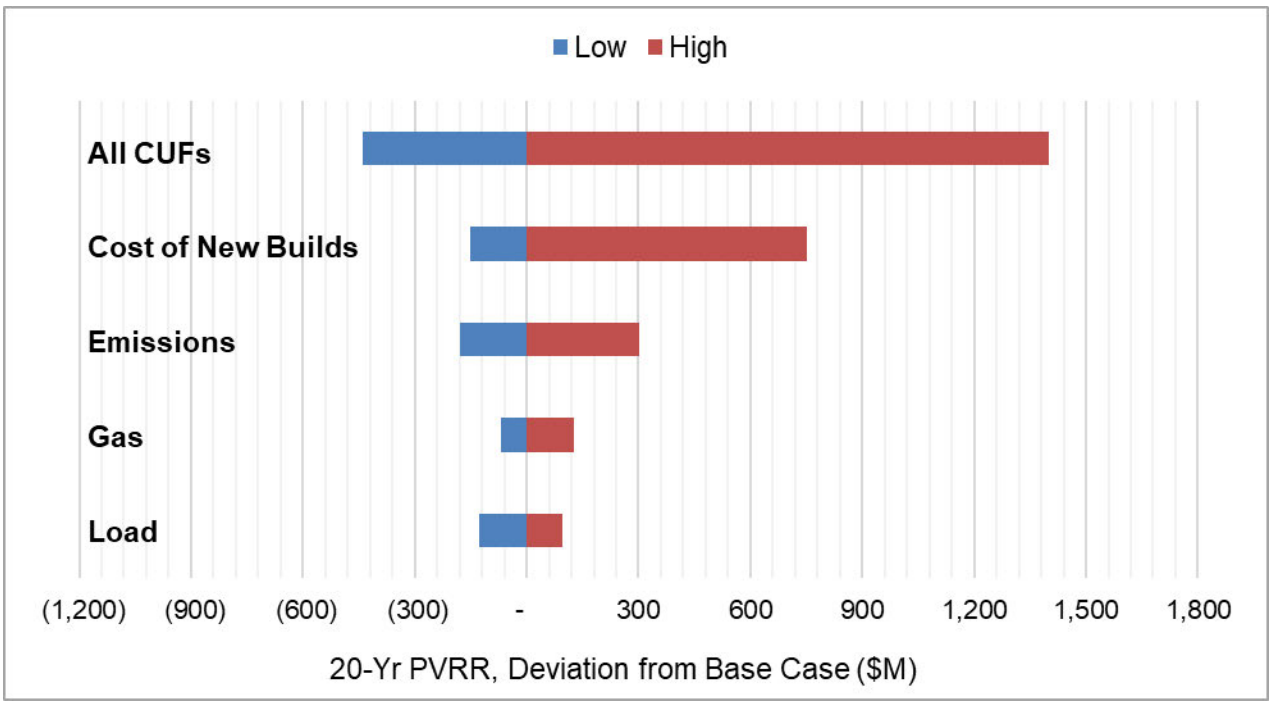


Figure 6-63 - Plan 8 Tornado Diagram ($ millions)

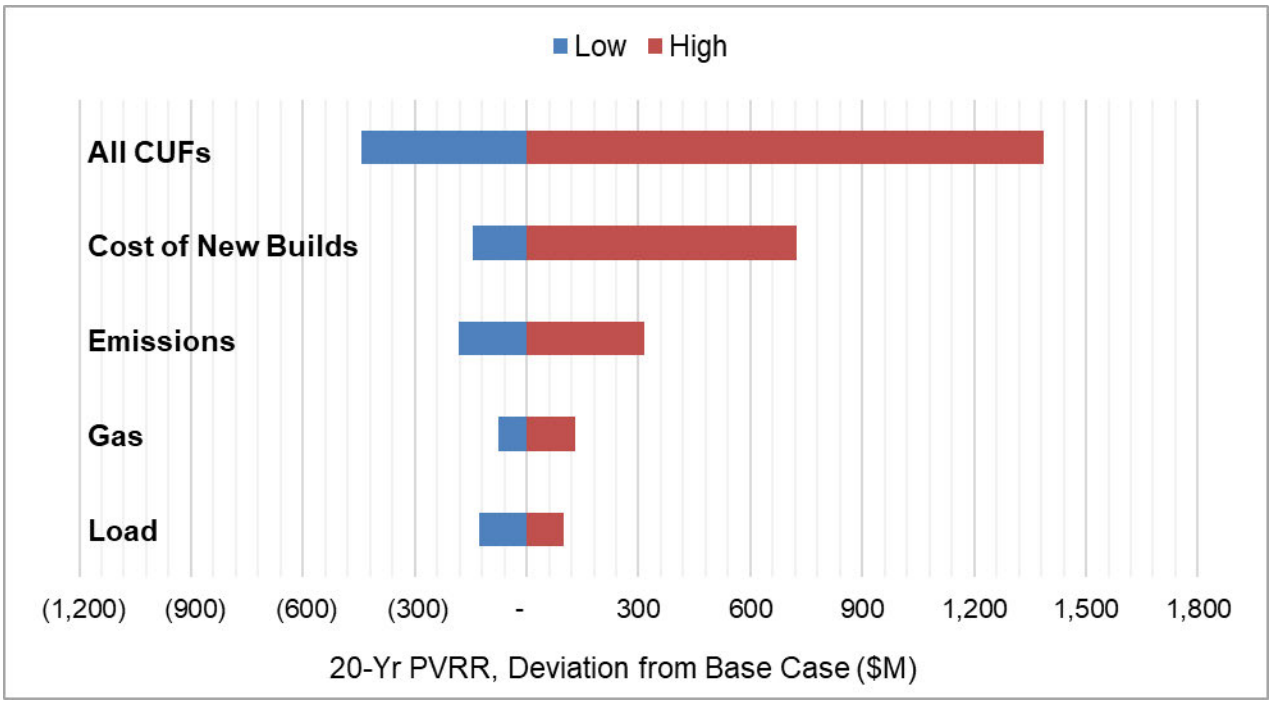


Figure 6-64 - Plan 9 Tornado Diagram ($ millions)

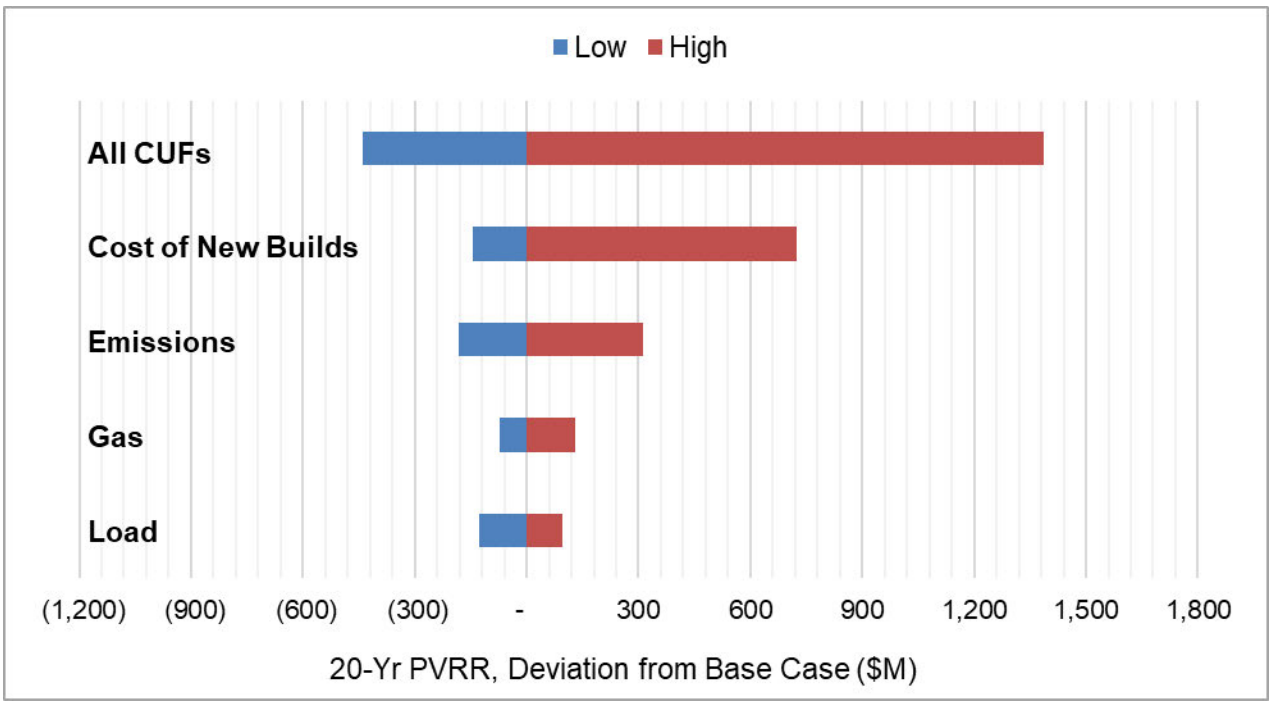


Figure 6-65 - Plan 10 Tornado Diagram ($ millions)

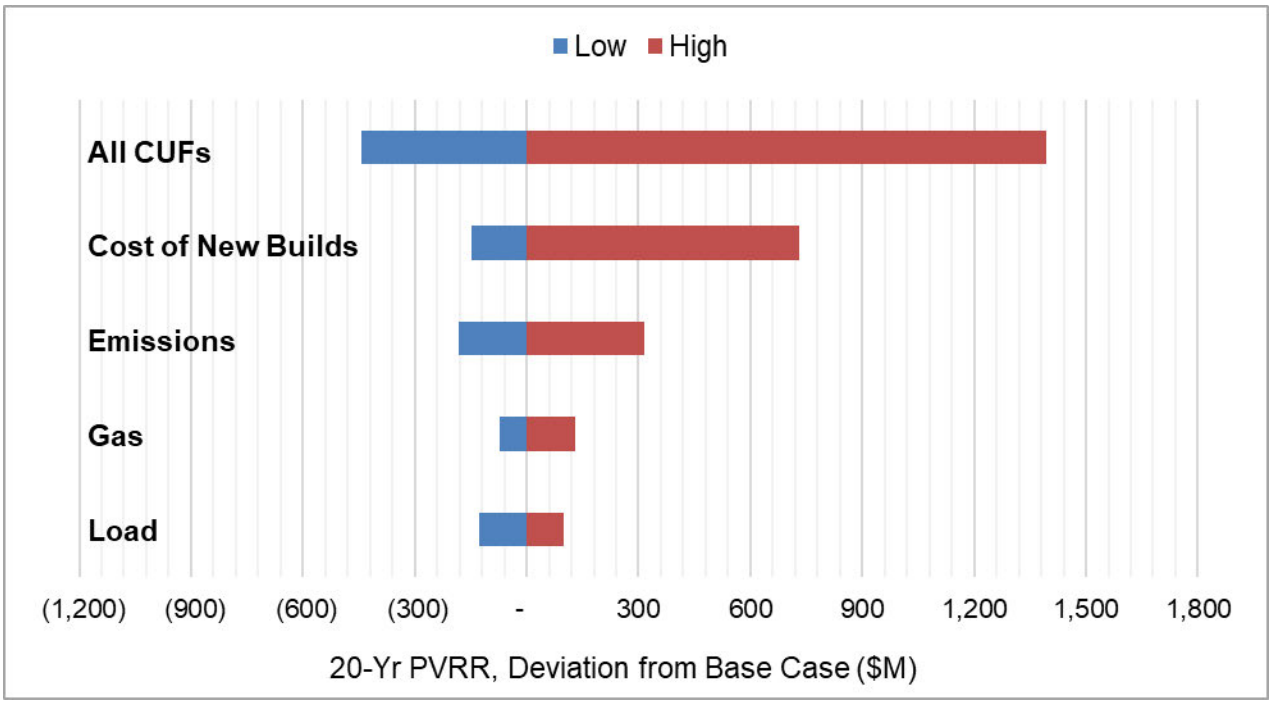


Figure 6-66 - Plan 11 Tornado Diagram ($ millions)

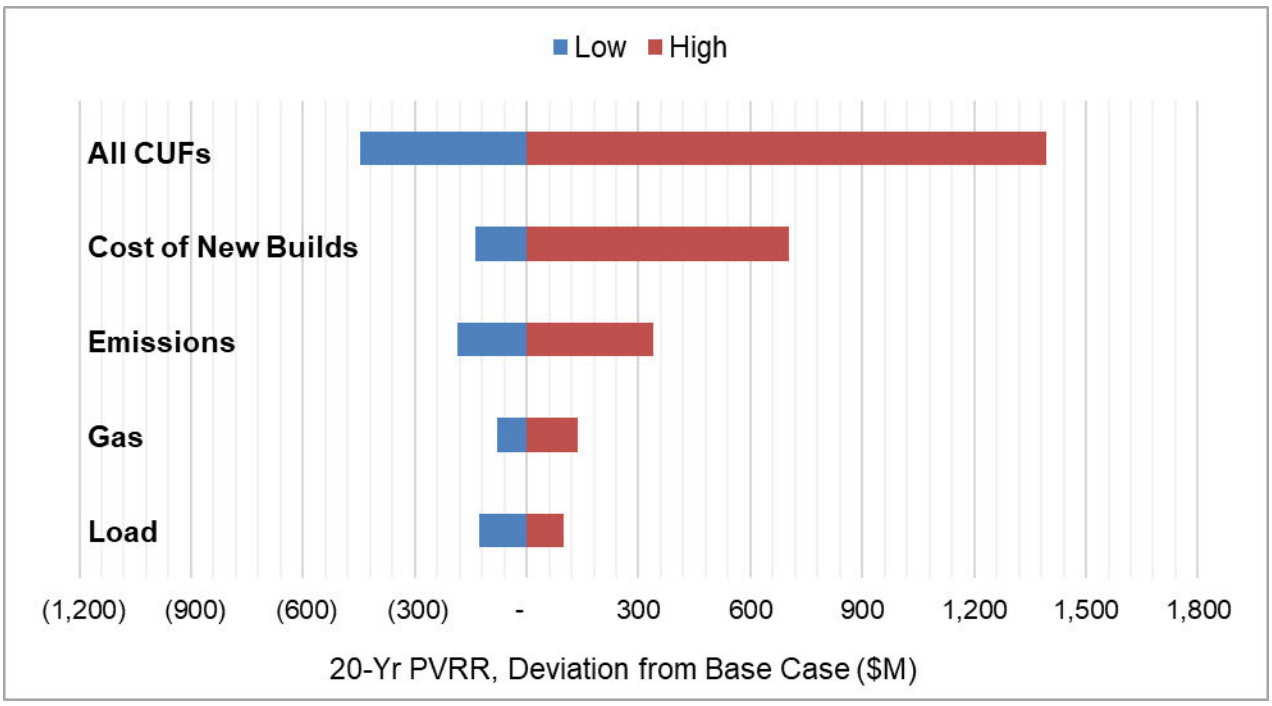


Figure 6-67 - Plan 12 Tornado Diagram ($ millions)

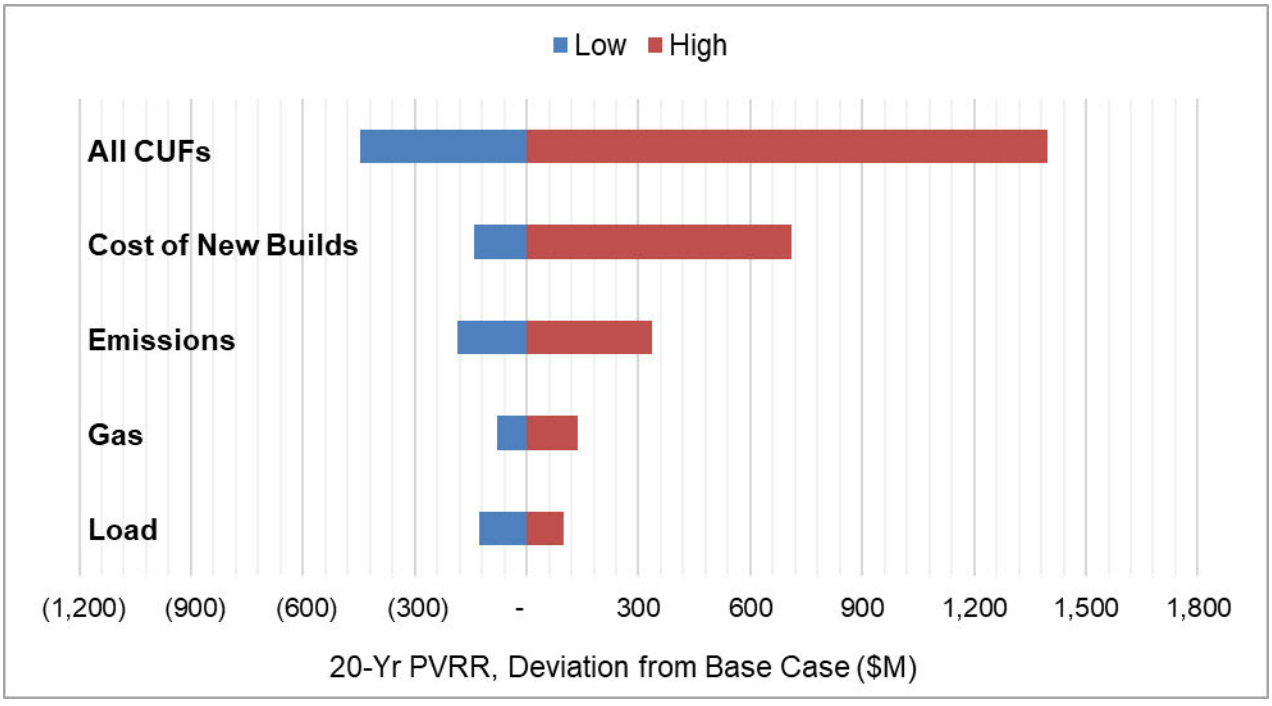


Figure 6-68 - Plan 13 Tornado Diagram ($ millions)

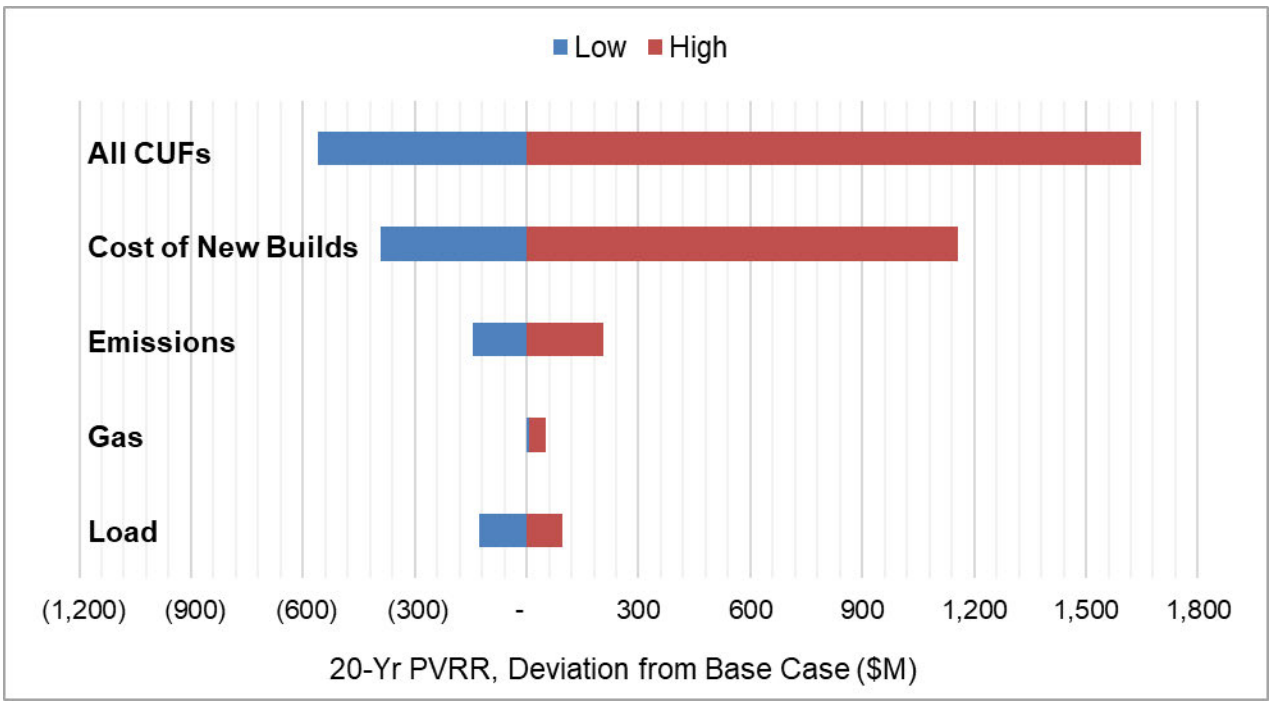


Figure 6-69 - Plan 14 Tornado Diagram ($ millions)

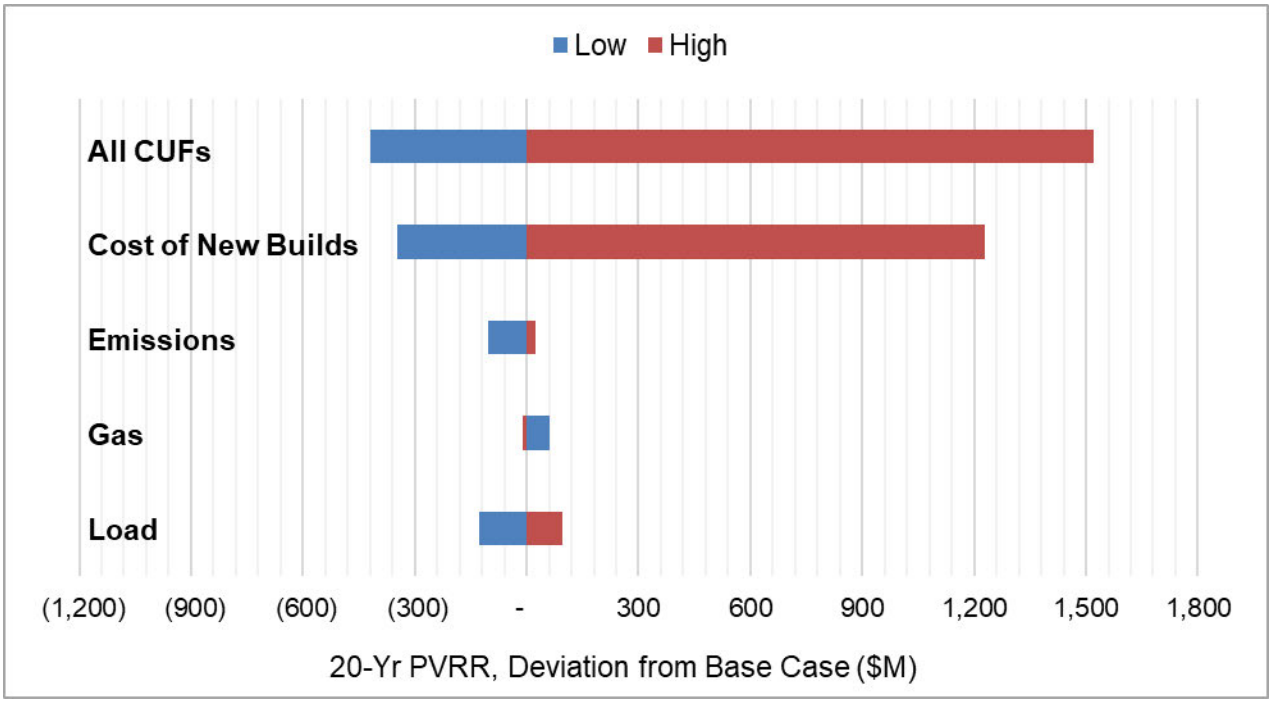


Figure 6-70 - Plan 15 Tornado Diagram ($ millions)

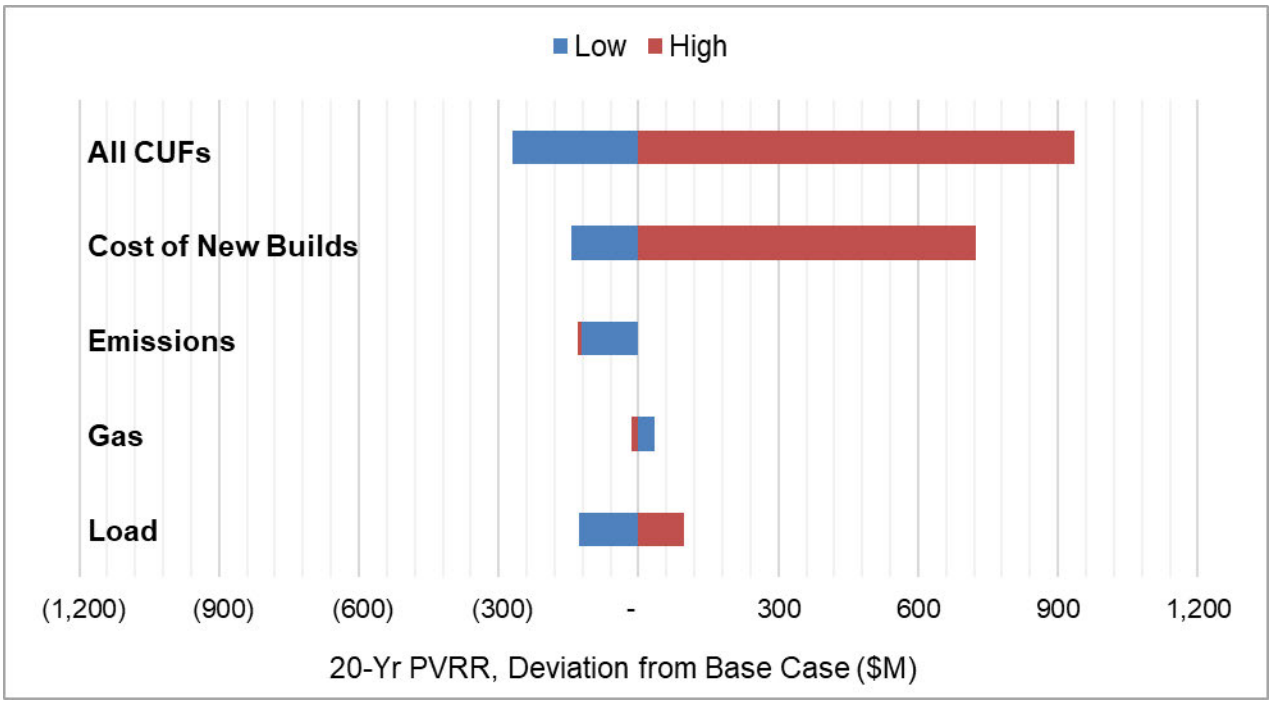


Figure 6-71 provides the expected value PVRR for each plan, incremental to the calculated Base Case PVRR, to provide an illustration of the total risk associated with each plan. The calculated PVRR is represented by the solid-filled bottom bars, while the risk values are represented by the grey-patterned bars above the PVRR bars.

Figure 6-71 - PVRR with Risk Value for Alternative Resource Plans – 20 Year NPV ($ millions)

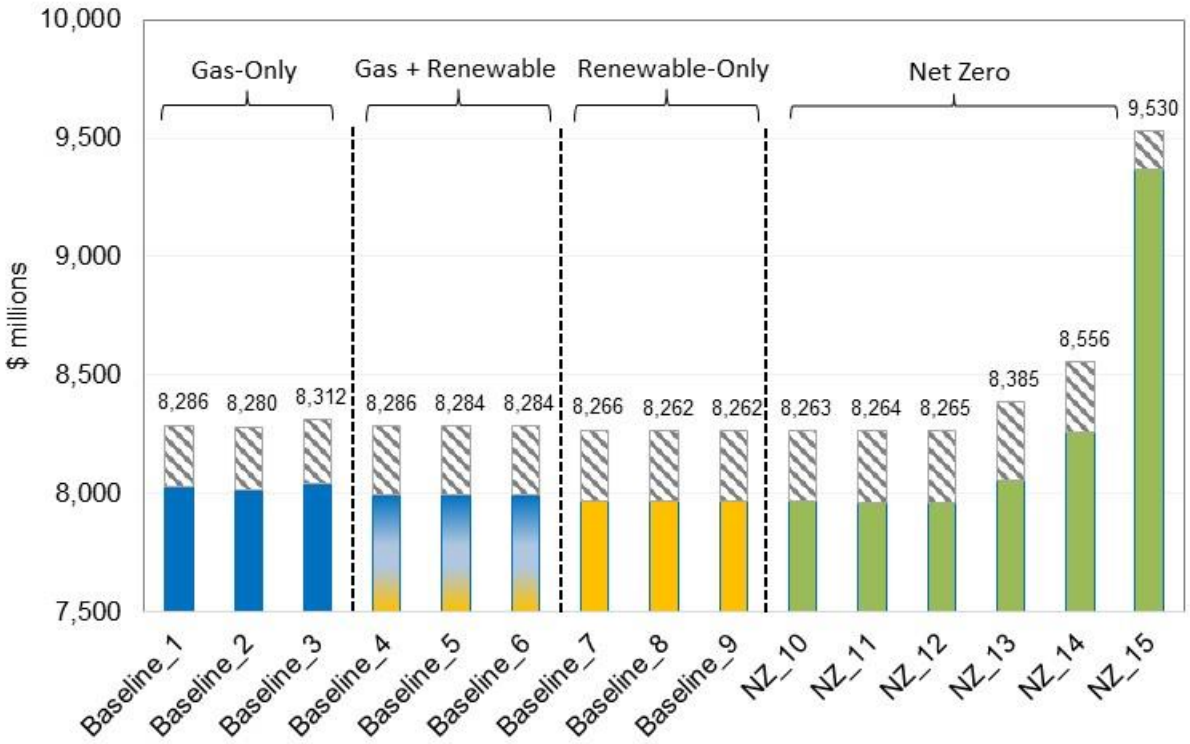
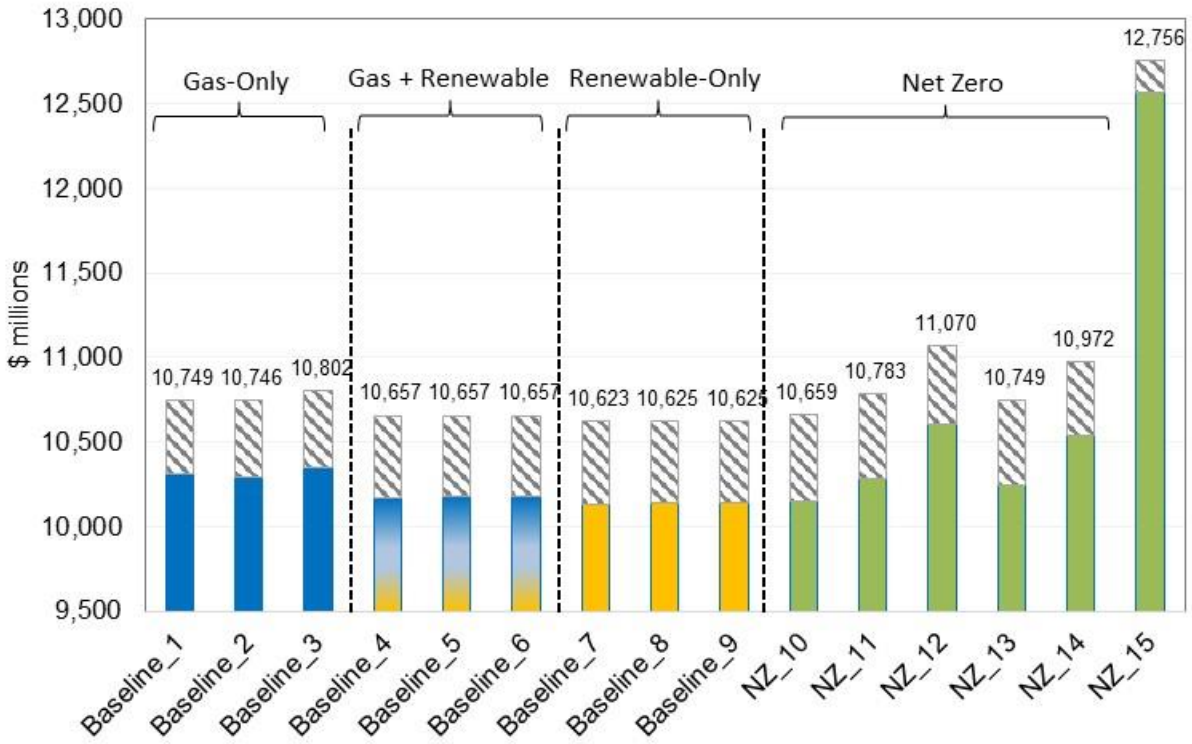


Figure 6-72 - PVRR with Risk Value for Alternative Resource Plans – 30 Year NPV ($ millions)

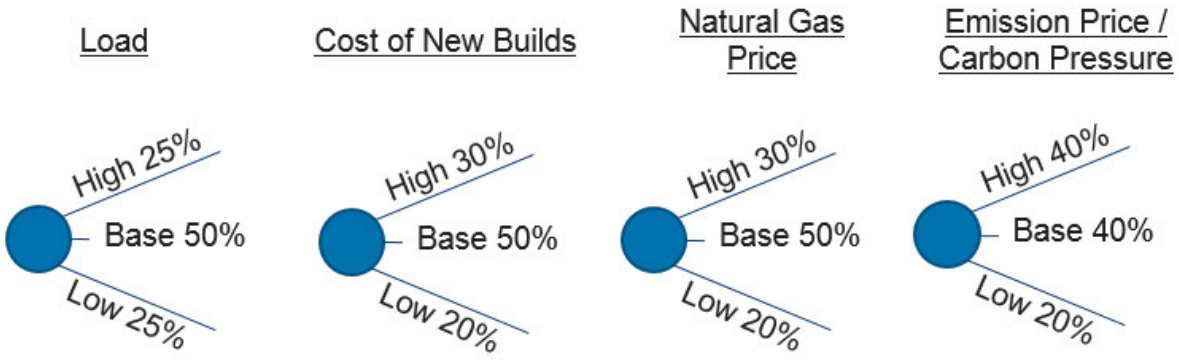


SECTION 7 CRITICAL UNCERTAIN FACTOR PROBABILITIES

(7) The utility decision-makers shall assign a probability pursuant to section (5) of this rule to each uncertain factor deemed critical by the utility. The utility shall compute the cumulative probability distribution of the values of each performance measure specified pursuant to 4 CSR 240-22.060(2). Both the expected performance and the risks of each alternative resource plan shall be quantified. The utility shall describe and document its risk assessment of each alternative resource plan.

Given the 15 alternative plans and 4 critical uncertain factors, Liberty-Empire evaluated the risk resilience of each portfolio by assessing the "expected value" or weighted average of each portfolio's PVRR across all critical uncertain factor scenarios, with each scenario being weighted according to the subjective probabilities assigned by the utility decision-makers. The subjective probabilities for the critical uncertain factors used to assess the alternative resource plans are provided in Figure 6-73.

Figure 6-73 - Uncertainty Tree



The subjective probabilities were assigned by the utility decision-makers after review and discussion of the various critical uncertain factor scenario trajectories. The three potential endpoints for four critical uncertain factors resulted in 81 endpoints per plan, probability-weighted depending on the subjective probabilities of the scenario components. Additional discussion of the rationale behind these weightings can be found in Section 7.2.

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

The expected value performance of each resource plan is provided in Table 6-69.

Table 6-69 - Expected Values of Alternative Plan Performance Measures

****Confidential in its Entirety****

[redacted]

(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.

Table 6-70 presents the standard deviation of performance measures between iterations for each of the alternative resource plans. Certain performance measures are not influenced by risk and therefore have zero standard deviation values.

Table 6-70 - Standard Deviation of Alternative Plan Performance Measures

****Confidential in its Entirety****

(C) The utility shall provide—

1. A discussion of the method the utility used to determine the cumulative probability—

Liberty-Empire considered each of the critical uncertain factors to act independently. The uncertainty tree approach determined the cumulative probability of the uncertainties considered for each plan and resulted in a total of 81 combinations or endpoints for each plan.

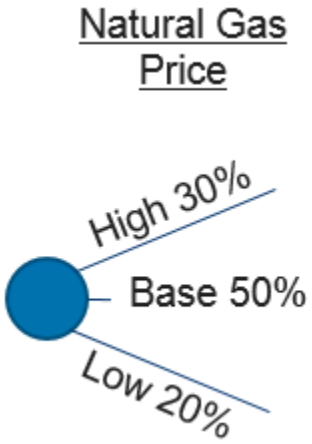
7.1 Development of Uncertain Factors

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 probabilities for each outcome were derived; and

Identification of uncertain factors and of the factors that were considered critical were described in Section 5. Natural gas prices, carbon prices, and capital costs were found to materially change the PVRR rankings of various portfolios. Load was added as a critical uncertain factor as it affects the potential build-out of any alternative resource plan.

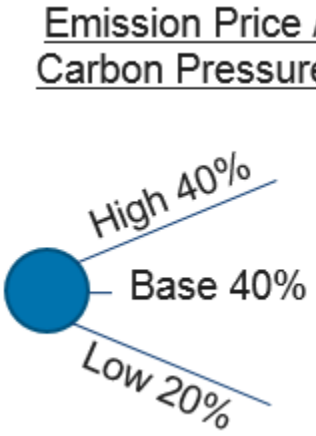
Liberty-Empire identified a range of uncertainty for each uncertain factor. Additional detail on the natural gas price scenarios can be found in Volume 4 Section 5.1. Figure 6-74 illustrates the subjective probabilities assigned to the natural gas price uncertainty factor. The high natural gas price case was weighted slightly higher than the low natural gas price case. This is because natural gas prices could be driven toward the high side due to any number of factors, including lower investment in natural gas infrastructure due to an increased focus on decarbonization, restrictions on resource or drilling or other supply-side shocks, or environmental regulations on producers. Low natural gas prices would require both lax regulation and abundant supply.

Figure 6-74 – Natural Gas Price Subjective Probabilities



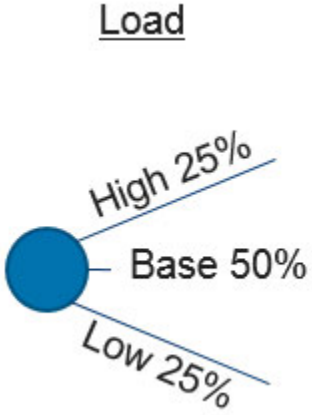
Additional detail on the carbon regulation scenarios can be found in Volume 4 Section 5.4.1. Given recently attempted federal action, existing activity in certain states and localities, and generally growing political attention to the issue, the Base Case includes carbon regulation beginning in 2026 that aims towards significant expansion of zero carbon emitting generation resources. The High case is based on carbon regulation that would drive net zero emissions from the power sector by 2040. The Base and High carbon pressure scenarios were equally weighted. The low scenario, where federal carbon pressure does not materialize or where regulation is done without a carbon price, includes a zero price on carbon emissions and was weighted at 20%.

Figure 6-75 - Environmental Cost Subjective Probabilities



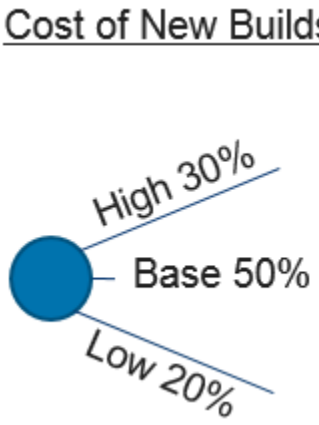
Load forecast uncertainties were discussed in Section 8 of Volume 3. Figure 6-76 illustrates the subjective probabilities assigned to the load scenarios. The high and low scenarios were created in direct compliance with the Commission's rule to create two additional normal weather load forecasts. These two forecasts are created by adjusting the economic inputs in the forecast model capturing economic uncertainty. Long-term load growth is highly uncertain, and can be driven by a variety of factors, including macroeconomic trends, distributed solar installations, and electric vehicle penetration. Given wide uncertainty around other factors influencing load growth, which are fairly evenly distributed to the upside and downside, an equal weighting of 25% was assigned to the high and low cases.

Figure 6-76 – Load Subjective Probabilities



Finally, critical uncertain factors related to the cost of new builds, including capital cost, generator interconnection cost, interest rates, federal tax credit provisions, and renewable capacity factors were developed for the high and low probabilities. Liberty-Empire's base case projections represent Liberty-Empire's view of the most reasonable cost outlooks for supply-side resource options. The lower band includes lower starting values for capital costs for all technologies, quicker declines in costs over time for technologies like solar and storage, lower interconnection costs, and long-term extensions to federal tax credits. The higher costs include higher capital costs for resources, higher interconnection costs, current tax credit law without future extensions, and higher interest rates. All capital cost inputs were based on the market scan approach described in Volume 4 and were reviewed by a third-party engineering firm, Black and Veatch. Figure 6-77 illustrates this portion of the uncertainty tree.

Figure 6-77 – Cost of New Builds Subjective Probabilities



7.2 Analysis of Uncertain Factors

B. Analyses supporting the utility's choice of ranges and probabilities for the uncertain factors;

The support underlying Liberty-Empire's ranges and probabilities for uncertain factors is provided in Sections 5, 6, and 7.

2. Plots of the cumulative probability distribution of each distinct performance measure for each alternative resource plan;

The following figures plot the cumulative probability distribution of each distinct performance measure for each alternative resource plan. These plots are sometimes referred to as risk profiles.

Figure 6-78 - Cumulative Probability of PVRR (20-Year) ($ millions)

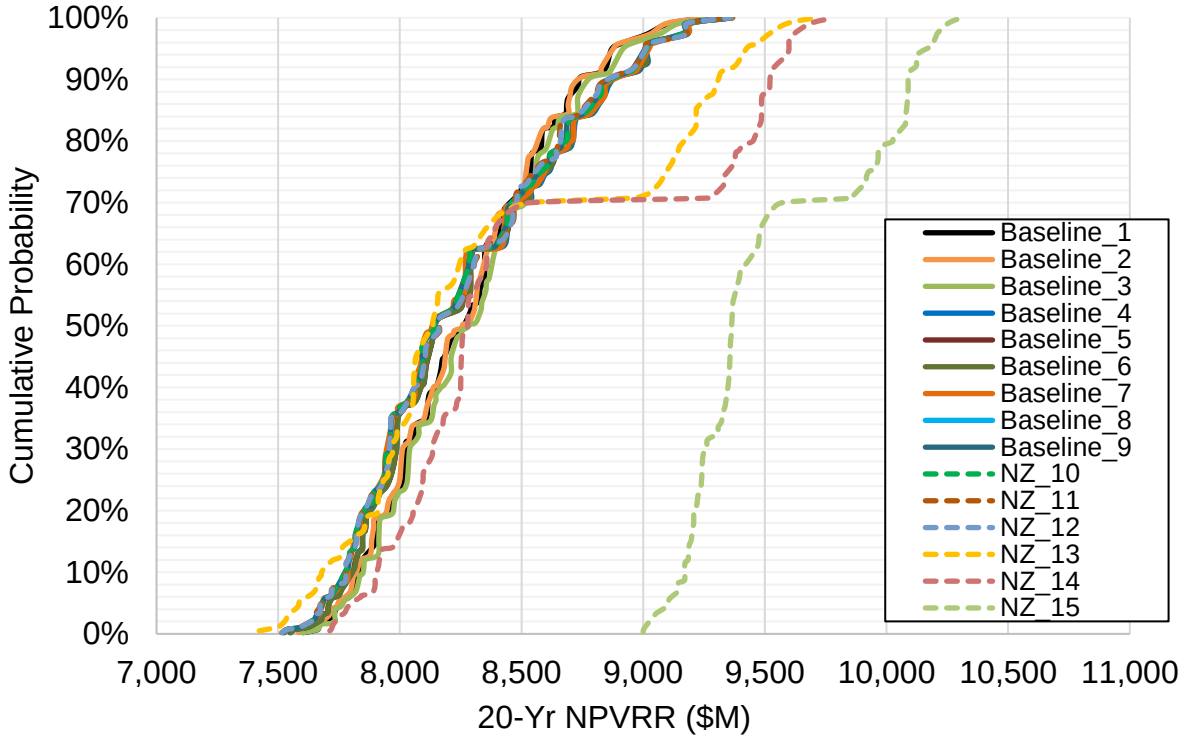


Figure 6-79 - Cumulative Probability of Probable Environmental Costs (NPV $ millions)

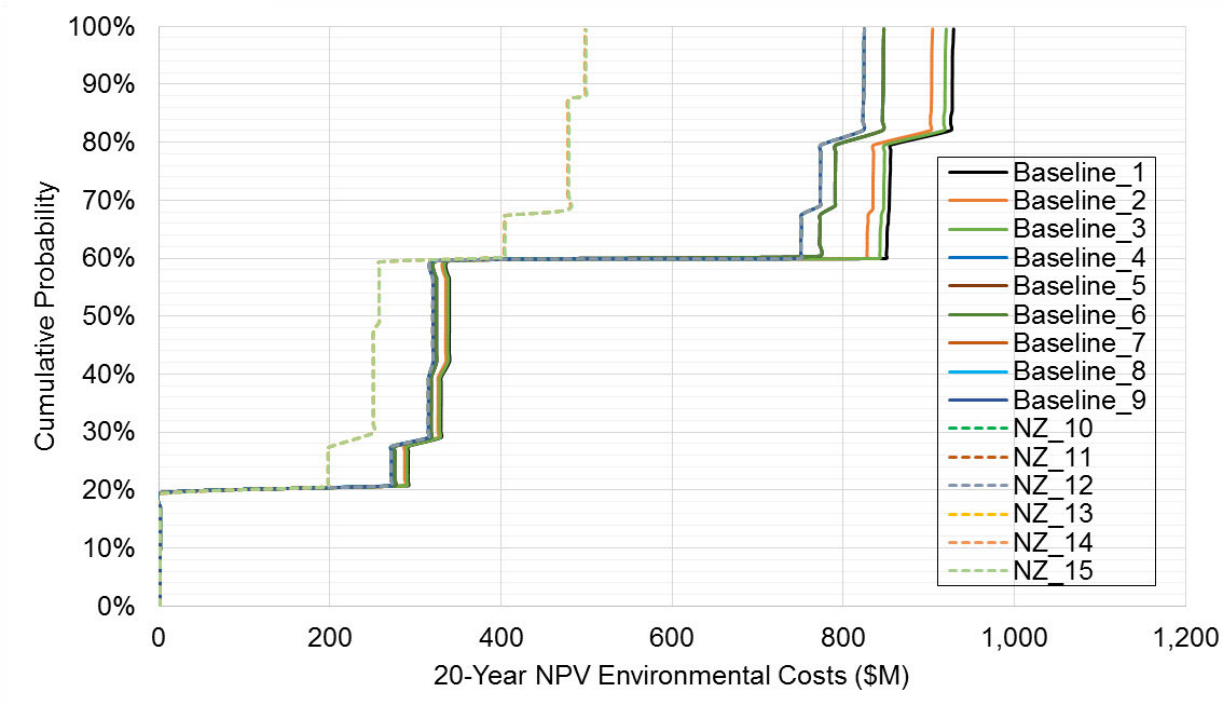


Figure 6-80 - Cumulative Probability of Levelized Average Rates (cents/kWh)

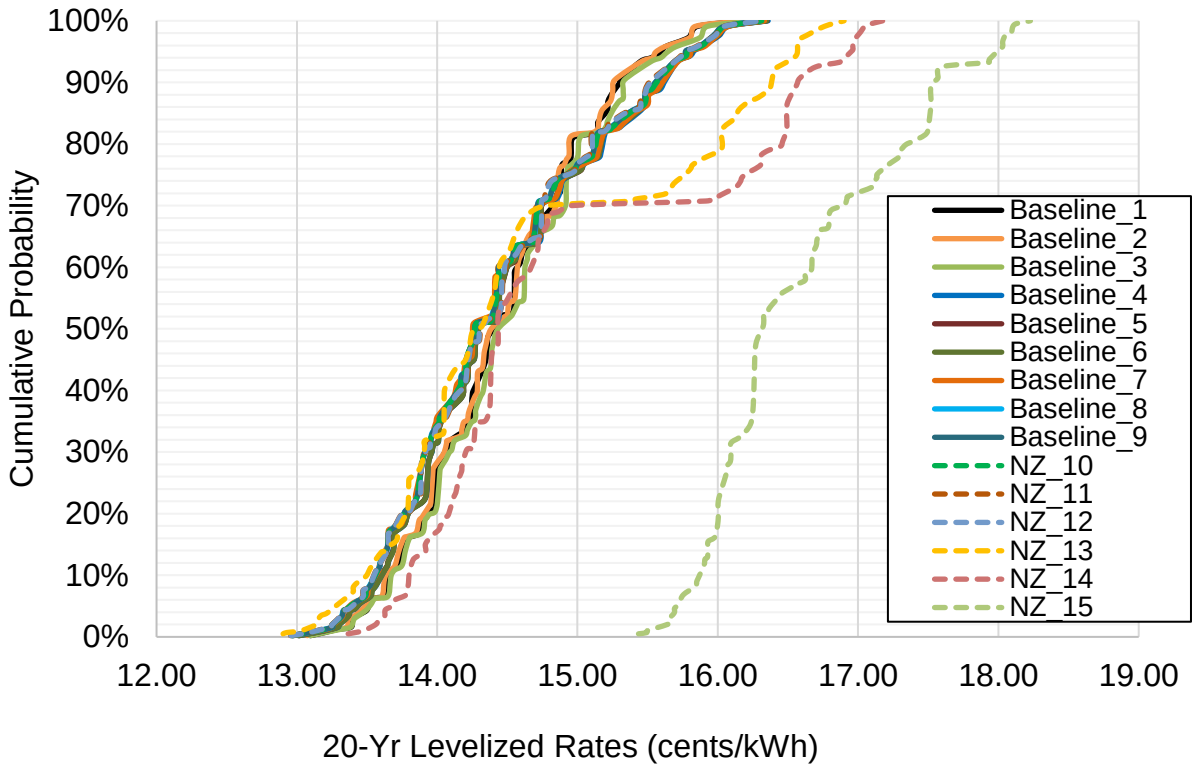


Figure 6-81 - Cumulative Probability of Max Rate Increases Plans 1-12 (%)

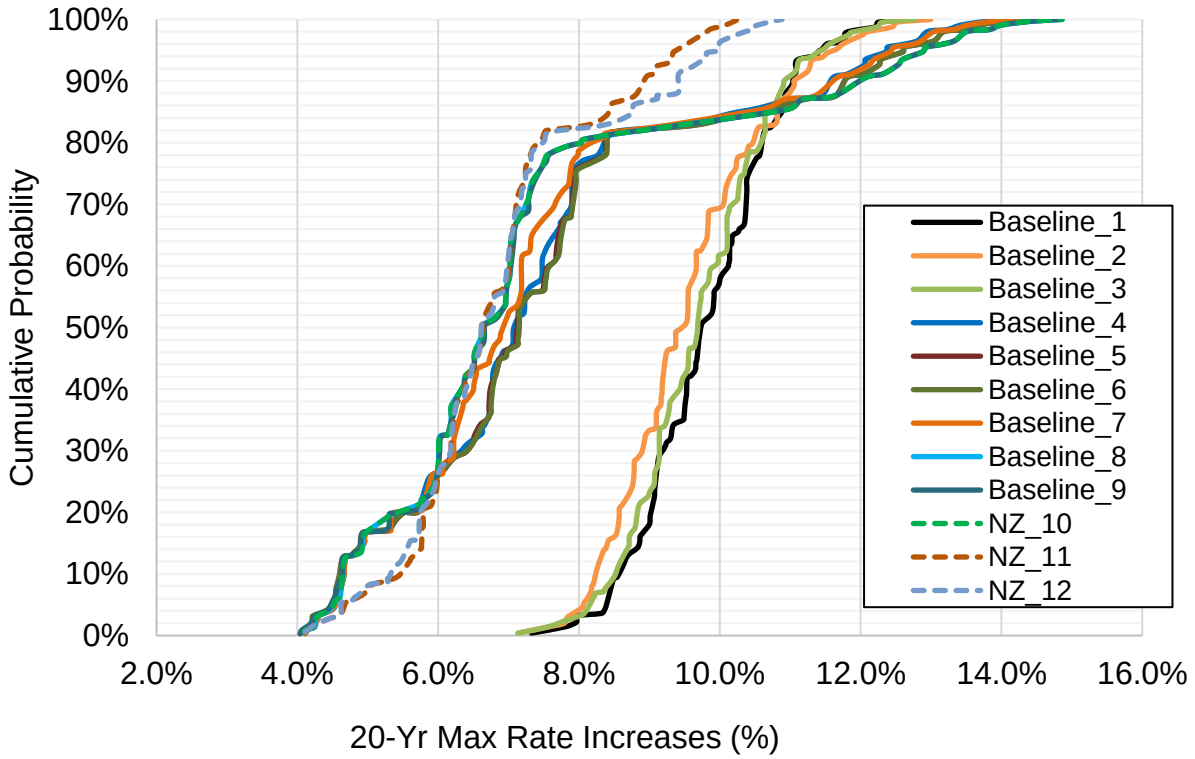
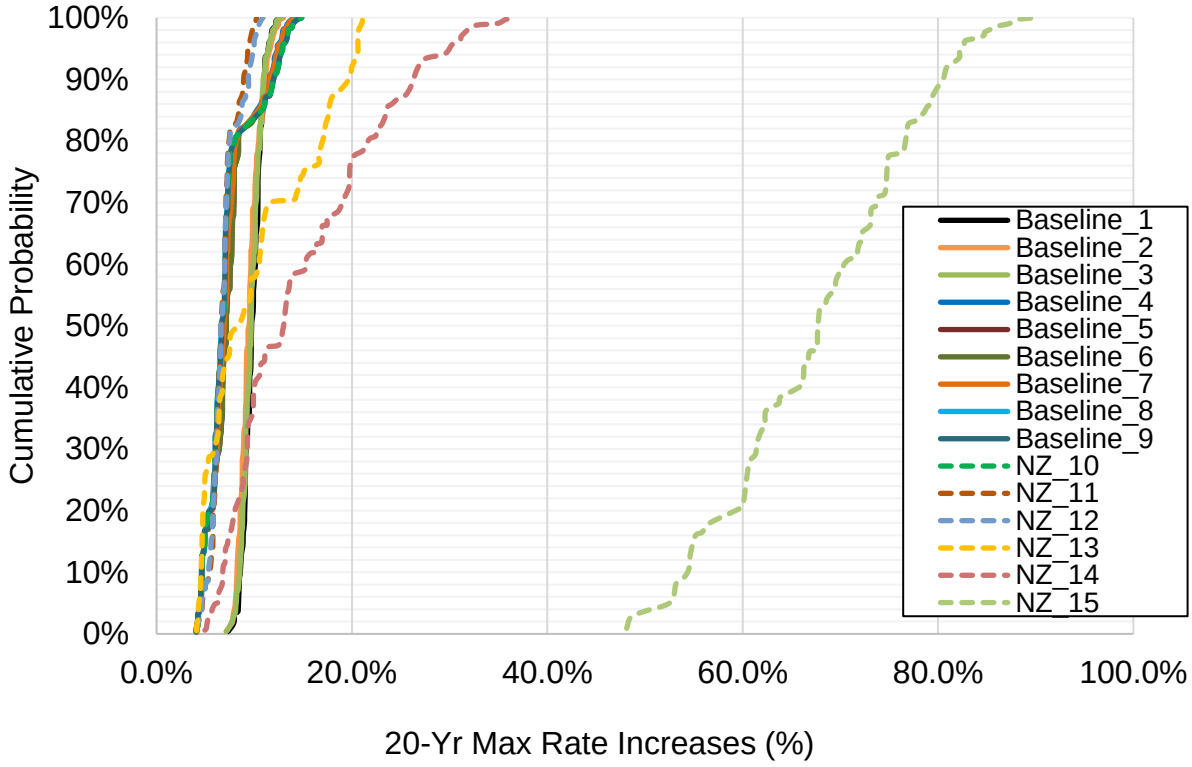


Figure 6-82 - Cumulative Probability of Max Rate Increases All Plans (%)



3. For each performance measure, a table that shows the expected value and the risk of each alternative resource plan; and

Table 6-71 provides the expected values of performance measures for each alternative resource plan. Table 6-72 indicates the risk as the standard deviation of performance measure values for each alternative resource plan.

7.3 Determination of Annual Unserved Hours in Plans

4. A plot of the expected level of annual unserved hours for each alternative resource plan over the planning horizon.

Liberty-Empire's modeling does not include any unserved hours for any alternative resource plan.

SECTION 8 CONTEMPORARY ISSUES

4 CSR 240-22.080(4)(C) No later than November 1, an order containing a list of special contemporary issues shall be issued by the commission for each utility to analyze and document in its next triennial compliance filing or annual update report. The commission shall not be limited to only the filed suggested special contemporary issues. If the commission determines that there are no special contemporary issues for a utility to analyze, an order shall be issued by the commission stating that there are no special contemporary issues.

8.1 Special Contemporary Issues

Rule 20 CSR 4240-22.080(4) requires Missouri utilities to consider and analyze special contemporary issues in their IRP triennial compliance filings or their annual IRP updates. Such special contemporary issues are contained in a Commission order with input from staff, public counsel, and interveners that are evolving new issues, which may not otherwise have been addressed by the utility or are continuations of unresolved issues from the preceding triennial compliance filing or annual update filing. In File No. EO-2022-0057, the Commission issued an order on October 27, 2021, effective November 6, 2021, establishing six (6) special contemporary planning issues for Liberty-Empire to analyze and document in its 2022 triennial Integrated Resource Plan. The responses to these 6 issues (a-f) are provided below.

8.1.1 Securitization Plan

(a) Provide details of its plan, if any, to utilize securitization. Details should include, but not be limited to: 1) type of items to be securitized; 2) explanation for need of securitization for each item; 3) how it plans to utilize securitization for each item; 4) estimated costs of securitized items; and 5) comparison of ratepayer costs and benefits related to its IRP planning. (Securitization is essentially a lower cost, long-term loan that ratepayers take out and pledge to repay using a portion of their future electricity bills using a long-term, lower-cost bond that will save customers money, some of which can be used as new capital).

At this time, the Company plans to utilize securitization in Missouri for Winter Storm Uri costs

and the unrecovered investment in the retired Asbury coal plant. On January 19, 2022, and pursuant to RSMo. §393.1700.2(2), the Company filed its Verified Petition for Financing Order seeking authorization to issue securitized utility tariff bonds to recover the extraordinary costs Empire incurred on behalf of its customers during Winter Storm Uri (Commission Case No. EO-2022-0040). On March 21, 2022, and pursuant to RSMo. §393.1700.2(1)), the Company filed its Verified Petition for Financing Order for authorization of the issuance of securitized utility tariff bonds regarding the retired Asbury generating plant (Commission Case No. EO-2022-0193). The details of the Company's plans, including the types of items to be securitized, the need for securitization, and the estimated costs and benefits may be found in the petitions filed in the two referenced dockets.

8.1.2 Ratepayer and Shareholder Risks

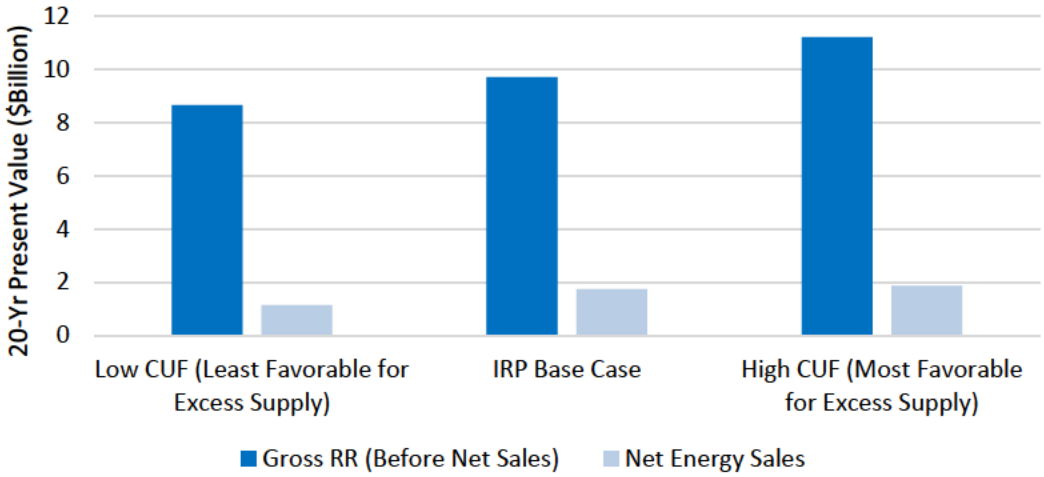
(b) Provide detailed analysis in its next triennial IRP filing comparing ratepayer risks and shareholder risks for additional generation resources that are not required to meet federal, state, or RTO requirements.

Excess supply can take the form of capacity or energy. All resource plans assessed by Liberty-Empire are designed to meet the SPP resource adequacy requirement of a 12 percent minimum reserve margin for capacity. This standard is specified for the summer peak; however, given reliability concerns during winter months in recent years, all resource plans for the 2022 Liberty-Empire IRP are also designed to achieve a minimum 12 percent reserve margin for winter peak. Given the winter-peaking nature of the Liberty-Empire system, when considering both summer and winter adequacy, there is minimal excess capacity supply in the proposed resource plans. Resources are optimized between seasons and added only up to the level at which the minimum reserve margin is satisfied in both seasons. In addition, due to the lower expected ELCC for solar resources in winter, higher levels of economic solar deployment result in relatively lower levels of capacity supply for winter peak in most renewable portfolios, meaning that the reserve margin is at the minimum level during winter, and only slightly above this level for summer months. Finally, Liberty-Empire believes any excess capacity included in the portfolio, while minimal, will

help to address reliability-related discussions currently occurring within several SPP Working Groups, including the potential for increasing reserve margins and decremented capacity for existing thermal resources.

From an energy perspective, the resource plans for the 2022 IRP generally result in annual net sales of energy (sales minus purchases). There exists interdependence between the levels of capacity and energy for renewables which cannot easily be decoupled; however, ratepayer risks stemming from net energy sales can be quantified to illustrate potential risk. For example, for the renewable-focused Plan 8 under base case market conditions, the 20-year present value of net energy sales is $1.7B, or 18% of the $9.7B gross revenue requirement. If assuming the most unfavorable energy market sales conditions used in the extreme low end of the Critical Uncertain Factor analysis (see Volume 6 Sections 5, 6, and 7 for detail) with a combination of low fuel prices, low emissions prices, and low demand resulting in low energy market prices, the 20-yr PV of net sales would be $1.1B. The countering case with the most favorable high energy price scenario yields a 20-year NPV for net energy sales of $1.9B. While this suggests downside risk could be greater than upside risk for excess energy sales value, the overall revenue requirement is also lower for the low case of market factors, resulting in lower overall net revenue requirement for ratepayers. Figure 6-83 illustrates this comparison. Therefore, even when excess energy supply is considered separate from capacity, offsetting cost factors provide a natural hedge to downside market scenarios, and excess supply does not pose a systemic risk to ratepayer value.

Figure 6-83 – Gross Revenue Requirement and Net Energy Sales Value Cases



8.1.3 Emergency Events

(c) Given the recent COVID pandemic and the Winter Storm Uri weather event, provide details of its plan for handling future emergency events such as these. The details provided should give a clear plan for maintaining supply-side resource generation and public welfare during emergency events.

As a part of its 2022 IRP Preferred Plan, Liberty-Empire intends to extend the life of two of its dual-fuel capable natural gas peaking resources, Energy Center 1 and 2, until 2035 to maintain and improve the capability of its generation portfolio to provide reliable services during any potential emergency events. These resources provided significant value to customers and helped stabilize the system during the events of Storm Uri due to their ability to operate on fuel oil in addition to natural gas. Liberty-Empire believes maintaining Energy Center 1 and 2 through 2035 could significantly help to hedge market risks at a relatively low cost of investment. As analyzed in Section 3.2, Liberty-Empire found only a small cost difference between retiring Energy Center 1 and 2 in 2026 vs. in 2035 (representing less than 0.1% of total portfolio costs over a 30-year period).

In addition, maintaining Energy Center 1 and 2 will provide other foreseeable benefits to address

reliability-related discussions currently occurring within SPP and several SPP Working Groups, including the potential for increasing reserve margins and decremented capacity for existing thermal resources. The Liberty-Empire system will be further bolstered with the retirement of Riverton units 10 and 11 in 2025 and replaced with new dual-fuel capable RICE units.

Furthermore, Liberty-Empire maintains Plant Emergency Operations plans and protocols for emergency preparedness as part of the business continuity plans. Before the winter season, Liberty-Empire's plants are inspected to ensure that all the winterization processes are undertaken in preparation for winter. Heat tracing and insulation audits are conducted and any identified gaps closed. The preventive maintenance tasks are completed as per the plant maintenance protocols. Following Storm Uri, the plan includes standardizing the training of plant personnel and standardizing pre-winter operations and preparations to align with the latest NERC and FERC recommendations. These recommendations have recently been published and will go in effect in 2023. The details in the revised policy and procedures for extreme weather preparations include:

- Responsibilities – Identification of which personnel are responsible for which portions of the extreme weather plan
- Training – A list of who is required for training, what they are to be trained on, and on what frequency they are to be trained
- Actionable items – A list of the preventative maintenance work orders that are used to prepare for extreme weather
- Upgrades – All winter related modernization and upgrades that are identified be performed before the winter season

8.1.4 Securitization Prospects

(d) Analyze and document the prospects for using securitization to support cost-effective accelerated retirement of coal generation assets and to channel the savings into cost-effective investments such as demand-side management, wind and solar generation, and storage. (Securitization is essentially a lower cost, long-term loan that ratepayers take out and pledge to repay using a portion of their future electricity bills using a long-term, lower-cost bond that will save customers money, some of which can be used as new capital).

Liberty-Empire is not the majority owner or operator of any of its remaining coal resources and does not expect accelerated retirement of any remaining coal units at this time.

8.1.5 Interconnection Costs

(e) Analyze and document the projected interconnection costs when evaluating additional supply-side options.

Liberty-Empire assessed current and future costs for new transmission interconnections during the normal course of the IRP study. Refer to Volume 4 for details.

8.1.6 Storage

(f) Analyze and document planning scenarios that include robust storage uptake consistent with FERC Order 841 including identifying current Battery Energy Storage System cost assumptions used to develop the scenario.

FERC Order 841 is intended to open markets for storage technologies to achieve full value of services provided to the system. Liberty-Empire portfolio optimizations attributed to storage the value for energy, capacity, and ancillary services to reflect full market access. Liberty-Empire considered several storage technologies as resource options for the portfolio optimization

analysis. Refer to Technical Volume 4 Section 2 for details. Utility and distributed scale storage was made available for selection in twelve of the fifteen resource portfolio themes considered. Refer to Technical Volume 6 Sections 3 and 4 for details.

SECTION 9 APPENDIX

Appendix 6A

Table 6A-1 – Avoided Costs for All Plans
****Confidential in its Entirety****

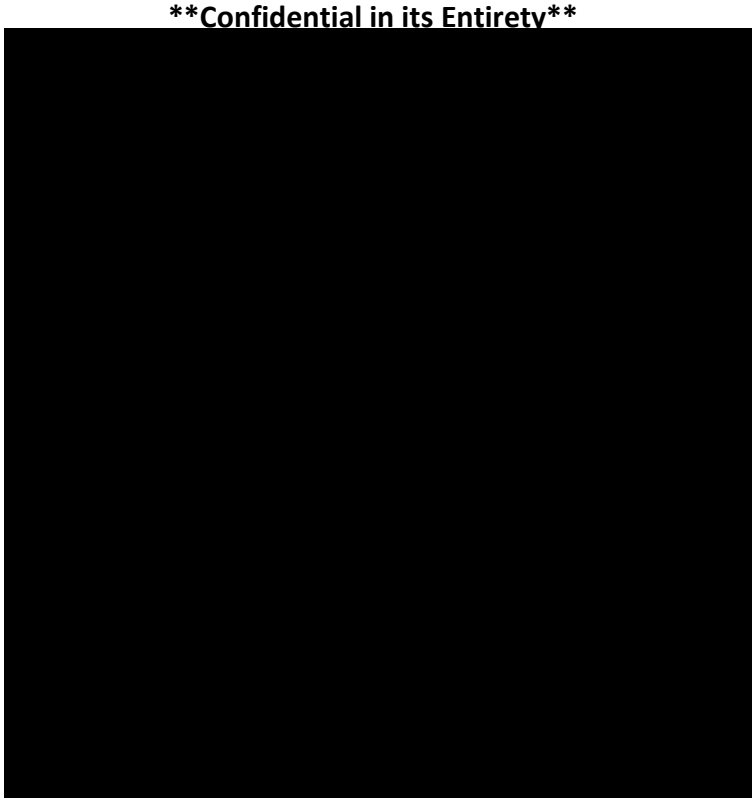


Table 6A-2 - PVRR (20 Years) For All Plan

Plan	Portfolio Name	20-Year NPVRR (2022-2041) ($M) – Base Case
1	Baseline_Central Gas	8,025
2	Baseline_Dist Gas RAP	8,011
3	Baseline_Dist Gas MAP	8,041
4	Baseline_Central Gas Renew	7,992
5	Baseline_Dist Gas Renew RAP	7,991
6	Baseline_Dist Gas Renew MAP	7,992
7	Baseline_Central Renew	7,967
8	Baseline_Dist Renew RAP	7,965
9	Baseline_Dist Renew MAP	7,965
10	NZ 2050 Renew	7,964
11	NZ 2050 SMR	7,962
12	NZ 2050 H2	7,963
13	NZ 2035 Renew	8,058
14	NZ 2035 SMR	8,259
15	NZ 2035 H2	9,368

Table 6A-3 - Annual Rate Increases for All Plans ($ in Millions)
****Confidential in its Entirety****

[redacted]

Table 6A-4 – Average Rate Revenue of All Plans
****Confidential in its Entirety****

[redacted]

Appendix 6B DSM Composition Tables

Table 6B-1 - DSM Composition of RAP DSM (MW)

Bundle Name	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051
Retail Lighting	2.17	4.83	7.19	7.78	7.80	7.81	7.81	7.85	7.86	7.88	7.42	6.87	4.85	2.70	0.69	0.25	0.26	0.28	0.30	0.31	0.33	0.35	0.37	0.37	0.37	0.37	0.38	0.38	0.38	0.38
Residential Behavioral	0.28	0.29	0.28	0.29	0.29	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.01	0.00	0.00	0.00	0.00
Commercial Custom	0.12	0.23	0.36	0.49	0.62	0.76	0.90	1.04	1.18	1.32	1.44	1.56	1.62	1.78	1.98	1.97	2.06	2.14	2.10	2.36	2.38	2.20	2.26	2.38	2.37	2.37	2.37	2.24	2.21	2.20
SEM	0.23	0.49	0.73	0.72	0.73	0.71	0.66	0.75	0.73	0.70	0.70	0.66	0.70	0.73	0.70	0.68	0.67	0.64	0.63	0.70	0.69	0.69	0.66	0.70	0.70	0.71	0.70	0.66	0.65	0.70
Retrocommissioning	0.73	1.53	2.36	2.97	3.64	4.29	4.68	5.23	5.08	4.92	4.91	4.71	4.95	5.28	5.10	5.11	5.19	5.07	5.33	5.86	6.19	6.26	6.05	6.18	6.20	6.26	6.36	6.09	5.87	6.33
Residential Prescriptive	1.17	2.39	3.55	4.90	6.22	7.56	8.82	10.40	11.76	13.27	14.23	15.66	16.92	18.00	18.95	20.19	20.54	21.02	21.06	21.91	21.88	21.59	21.89	22.55	22.58	22.90	22.71	22.37	22.72	22.72
Appliance Recycling	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.03	0.05	0.07	0.08	0.10	0.12	0.12	0.12	0.12	0.12	0.12	0.13	0.12	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13
Commercial Prescriptive	0.84	1.68	2.46	3.34	3.92	4.41	4.96	5.53	6.28	7.01	7.50	8.05	8.49	9.28	10.05	10.14	10.30	10.34	9.98	10.45	10.23	9.58	9.43	9.31	8.94	8.57	8.21	7.67	7.29	6.97
Midstream Food Service	0.02	0.03	0.05	0.07	0.09	0.12	0.14	0.16	0.18	0.21	0.22	0.24	0.23	0.21	0.19	0.18	0.16	0.14	0.11	0.09	0.07	0.05	0.03	0.01	0.01	0.01	0.01	0.00	0.00	0.00

Table 6B-2 - DSM Composition of MAP DSM (MW)

Bundle Name	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051
Retail Lighting	3.30	7.30	10.73	11.48	11.50	11.52	11.52	11.57	11.59	11.62	10.90	10.07	7.01	3.81	0.86	0.32	0.34	0.37	0.39	0.41	0.43	0.46	0.48	0.48	0.48	0.48	0.49	0.48	0.48	0.48
Residential Behavioral	0.43	0.43	0.41	0.41	0.41	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Commercial Custom	0.18	0.34	0.53	0.72	0.91	1.11	1.30	1.48	1.67	1.86	2.01	2.17	2.22	2.43	2.68	2.64	2.74	2.82	2.73	3.06	3.04	2.76	2.81	2.95	2.91	2.87	2.85	2.66	2.61	2.58
SEM	0.33	0.70	1.04	1.01	0.67	0.33	0.29	0.66	0.95	0.90	0.89	0.83	0.86	0.89	0.84	0.81	0.79	0.74	0.72	0.78	0.77	0.75	0.73	0.77	0.77	0.79	0.77	0.73	0.71	0.77
Retrocommissioning	1.03	2.14	3.29	4.10	4.85	5.56	6.06	6.81	6.66	6.37	6.26	5.93	6.16	6.49	6.20	6.16	6.20	6.00	6.29	6.86	7.24	7.29	6.99	7.10	7.10	7.15	7.27	6.97	6.71	7.24
Residential Prescriptive	1.87	3.77	5.54	7.58	9.53	11.47	13.24	15.47	17.33	19.38	20.53	22.32	23.85	25.09	26.13	27.51	27.54	27.74	27.36	27.95	27.44	26.66	26.63	27.07	26.76	26.83	26.32	25.69	25.87	25.68
Appliance Recycling	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.05	0.07	0.09	0.11	0.13	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15
Commercial Prescriptive	1.21	2.40	3.48	4.69	5.50	6.17	6.90	7.64	8.62	9.55	10.14	10.82	11.33	12.31	13.25	13.23	13.31	13.25	12.70	13.20	12.80	11.86	11.57	11.30	10.74	10.19	9.68	8.95	8.44	8.00
Midstream Food Service	0.02	0.05	0.07	0.10	0.13	0.16	0.19	0.22	0.25	0.28	0.30	0.32	0.30	0.27	0.24	0.22	0.19	0.16	0.13	0.11	0.08	0.05	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Appendix 6C Composition of DSM Energy Provided Tables

Table 6C-1 - Composition of DSM Energy Provided in RAP DSM (MWh)

Bundle Name	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051
Retail Lighting	4,679	10,423	15,532	16,744	16,800	16,829	16,861	16,893	16,933	16,973	16,002	14,819	10,450	5,799	1,482	538	557	599	638	676	714	753	791	786	796	805	813	819	818	816
Residential Behavioral	719	725	731	738	743	32	11	11	11	11	11	11	11	12	12	12	12	12	12	12	13	13	13	13	13	13	13	13	13	13
Commercial Custom	611	1,238	1,879	2,571	3,274	3,987	4,710	5,442	6,182	6,929	7,559	8,195	8,785	9,367	9,937	10,376	10,804	11,222	11,473	11,686	11,726	11,750	11,760	11,757	11,743	11,718	11,684	11,641	11,591	11,533
SEM	318	635	951	948	944	940	936	931	927	922	917	912	907	902	896	891	886	880	875	873	878	886	892	892	892	892	892	892	892	892
Retrocommissioning	1,793	3,601	5,408	6,998	8,568	10,130	11,685	11,655	11,622	11,607	11,611	11,619	11,672	11,751	11,840	12,022	12,255	12,513	12,968	13,532	14,112	14,339	14,376	14,394	14,422	14,459	14,488	14,488	14,488	14,488
Residential Prescriptive	2,823	5,710	8,718	11,806	15,008	18,277	21,610	25,006	28,465	31,961	34,798	37,662	40,477	43,300	46,144	48,691	49,634	50,565	51,394	51,927	52,454	52,950	53,383	53,743	54,041	54,272	54,444	54,573	54,657	54,682
Appliance Recycling	-	-	-	-	-	-	-	-	125	252	379	497	614	732	851	859	866	874	882	892	903	913	922	930	936	941	944	944	944	944
Commercial Prescriptive	5,380	10,989	15,857	21,327	25,083	28,157	31,715	35,412	40,147	44,787	48,080	51,460	55,446	59,470	63,439	64,863	65,726	66,137	65,755	65,222	63,695	61,982	60,149	57,984	55,746	53,458	51,128	48,887	46,651	44,442
Midstream Food Service	47	100	158	220	285	352	421	491	562	625	681	736	697	648	597	541	481	417	351	282	212	150	92	37	28	25	19	14	10	10

Table 6C-2 - Composition of DSM Energy Provided in MAP DSM (MWh)

Bundle Name	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051
Retail Lighting	7,123	15,732	23,201	24,721	24,764	24,808	24,854	24,900	24,956	25,012	23,516	21,697	15,111	8,203	1,867	682	741	793	841	887	934	981	1,028	1,034	1,038	1,041	1,043	1,043	1,034	1,024
Residential Behavioral	1,090	1,077	1,063	1,051	1,038	44	15	14	14	14	14	14	14	14	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13
Commercial Custom	884	1,778	2,677	3,634	4,594	5,553	6,510	7,466	8,418	9,367	10,132	10,896	11,580	12,244	12,885	13,333	13,762	14,173	14,340	14,456	14,324	14,184	14,036	13,885	13,730	13,575	13,419	13,265	13,114	12,966
SEM	460	912	1,355	1,330	878	435	410	813	1,208	1,185	1,162	1,140	1,118	1,097	1,077	1,056	1,037	1,017	998	980	974	975	981	981	981	981	981	981	981	981
Retrocommissioning	2,595	5,169	7,703	9,886	11,664	13,398	15,438	15,502	15,573	15,340	15,140	14,955	14,840	14,766	14,712	14,794	14,950	15,140	15,616	16,215	16,862	17,026	16,971	16,911	16,883	16,885	16,916	16,916	16,916	16,916
Residential Prescriptive	4,472	8,956	13,537	18,153	22,851	27,559	32,274	36,994	41,719	46,405	49,900	53,372	56,704	59,991	63,252	65,958	66,152	66,330	66,351	65,847	65,391	64,978	64,558	64,114	63,665	63,203	62,739	62,294	61,866	61,451
Appliance Recycling	-	-	-	-	-	-	-	-	172	343	512	667	818	969	1,119	1,113	1,108	1,103	1,098	1,093	1,093	1,093	1,094	1,095	1,097	1,100	1,103	1,103	1,103	1,103
Commercial Prescriptive	7,705	15,609	22,361	29,868	35,026	39,237	43,945	48,764	54,878	60,808	64,818	68,927	73,767	78,617	83,339	84,287	84,584	84,440	83,338	82,059	79,356	76,463	73,492	70,146	66,764	63,384	60,021	56,866	53,799	50,845
Midstream Food Service	68	143	223	308	396	485	575	666	757	836	907	974	908	836	757	674	588	501	412	322	231	151	79	10	8	5	4	2	0	0

Appendix 6D Plan Tornado Diagrams Tables

Table 6D-1 - Plan 1 Tornado Diagram ($ in Millions)

Baseline_1 PVRR ($M)	Low (below Base)	High (above Base)	Base
Load	(127)	97	8,025
Gas	(116)	188	
Emissions	(195)	327	
LCOE	(62)	518	
All Critical Uncertain Factors	(423)	1,237	

Table 6D-2 - Plan 2 Tornado Diagram ($ in Millions)

Baseline_2 PVRR ($M)	Low (below Base)	High (above Base)	Base
Load	(127)	101	8,011
Gas	(119)	185	
Emissions	(201)	352	
LCOE	(57)	512	
All Critical Uncertain Factors	(428)	1,248	

Table 6D-3 - Plan 3 Tornado Diagram ($ in Millions)

Baseline_3 PVRR ($M)	Low (below Base)	High (above Base)	Base
Load	(127)	100	8,041
Gas	(125)	193	
Emissions	(204)	355	
LCOE	(62)	520	
All Critical Uncertain Factors	(441)	1,268	

Table 6D-4 - Plan 4 Tornado Diagram ($ in Millions)

Baseline_4 PVRR ($M)	Low (below Base)	High (above Base)	Base
Load	(127)	96	7,992
Gas	(77)	137	
Emissions	(180)	297	
LCOE	(143)	730	
All Critical Uncertain Factors	(440)	1,376	

Table 6D-5 - Plan 5 Tornado Diagram ($ in Millions)

Baseline_5 PVRR ($M)	Low (below Base)	High (above Base)	Base
Load	(127)	96	7,991
Gas	(77)	137	
Emissions	(181)	300	
LCOE	(145)	724	
All Critical Uncertain Factors	(443)	1,373	

Table 6D-6 - Plan 6 Tornado Diagram ($ in Millions)

Baseline_6 PVRR ($M)	Low (below Base)	High (above Base)	Base
Load	(127)	96	7,992
Gas	(76)	137	
Emissions	(180)	298	
LCOE	(145)	724	
All Critical Uncertain Factors	(441)	1,370	

Table 6D-7 - Plan 7 Tornado Diagram ($ in Millions)

Baseline_7 PVRR ($M)	Low (below Base)	High (above Base)	Base
Load	(127)	96	7,967
Gas	(69)	126	
Emissions	(179)	303	
LCOE	(152)	750	
All Critical Uncertain Factors	(440)	1,399	

Table 6D-8 - Plan 8 Tornado Diagram ($ in Millions)

Baseline_8 PVRR ($M)	Low (below Base)	High (above Base)	Base
Load	(127)	98	7,965
Gas	(74)	130	
Emissions	(183)	316	
LCOE	(146)	725	
All Critical Uncertain Factors	(443)	1,388	

Table 6D-9 - Plan 9 Tornado Diagram ($ in Millions)

Baseline_9 PVRR ($M)	Low (below Base)	High (above Base)	Base
Load	(127)	98	7,965
Gas	(73)	129	
Emissions	(182)	314	
LCOE	(146)	725	
All Critical Uncertain Factors	(441)	1,385	

Table 6D-10 - Plan 10 Tornado Diagram ($ in Millions)

NZ_10 PVRR ($M)	Low (below Base)	High (above Base)	Base
Load	(127)	98	7,964
Gas	(74)	129	
Emissions	(183)	315	
LCOE	(147)	731	
All Critical Uncertain Factors	(444)	1,393	

Table 6D-11 - Plan 11 Tornado Diagram ($ in Millions)

NZ_11 PVRR ($M)	Low (below Base)	High (above Base)	Base
Load	(127)	100	7,962
Gas	(79)	138	
Emissions	(186)	340	
LCOE	(139)	704	
All Critical Uncertain Factors	(448)	1,395	

Table 6D-12 - Plan 12 Tornado Diagram ($ in Millions)

NZ_12 PVRR ($M)	Low (below Base)	High (above Base)	Base
Load	(127)	99	7,963
Gas	(79)	136	
Emissions	(186)	336	
LCOE	(140)	709	
All Critical Uncertain Factors	(447)	1,395	

Table 6D-13 - Plan 13 Tornado Diagram ($ in Millions)

NZ_13 PVRR ($M)	Low (below Base)	High (above Base)	Base
Load	(127)	96	8,058
Gas	7	45	
Emissions	(146)	204	
LCOE	(390)	1,156	
All Critical Uncertain Factors	(561)	1,647	

Table 6D-14 - Plan 14 Tornado Diagram ($ in Millions)

NZ_14 PVRR ($M)	Low (below Base)	High (above Base)	Base
Load	(127)	96	8,259
Gas	62	(9)	
Emissions	(102)	24	
LCOE	(346)	1,228	
All Critical Uncertain Factors	(418)	1,520	

Table 6D-15 - Plan 15 Tornado Diagram ($ in Millions)

NZ_15 PVRR ($M)	Low (below Base)	High (above Base)	Base
Load	(127)	98	9,368
Gas	35	(14)	
Emissions	(121)	(9)	
LCOE	(143)	724	
All Critical Uncertain Factors	(269)	936	

Appendix 6E Cumulative Probability Tables

Table 6E-1 - Cumulative Probability Plans 1-9 ($ in Millions)

Baseline_1	Baseline_1	Baseline_2	Baseline_2	Baseline_3	Baseline_3	Baseline_4	Baseline_4	Baseline_5	Baseline_5	Baseline_6	Baseline_6	Baseline_7	Baseline_7	Baseline_8	Baseline_8	Baseline_9	Baseline_9
20-Yr NPVRR ($M)	Cumulative Prob %	20-Yr NPVRR ($M)	Cumulative Prob %	20-Yr NPVRR ($M)	Cumulative Prob %	20-Yr NPVRR ($M)	Cumulative Prob %	20-Yr NPVRR ($M)	Cumulative Prob %	20-Yr NPVRR ($M)	Cumulative Prob %	20-Yr NPVRR ($M)	Cumulative Prob %	20-Yr NPVRR ($M)	Cumulative Prob %	20-Yr NPVRR ($M)	Cumulative Prob %
7,602	0.200%	7,583	0.200%	7,599	0.200%	7,552	0.200%	7,548	0.200%	7,551	0.200%	7,527	0.200%	7,522	0.200%	7,524	0.200%
7,663	0.70%	7,641	0.70%	7,661	0.70%	7,568	0.70%	7,565	0.70%	7,566	0.70%	7,534	0.70%	7,535	0.70%	7,537	0.70%
7,664	1.20%	7,649	1.20%	7,670	1.20%	7,625	1.10%	7,621	1.10%	7,624	1.10%	7,599	1.10%	7,594	1.10%	7,597	1.10%
7,674	1.60%	7,656	1.60%	7,672	1.60%	7,671	2.10%	7,669	2.10%	7,670	2.10%	7,638	2.10%	7,639	2.10%	7,640	2.10%
7,726	2.85%	7,706	2.85%	7,730	1.80%	7,679	2.30%	7,675	2.30%	7,678	2.30%	7,653	2.30%	7,648	2 30%	7,651	2.30%
7,729	3.05%	7,714	3.85%	7,732	3.05%	7,680	2.70%	7,677	2.70%	7,679	2.70%	7,654	2.70%	7,653	2.70%	7,655	2.70%
7,737	4.05%	7,715	4.05%	7,734	4.05%	7,689	3.20%	7,686	3.20%	7,689	3.20%	7,665	3.00%	7,660	3 20%	7,663	3.20%
7,751	4.45%	7,739	4.45%	7,757	4.45%	7,704	3.50%	7,702	3.50%	7,703	3.50%	7,671	3.50%	7,668	3 50%	7,669	3.50%
7,767	5.45%	7,752	5.45%	7,774	5.45%	7,708	4.75%	7,707	4.75%	7,708	4.75%	7,684	4.75%	7,678	4.75%	7,680	4.75%
7,792	5.95%	7,773	5.95%	7,792	5.95%	7,722	5.75%	7,720	5.75%	7,720	5.75%	7,687	5.75%	7,692	5.75%	7,693	5.75%
7,813	6.95%	7,797	6.95%	7,820	6.95%	7,749	6.25%	7,747	6.25%	7,748	6.25%	7,716	6.25%	7,717	6 25%	7,718	6.25%
7,829	9.45%	7,810	9.45%	7,836	9.45%	7,761	7.25%	7,759	7.25%	7,762	7.25%	7,744	7.25%	7,733	7 25%	7,736	7.25%
7,835	10.45%	7,820	9.75%	7,847	9.75%	7,776	8.05%	7,773	8.05%	7,775	8.05%	7,749	8.05%	7,748	8 05%	7,750	8.05%
7,836	10.75%	7,827	10.75%	7,852	10.75%	7,812	10.55%	7,811	10.55%	7,812	10.55%	7,785	8.65%	7,782	10.55%	7,783	10.55%
7,846	11.25%	7,835	11.55%	7,853	11.55%	7,815	11.05%	7,813	11.05%	7,816	11.05%	7,787	9.25%	7,787	11.05%	7,790	11.05%
7,847	12.05%	7,835	12.05%	7,856	12.05%	7,820	12.05%	7,818	12.05%	7,820	12.05%	7,787	11.75%	7,789	11.65%	7,790	11.65%
7,898	14.55%	7,878	12.80%	7,910	12.80%	7,826	12.65%	7,824	12.65%	7,825	12.65%	7,797	12.25%	7,793	12.25%	7,793	12.25%
7,899	15.30%	7,885	15.30%	7,914	15.30%	7,831	13.25%	7,829	13.25%	7,829	13.25%	7,802	13.25%	7,795	13.25%	7,797	13.25%
7,908	16.55%	7,892	17.30%	7,915	17.30%	7,847	14.00%	7,844	13.65%	7,846	13.65%	7,814	15.25%	7,813	14.00%	7,814	14.00%
7,909	18.55%	7,893	18.55%	7,919	18.55%	7,847	14.40%	7,846	14.40%	7,847	14.40%	7,816	16.00%	7,819	16.00%	7,819	16.00%
7,919	18.95%	7,911	18.95%	7,929	18.95%	7,849	16.40%	7,847	16.40%	7,847	16.40%	7,821	16.40%	7,820	16.40%	7,822	16.40%
7,958	19.35%	7,942	19.55%	7,969	19.55%	7,858	16.80%	7,858	16.80%	7,858	16.80%	7,836	16.80%	7,838	18.90%	7,839	18.90%
7,958	19.95%	7,954	21.55%	7,979	21.55%	7,865	19.30%	7,864	19.30%	7,865	19.30%	7,840	19.30%	7,848	19.30%	7,848	19.30%
7,962	21.95%	7,969	22.55%	7,991	22.55%	7,890	20.55%	7,889	20.55%	7,890	20.55%	7,866	20.55%	7,860	20.55%	7,862	20.55%
7,981	22.95%	7,975	22.95%	7,994	22.95%	7,915	22.55%	7,914	22.55%	7,916	22.55%	7,880	20.85%	7,884	20.85%	7,885	20.85%
7,998	23.55%	7,987	23.55%	8,020	23.55%	7,919	22.85%	7,917	22.85%	7,917	22.85%	7,897	22.85%	7,890	22.85%	7,892	22.85%
8,021	25.05%	8,000	25.05%	8,031	25.05%	7,944	23.85%	7,942	23.85%	7,943	23.85%	7,910	23.85%	7,916	23.85%	7,917	23.85%
8,021	26.05%	8,011	30.05%	8,041	30.05%	7,955	24.85%	7,956	24.85%	7,956	24.85%	7,925	24.85%	7,934	25.35%	7,935	25.35%
8,025	31.05%	8,033	31.05%	8,057	31.05%	7,968	26.35%	7,968	26.35%	7,968	26.35%	7,937	26.05%	7,941	26.35%	7,941	26.35%
8,051	31.35%	8,038	31.35%	8,064	31.35%	7,977	27.85%	7,977	27.85%	7,977	27.85%	7,938	27.55%	7,943	27.85%	7,942	27.85%
8,058	32.35%	8,045	32.85%	8,078	32.35%	7,982	29.05%	7,981	29.05%	7,981	29.05%	7,941	29.05%	7,945	29.05%	7,945	29.05%
8,061	33.85%	8,054	33.85%	8,082	33.85%	7,987	30.05%	7,985	30.05%	7,987	30.05%	7,967	34.05%	7,962	30.05%	7,964	30.05%
8,105	34.85%	8,095	34.60%	8,127	34.60%	7,992	35.05%	7,991	35.05%	7,992	35.05%	7,969	35.05%	7,965	35.05%	7,965	35.05%
8,112	35.65%	8,112	37.10%	8,140	37.10%	8,005	36.05%	8,006	36.05%	8,007	36.05%	7,990	35.85%	7,998	36.05%	7,998	36.05%
8,114	36.40%	8,122	38.10%	8,149	37.90%	8,011	36.85%	8,012	36.85%	8,012	36.85%	7,993	36.85%	8,002	36.85%	8,002	36.85%
8,121	38.90%	8,129	38.90%	8,149	38.90%	8,061	37.60%	8,061	37.60%	8,061	37.60%	8,031	37.60%	8,029	37.60%	8,030	37.60%
8,150	40.10%	8,139	40.10%	8,172	40.10%	8,088	40.10%	8,087	40.10%	8,088	40.10%	8,057	38.20%	8,062	40.10%	8,063	40.10%
8,167	42.60%	8,152	40.40%	8,182	40.40%	8,100	40.70%	8,098	40.70%	8,098	40.70%	8,062	38.80%	8,068	40.70%	8,067	40.70%
8,175	44.60%	8,180	42.90%	8,211	42.40%	8,105	43.20%	8,108	43.20%	8,107	43.20%	8,063	41.30%	8,080	41.30%	8,079	41.30%
8,183	44.90%	8,187	44.90%	8,211	44.90%	8,108	43.80%	8,110	43.80%	8,108	43.80%	8,085	43.80%	8,094	44.30%	8,094	43.80%
8,213	47.90%	8,197	47.90%	8,234	47.90%	8,129	46.80%	8,129	46.80%	8,129	46.80%	8,093	46.80%	8,094	46.80%	8,094	46.80%
8,233	48.30%	8,218	48.65%	8,253	48.65%	8,139	48.80%	8,140	48.80%	8,139	48.80%	8,109	48.80%	8,127	48.80%	8,126	48.80%
8,244	49.05%	8,225	49.25%	8,254	49.25%	8,140	49.20%	8,140	49.20%	8,140	49.20%	8,126	49.20%	8,141	49.20%	8,141	49.20%
8,255	49.65%	8,255	49.65%	8,273	49.65%	8,158	51.20%	8,160	51.20%	8,160	51.20%	8,146	51.20%	8,152	51.20%	8,152	51.20%
8,266	50.25%	8,259	50.25%	8,291	50.25%	8,246	52.70%	8,246	52.70%	8,246	52.70%	8,212	52.70%	8,216	52.70%	8,216	52.70%
8,289	52.25%	8,284	50.55%	8,313	50.55%	8,260	54.20%	8,262	54.20%	8,261	54.20%	8,224	54.20%	8,234	54.20%	8,233	54.20%
8,296	53.25%	8,306	52.55%	8,333	52.55%	8,287	55.20%	8,289	55.20%	8,289	55.20%	8,265	55.40%	8,280	59.20%	8,279	59.20%
8,310	53.55%	8,308	53.15%	8,336	53.55%	8,289	60.20%	8,291	60.20%	8,290	60.20%	8,269	60.40%	8,286	60.40%	8,284	60.40%
8,327	54.15%	8,313	54.15%	8,340	54.15%	8,293	61.20%	8,295	61.20%	8,294	61.20%	8,272	61.40%	8,291	61.40%	8,290	61.40%
8,328	55.65%	8,317	55.65%	8,353	55.65%	8,307	62.40%	8,308	62.40%	8,307	62.40%	8,283	62.40%	8,291	62.40%	8,291	62.40%
8,332	56.25%	8,322	57.15%	8,357	57.15%	8,412	62.70%	8,403	62.70%	8,406	62.70%	8,413	62.70%	8,377	62.70%	8,380	62.70%
8,348	57.75%	8,330	57.75%	8,367	57.75%	8,435	63.45%	8,428	63.45%	8,429	63.45%	8,427	65.70%	8,400	63.45%	8,401	63.45%
8,352	62.75%	8,364	62.75%	8,395	62.75%	8,444	65.95%	8,446	65.95%	8,445	65.95%	8,430	66.45%	8,440	66.45%	8,438	66.45%
8,389	64.25%	8,388	64.25%	8,429	64.25%	8,458	68.95%	8,461	68.95%	8,459	68.95%	8,433	68.95%	8,445	68.95%	8,443	68.95%
8,416	65.75%	8,389	64.70%	8,430	64.70%	8,479	69.55%	8,476	69.55%	8,479	69.55%	8,445	69.55%	8,450	69.55%	8,453	69.55%
8,417	66.20%	8,396	66.20%	8,434	66.20%	8,485	70.15%	8,481	70.15%	8,479	70.15%	8,485	70.15%	8,466	70.15%	8,464	70.15%
8,427	66.95%	8,404	67.40%	8,435	67.40%	8,538	70.45%	8,530	70.45%	8,533	70.45%	8,534	71.65%	8,503	71.65%	8,505	71.65%
8,427	68.15%	8,405	68.15%	8,439	68.15%	8,539	71.95%	8,531	71.95%	8,533	71.95%	8,539	71.95%	8,504	71.95%	8,507	71.95%
8,433	69.15%	8,455	69.15%	8,481	69.15%	8,546	72.55%	8,538	72.55%	8,540	72.55%	8,547	72.55%	8,515	72.55%	8,517	72.55%
8,496	71.65%	8,481	69.75%	8,511	69.75%	8,576	73.00%	8,568	73.00%	8,569	73.00%	8,564	73.00%	8,536	73.00%	8,537	73.00%
8,500	72.25%	8,511	70.65%	8,543	72.25%	8,595	74.50%	8,588	74.50%	8,589	74.50%	8,590	74.50%	8,563	74.50%	8,563	74.50%
8,526	73.45%	8,513	73.15%	8,552	73.15%	8,617	75.25%	8,609	75.25%	8,611	75.25%	8,606	76.00%	8,581	75.25%	8,583	75.25%
8,539	74.35%	8,523	76.15%	8,561	76.15%	8,630	76.75%	8,633	76.75%	8,631	76.75%	8,612	76.75%	8,611	76.45%	8,613	76.45%
8,539	74.95%	8,529	77.35%	8,566	77.35%	8,641	77.95%	8,633	77.95%	8,635	77.95%	8,642	77.95%	8,620	77.95%	8,618	77.95%
8,543	77.95%	8,544	77.95%	8,577	77.95%	8,697	78.85%	8,690	78.85%	8,691	78.85%	8,686	78.85%	8,658	78.85%	8,658	78.85%
8,579	78.85%	8,556	78.85%	8,602	78.85%	8,710	79.75%	8,703	79.75%	8,703	79.75%	8,694	79.75%	8,670	79.75%	8,670	79.75%
8,588	81.85%	8,586	81.85%	8,628	81.85%	8,713	80.35%	8,705	80.35%	8,707	80.35%	8,714	80.35%	8,682	80.35%	8,684	80.35%
8,632	82.30%	8,607	82.30%	8,647	82.30%	8,722	83.35%	8,715	83.35%	8,716	83.35%	8,717	83.35%	8,689	83.35%	8,690	83.35%
8,639	83.80%	8,624	83.80%	8,661	83.80%	8,738	83.95%	8,733	83.95%	8,733	83.95%	8,747	83.95%	8,726	83.95%	8,726	83.95%
8,681	84.40%	8,690	84.40%	8,727	84.40%	8,790	84.40%	8,783	84.40%	8,784	84.40%	8,779	84.40%	8,752	84.40%	8,753	84.40%
8,686	85.90%	8,691	85.90%	8,731	85.60%	8,818	85.90%	8,810	85.90%	8,811	85.90%	8,813	85.90%	8,787	85.90%	8,788	85.90%
8,693	87.10%	8,698	87.10%	8,731	87.10%	8,842	87.40%	8,837	87.40%	8,837	87.40%	8,843	87.40%	8,822	87.70%	8,822	87.70%
8,731	88.90%	8,708	88.90%	8,754	88.90%	8,861	89.20%	8,855	89.20%	8,855	89.20%	8,846	89.20%	8,826	89.20%	8,825	89.20%
8,743	90.40%	8,748	90.40%	8,788	90.40%	8,892	90.40%	8,886	90.40%	8,887	90.40%	8,900	90.40%	8,880	90.40%	8,880	90.40%
8,814	91.00%	8,824	91.00%	8,856	91.00%	8,979	91.30%	8,972	91.30%	8,972	91.30%	8,965	91.30%	8,944	91.30%	8,943	91.30%
8,847	91.90%	8,828	91.90%	8,873	91.90%	8,997	92.20%	8,993	92.20%	8,991	92.20%	8,983	92.20%	8,967	92.20%	8,966	92.20%
8,870	94.90%	8,875	94.90%	8,915	94.90%	9,020	92.80%	9,015	92.80%	9,015	92.80%	9,027	95.20%	9,012	95.20%	9,011	95.20%
8,907	95.80%	8,899	95.80%	8,949	95.80%	9,025	95.80%	9,021	95.80%	9,020	95.80%	9,037	95.80%	9,019	95.80%	9,018	95.80%
9,014	97.30%	9,025	97.30%	9,064	97.30%	9,180	97.30%	9,176	97.30%	9,175	97.30%	9,186	97.60%	9,173	97.60%	9,171	97.60%
9,107	99.10%	9,098	99.10%	9,148	99.10%	9,196	99.10%	9,192	99.10%	9,190	99.10%	9,190	99.10%	9,176	99.10%	9,175	99.10%
9,262	100.00%	9,260	100.00%	9,309	100.00%	9,368	100.00%	9,364	100.00%	9,362	100.00%	9,366	100.00%	9,353	100.00%	9,351	100.00%

Table 6E-2 - Cumulative Probability Plans 10-15 ($ in Millions)

NZ_10	NZ_10	NZ_11	NZ_11	NZ_12	NZ_12	NZ_13	NZ_13	NZ_14	NZ_14	NZ_15	NZ_15
20-Yr NPVRR ($M)	Cumulative Prob %	20-Yr NPVRR ($M)	Cumulative Prob %	20-Yr NPVRR ($M)	Cumulative Prob %	20-Yr NPVRR ($M)	Cumulative Prob %	20-Yr NPVRR ($M)	Cumulative Prob %	20-Yr NPVRR ($M)	Cumulative Prob %
7,521	0.200%	7,515	0.200%	7,516	0.200%	7,422	0.500%	7,712	0.500%	9,000	0.300%
7,534	0.70%	7,536	0.70%	7,536	0.70%	7,463	0.80%	7,719	0.80%	9,003	0.80%
7,593	1.10%	7,587	1.10%	7,589	1.10%	7,497	1.00%	7,729	1.80%	9,021	1.80%
7,638	2.10%	7,639	2.10%	7,640	2.10%	7,526	2.00%	7,742	2.20%	9,034	2.40%
7,647	2.30%	7,641	2.30%	7,643	2.30%	7,541	3.00%	7,747	2.80%	9,043	2.80%
7,652	2.70%	7,648	2.80%	7,650	2.80%	7,557	3.60%	7,772	3.40%	9,056	3.40%
7,661	3.20%	7,652	3.20%	7,652	3.20%	7,570	4.00%	7,786	4.40%	9,097	4.40%
7,666	3.50%	7,672	4.45%	7,672	3.50%	7,584	4.60%	7,816	5.40%	9,099	4.60%
7,678	4.75%	7,673	4.75%	7,673	4.75%	7,585	5.00%	7,841	6.00%	9,107	5.60%
7,690	5.75%	7,696	5.75%	7,696	5.75%	7,591	5.40%	7,841	6.20%	9,122	6.20%
7,716	6.25%	7,717	6.25%	7,718	6.25%	7,604	5.90%	7,887	6.60%	9,143	6.95%
7,733	7.25%	7,720	7.25%	7,723	7.25%	7,624	6.10%	7,894	7.10%	9,143	8.20%
7,747	8.05%	7,747	8.05%	7,748	8.05%	7,652	7.10%	7,898	7.90%	9,168	8.60%
7,782	10.55%	7,774	8.55%	7,776	8.55%	7,668	9.10%	7,899	9.10%	9,171	9.00%
7,787	11.05%	7,776	11.05%	7,777	11.05%	7,676	9.40%	7,913	11.10%	9,171	11.50%
7,788	11.65%	7,787	12.05%	7,789	12.05%	7,681	10.20%	7,914	11.50%	9,184	12.00%
7,792	12.25%	7,795	12.65%	7,794	12.65%	7,709	11.40%	7,925	13.50%	9,186	13.50%
7,795	13.25%	7,806	13.25%	7,804	13.25%	7,726	12.00%	7,933	13.80%	9,190	14.50%
7,813	14.00%	7,811	14.00%	7,812	14.00%	7,752	12.40%	7,967	14.00%	9,198	15.30%
7,817	16.00%	7,819	14.40%	7,819	14.40%	7,763	13.40%	7,982	14.80%	9,202	16.80%
7,819	16.40%	7,823	16.40%	7,823	16.40%	7,767	14.20%	7,997	16.00%	9,208	18.00%
7,838	18.90%	7,835	18.90%	7,836	18.90%	7,809	15.45%	8,008	17.00%	9,208	20.00%
7,846	19.30%	7,854	20.15%	7,855	20.15%	7,824	16.05%	8,014	17.60%	9,218	20.30%
7,860	20.55%	7,865	20.55%	7,863	20.55%	7,851	16.80%	8,038	18.00%	9,225	22.30%
7,883	20.85%	7,883	22.55%	7,884	22.55%	7,862	18.80%	8,054	19.25%	9,225	22.50%
7,890	22.85%	7,893	22.85%	7,892	22.85%	7,877	19.30%	8,054	19.65%	9,235	23.00%
7,915	23.85%	7,923	23.85%	7,922	23.85%	7,909	19.70%	8,064	20.40%	9,241	25.50%
7,934	25.35%	7,933	25.35%	7,933	25.35%	7,912	22.20%	8,088	22.90%	9,241	26.70%
7,940	26.35%	7,948	26.85%	7,947	26.85%	7,931	24.70%	8,089	23.90%	9,247	29.20%
7,942	27.85%	7,954	27.85%	7,956	27.85%	7,950	25.70%	8,095	24.90%	9,264	30.00%
7,944	29.05%	7,958	29.05%	7,956	29.05%	7,951	27.20%	8,099	26.40%	9,264	31.50%
7,962	30.05%	7,962	34.05%	7,963	34.05%	7,956	28.40%	8,133	28.90%	9,308	32.50%
7,964	35.05%	7,967	35.05%	7,963	35.05%	7,970	29.40%	8,133	30.40%	9,308	33.50%
7,997	36.05%	8,007	36.05%	8,006	36.05%	7,973	30.90%	8,157	32.90%	9,322	34.50%
8,001	36.85%	8,022	36.85%	8,019	36.85%	7,986	31.90%	8,175	33.40%	9,325	35.75%
8,029	37.60%	8,032	37.60%	8,031	37.60%	7,990	33.15%	8,177	34.00%	9,331	36.35%
8,062	40.10%	8,062	40.10%	8,062	40.10%	8,004	33.65%	8,185	35.50%	9,335	36.75%
8,066	40.70%	8,086	40.70%	8,083	40.70%	8,027	34.65%	8,226	36.50%	9,337	37.15%
8,078	41.30%	8,100	43.70%	8,099	43.70%	8,053	37.15%	8,235	37.75%	9,345	39.15%
8,094	43.80%	8,110	44.30%	8,105	44.30%	8,058	42.15%	8,248	38.75%	9,354	42.15%
8,094	46.80%	8,112	46.80%	8,109	46.80%	8,065	42.90%	8,250	41.75%	9,358	47.15%
8,125	48.80%	8,157	48.80%	8,153	48.80%	8,065	44.90%	8,252	43.75%	9,360	47.90%
8,139	49.20%	8,164	49.20%	8,161	49.20%	8,103	47.90%	8,259	48.75%	9,362	48.40%
8,152	51.20%	8,164	51.20%	8,162	51.20%	8,128	49.40%	8,277	49.50%	9,368	53.40%
8,216	52.70%	8,227	52.70%	8,226	52.70%	8,136	50.00%	8,283	54.50%	9,372	54.40%
8,234	54.20%	8,257	54.20%	8,253	54.20%	8,137	51.00%	8,302	55.00%	9,393	57.40%
8,280	59.20%	8,302	59.20%	8,299	59.20%	8,154	53.50%	8,322	57.00%	9,403	59.40%
8,283	60.40%	8,306	60.20%	8,304	60.20%	8,162	55.50%	8,355	59.50%	9,421	60.00%
8,289	61.40%	8,320	61.40%	8,315	61.40%	8,218	57.00%	8,358	62.50%	9,466	62.50%
8,290	62.40%	8,322	62.40%	8,317	62.40%	8,263	62.00%	8,365	64.00%	9,475	63.50%
8,384	62.70%	8,345	62.70%	8,352	62.70%	8,304	63.00%	8,392	65.00%	9,477	65.00%
8,406	63.45%	8,373	63.45%	8,380	63.45%	8,358	66.00%	8,393	66.00%	9,485	66.00%
8,439	66.45%	8,418	64.05%	8,425	64.05%	8,427	68.50%	8,448	68.50%	9,522	68.50%
8,444	68.95%	8,466	67.05%	8,462	67.05%	8,538	70.00%	8,537	70.00%	9,573	70.00%
8,457	69.55%	8,467	69.55%	8,464	69.55%	8,960	70.75%	9,277	70.75%	9,864	70.75%
8,463	70.15%	8,472	69.85%	8,479	69.85%	9,005	71.20%	9,290	71.20%	9,865	71.20%
8,509	71.65%	8,477	71.35%	8,483	71.35%	9,023	71.50%	9,328	72.70%	9,902	72.70%
8,510	71.95%	8,488	71.95%	8,494	71.95%	9,064	73.00%	9,330	73.30%	9,917	73.30%
8,521	72.55%	8,500	72.55%	8,495	72.55%	9,088	74.50%	9,332	74.20%	9,918	74.20%
8,542	73.00%	8,514	73.00%	8,519	73.00%	9,096	75.10%	9,361	75.70%	9,928	75.10%
8,569	74.50%	8,539	74.50%	8,545	74.50%	9,111	76.00%	9,375	76.60%	9,951	75.40%
8,588	75.25%	8,555	75.25%	8,561	75.25%	9,120	76.60%	9,381	78.10%	9,965	76.90%
8,617	76.45%	8,583	76.45%	8,589	76.45%	9,127	77.50%	9,392	78.40%	9,968	78.40%
8,619	77.95%	8,636	77.35%	8,641	77.35%	9,142	78.25%	9,411	79.30%	9,987	79.30%
8,664	78.85%	8,646	78.85%	8,642	78.85%	9,147	78.85%	9,448	79.90%	10,024	79.90%
8,676	79.75%	8,654	79.75%	8,659	79.75%	9,150	79.15%	9,459	80.65%	10,027	80.50%
8,688	80.35%	8,655	80.35%	8,661	80.35%	9,214	82.15%	9,464	81.25%	10,046	81.25%
8,695	83.35%	8,666	83.35%	8,672	83.35%	9,215	83.35%	9,483	83.05%	10,072	82.45%
8,731	83.95%	8,714	83.95%	8,718	83.95%	9,219	84.85%	9,487	84.25%	10,078	82.75%
8,758	84.40%	8,734	84.40%	8,739	84.40%	9,219	85.30%	9,488	87.25%	10,080	84.55%
8,793	85.90%	8,766	85.90%	8,771	85.90%	9,263	87.10%	9,503	87.70%	10,082	85.00%
8,827	87.70%	8,806	87.70%	8,811	87.70%	9,287	87.70%	9,518	88.00%	10,089	88.00%
8,832	89.20%	8,822	89.20%	8,825	89.20%	9,295	88.60%	9,524	91.00%	10,091	91.00%
8,886	90.40%	8,871	90.40%	8,874	90.40%	9,310	90.10%	9,543	92.20%	10,122	92.20%
8,949	91.30%	8,933	91.30%	8,937	91.30%	9,324	91.30%	9,583	93.70%	10,125	94.00%
8,972	92.20%	8,967	92.20%	8,969	92.20%	9,378	92.20%	9,598	94.60%	10,189	95.50%
9,017	95.20%	9,012	95.20%	9,014	95.20%	9,429	95.20%	9,600	96.40%	10,194	96.10%
9,024	95.80%	9,013	95.80%	9,016	95.80%	9,465	95.80%	9,615	97.00%	10,204	97.00%
9,178	97.60%	9,176	97.30%	9,178	97.30%	9,526	97.60%	9,626	97.60%	10,212	97.60%
9,181	99.10%	9,177	99.10%	9,179	99.10%	9,593	99.10%	9,688	99.10%	10,253	99.10%
9,358	100.00%	9,357	100.00%	9,358	100.00%	9,705	100.00%	9,780	100.00%	10,304	100.00%