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J. David Palmer
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December 30, 2022

Ms. Jennifer Ivory, Secretary
Arkansas Public Service Commission
P. O. Box 400
Little Rock, Arkansas 72203-0400

Re: APSC Docket No. 07-016-U
Entergy Arkansas, LLC 2021 Integrated Resource Plan Mid-Cycle Update

Ms. Ivory:

Consistent with Section 5 of Attachment 1 to the Arkansas Public Service Commission Order No. 6 – Docket No. 06-028-R Resource Planning Guidelines for Electric Utilities, Entergy Arkansas, LLC submits its 2021 Integrated Resource Plan Mid-Cycle Update.

Should you have any questions concerning this filing, please call me at (501) 377-3571.

Sincerely,

/s/ J. David Palmer

DP/dh

Attachments
c: All Parties of Record

Entergy Arkansas

2021 Integrated Resource Plan Mid-Cycle Update

Submitted December 30, 2022

2021 Integrated Resource Plan Mid-Cycle Update

Introduction

In October 2021, Entergy Arkansas, LLC ("EAL") filed its 2021 Integrated Resource Plan ("2021 IRP") in Docket No. 07-016-U. The 2021 IRP Report filing was the culmination of more than a year-long effort including detailed, long-term forecasts and assumptions, portfolio production cost modeling, and stakeholder engagement process. The 2021 IRP development began in mid-2020, and the first stakeholder meeting took place August 25, 2020. Instead of analyzing and planning for one set of outcomes, EAL's 2021 IRP employed a futures-based approach to evaluate portfolios across a broad range of potential future conditions as well as four additional sensitivity portfolios. The development of the next IRP will begin next year to be completed in 2024.

This document describes the mid-cycle update to EAL's 2021 IRP ("2021 IRP Update") consistent with the Commission's Resource Planning Guidelines from Order No. 6 in Docket No. 06-028-R. Similar to prior IRPs, EAL's 2021 IRP Update reflects the fact that uncertainty remains an issue that must be considered in long-term resource planning, with no outcome providing absolute certainty as to the appropriate path for the utility to take. EAL's specific long-term resource planning actions (e.g., capacity additions) typically are subject to review and approval by the Commission. The Action Plan contained within this 2021 IRP Update reflects EAL's current expectations regarding the planning actions the Company will take over the next several years and identifies a preferred portfolio based on information currently available.

Implementation of the Plan

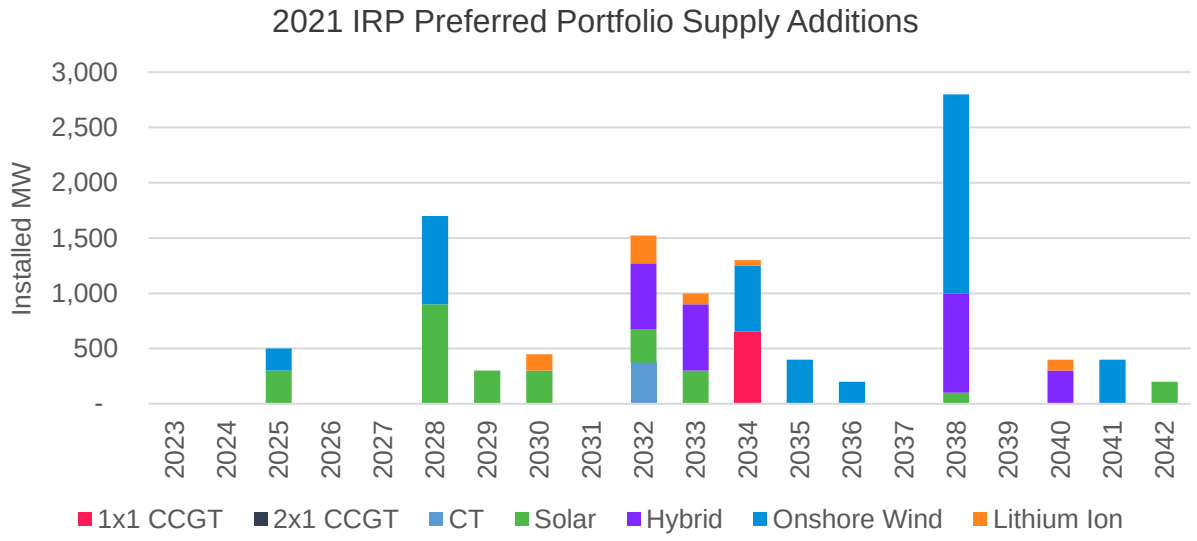
The action items below represent a pragmatic approach to EAL's integrated planning over the 2021 - 2024 time frame. The purpose of 2021 IRP Update is to refresh the implementation of the 2021 IRP Action Plan. In its review of the 2021 IRP Action Plan, EAL concluded that most of the action items are progressing as planned. The status of each item as of the fourth quarter of 2022 is summarized in the table below.

2021 IRP Action Plan Progress

1. Complete the Acquisitions of Searcy, Walnut Bend, and West Memphis Solar Build-Own-transfer Resources	EAL completed the acquisition of Searcy Solar in January 2022 and is working to complete the acquisitions of Walnut Bend and West Memphis facilities.
2. Complete the 2021 Renewables RFP	In August 2021, EAL issued its 2021 Renewables RFP and completed the RFP in early 2022. EAL plans to seek approval of the 2021 Renewables RFP selections in 2023.
3. Effectuate the Deactivation of Lake Catherine 4 in 2025	In preparation for the assumed deactivation of Lake Catherine Unit 4 in 2025, EAL is evaluating the Lake Catherine 4 site and determining the best path forward. The results of that evaluation will be considered as part of the 2024 IRP.
4. Identify Demand-side Management Opportunities	EAL is exploring a potential DR device that is compatible with AMI communications. Evaluation of this two-way communication device is underway, and a potential pilot could take place in 2023.
5. Continue Participation in EE	EAL will continue to offer cost effective EE and DR programs within the Commission's Rules for Conservation and EE Programs and subsequent future Commission orders as provided through Arkansas law, including the targets defined in EAL's 2023 bridge year as filed in in Docket No. 07-085-TF.
6. Pursue Power Resiliency	EAL will develop and implement customer-centric power resiliency solutions. Power Through represents EAL's initial power resiliency offering. Upon APSC approval, EAL will offer Power Through to its customers starting in 2023 time period.
7. Implement Sustainable Solutions	EAL continues to work toward the development and implementation of customer-centric sustainability solutions. Green Promise is a green tariff designed to assist residential (including low-income) and nonresidential customers in the achievement of their sustainability objectives. EAL has begun offering Green Promise to its customers, and the current non-residential designated solar capacity is fully subscribed. Also, in conjunction with Action Plan Item #2, additional customer-centric sustainability solutions will be considered as additional renewable resources are selected.

8. Evaluate Stakeholder Engagement	Stakeholder engagement was an important part of the development of the most recent IRP. EAL hosted a stakeholder meeting to review the mid-cycle update on November 2, 2022. EAL will continue to review the stakeholder report, which can be found in Appendix H of the 2021 IRP report, and taking steps to address feedback regarding the Company's IRP process.

The chart below shows the annual incremental supply additions in the 2021 IRP Preferred Portfolio (Future 1 Sensitivity Portfolio 4).



In addition to the progress toward the action plan items reviewed above, EAL also considered revisions to the Preferred Portfolio in response to customer interest in renewable energy. Increasingly, our customers are becoming more interested in sourcing their power from cleaner, more sustainable sources of energy, with clear preference for renewable resources like solar. This is evidenced by the strong interest in Green Promise, as discussed above. Utility offerings like Green Promise are an option sought by many customers to provide them the ability to subscribe directly to output from a renewable resource while avoiding the financial and operational risks associated with building or contracting for their own renewable facilities. In response to EAL's customer needs, the evaluation of additional renewable resources was completed as part of this 2021 IRP Update.

For the 2021 IRP Update, a small number of revisions were made to the Preferred Portfolio in order to better align with the updated load forecast, which is described below. The Driver Solar resource was also added to the portfolio in 2025. A second portfolio, Portfolio 2, was also developed and evaluated as part of the 2021 IRP Update. Portfolio 2 is identical to the updated Preferred Portfolio with the exception of 1,000 MW of incremental renewable resources added in 2026. To assess the additional 1,000 MW of renewables, the total relevant supply cost was modeled for both portfolios under the 2021 IRP Future 1 set of assumptions with only the load forecast being updated since the 2021 IRP. The modeling and results are described in more detail below.

Load Analysis and Forecasting

Load Scenario Introduction

Each year, EAL develops a load forecast that is used for financial and resource planning. That load forecast is developed sequentially starting with a forecast of monthly billed energy by customer class, which is then converted to a calendar month view, which is then converted into hourly loads across each month. That load forecast is often used as the Base Case or Reference Case for scenario analysis, including for the IRP process.

For this report, EAL is using a scenario referred to as the "Mid-Cycle Scenario", which is based on EAL's 2022 Reference Case forecast with some adjustments for new industrial load as well as significant electrification load opportunity over the planning horizon. Elements of this scenario's components are discussed below along with a comparison of that scenario's results to the results of the Future 1 scenario from EAL's 2021 IRP.

Reference Case Energy Forecast

The Reference Case energy forecast was developed using a bottom-up approach by customer class – residential, commercial, large industrial, small industrial, and governmental. The forecast was developed using historic sales volumes, customer counts, and temperature inputs from January 2010 through April 2021 as well as future estimates for normal weather and energy efficiency. In addition, the forecast includes future growth in large industrial usage, estimates of future consumption growth from EVs, declines due to future rooftop solar adoption, as well as adjustments to consumption as a result of the COVID pandemic.

Regression Models for Non-Large Industrial Forecasts

The energy forecasts for the residential, commercial, small industrial, and governmental classes were developed individually using statistical regressions and MetrixND software and a mix of historical data and forward-looking data. The historical data primarily includes monthly billed consumption volumes by class, customer count by class, and temperature data converted to cooling degree days (CDDs) and heating degree days (HDDs). Some of the forecasts also use indices for elements such as population, employment, and levels of end-use consumption for things such as heating/cooling, refrigeration, and lighting. These data are used within the Metrix ND software to develop statistical relationships between historical consumption levels and explanatory variables such as weather, economic factors, and/or month-of-year. Normal weather is developed using the last 20 years of weather data and is used with economic factors and/or month-of-year to develop the energy forecast.

Residential and Commercial Energy Forecasts

The long-term residential and commercial forecasts are relatively flat in the near-term as small increases in customer counts over time are dampened by decreases in average use per customer ("UPC") due to the effects of energy efficiency. Longer term, both forecasts start to turn upward as expected increases in electric vehicle adoption result in increased electricity consumption. Even with that growth, the annual growth for these two classes combined is 0.2%/yr. CAGR (2022-42).

Governmental Forecast

Governmental electricity consumption represented around 1% of EAL's total volume in 2019, though in the Reference Case forecast, these energy levels decrease by 30% due to significant levels of customer-contracted solar energy that is expected in EAL's area.

Small Industrial Forecast

The small industrial forecast includes industrial usage that is not forecasted individually in the large industrial forecast process described below. Forecasts are based on historical trends and IHS economic indices for employment in EAL's service area. EAL's small industrial energy is expected to be flat-to-declining based on these trends.

Large Industrial Forecast

The large industrial forecast reflects significant near-term growth, primarily due to a large prospective customer's announcement to build a new facility in EAL's area. All of the large industrial growth included in the Reference Case forecast increases the expected large industrial consumption volume from 3.7TWh in 2023 to almost 7TWh by 2025 with relatively flat 0.125%/yr. CAGR assumed from 2025 through 2042.

Demand Side Management (DSM)

EAL has had company-sponsored DSM programs since 2008, such as ones targeted for lighting, appliances, and HVAC efficiency. The effects of each program year's DSM efforts carry forward into future years, resulting in lower electricity consumption for years to come. For the Reference Case forecast, EAL assumes that incremental programs will continue into the future, reducing consumption over levels that would occur if new programs ended.

Solar

The Reference Case forecast includes modest reductions in energy as a result of expanding adoption of customer-owned, behind-the-meter (rooftop) solar. The forecast also includes expected reductions in energy as a result of Act 464 in Arkansas, affecting the Commercial and Governmental customer classes. By 2042, these factors are expected to reduce combined sales to the residential, commercial, and governmental classes by 6.7% based on current subsidies provided under Arkansas law.[1]

Electric Vehicles (EVs)

The Reference Case forecast includes an assumed level of additional energy consumption resulting from the adoption of EVs as well as growth in the numbers of total on-road EVs over time as overall population is expected to continue to increase. The adoption over time is gradual based on an S-curve that assumes 99% of all light-duty vehicle sales will be EVs by 2075. The effects for EAL are based on the estimated proportional numbers of vehicles in each jurisdiction

[1] As explained by the Company in other proceedings, remote solar facilities export their entire generation to the grid, which is then off-set at other customer locations without reducing any energy consumption. See, e.g., Klucher Direct Testimony in Docket No. 22-061-U at 10. Because there is no reduction in consumption and EAL cannot rely on net-metering facilities to meet the Company's capacity and energy obligations, the Act 464 adjustments performed in the Reference Case are added back to determine the IRP capacity position.

within Entergy's footprint. By 2042, it is expected that EVs could add over 1,000,000 MWh to EAL's annual electricity demand.

Electrification

The Reference Case forecast assumed certain levels of increased electricity consumption due to electrification such as diesel-to-electric conversions, electric drive forklifts, electrified billboard, and other programs. These programs may be expected to add just over 440,000 MWh of consumption by 2042.

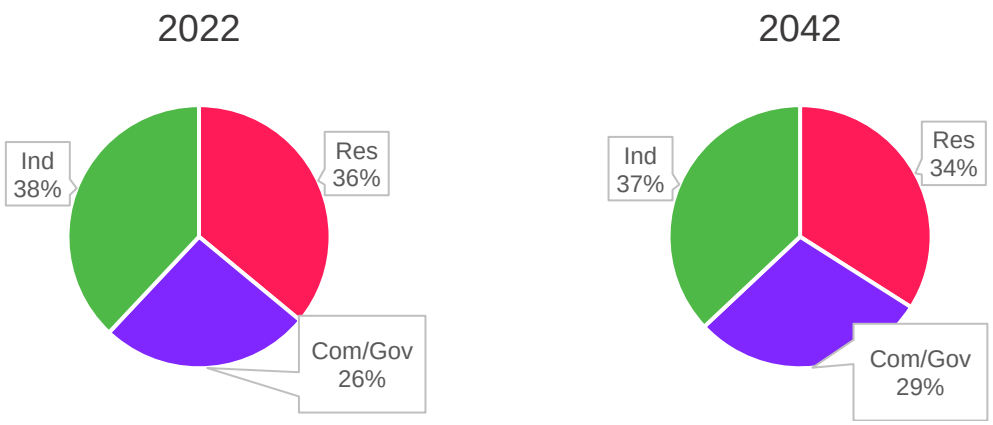
Additionally, and most significantly, the Mid-Cycle Scenario forecast includes large amounts of incremental electrification opportunity. This electrification was based on several elements, most of which start at small levels that increase over time. These elements include:

- Increased space heating and water heating load for residential and commercial above levels already included in the forecast
- Industrial electrification coming from growing production of hydrogen for use as an energy source, decommissioning of cogeneration, process electrification, and carbon capture

This incremental electrification added over 9,000,000 MWh to the annual sales volume by 2042 and added roughly 1,100MW to the forecasted peak.

Mid-Cycle Forecast Results

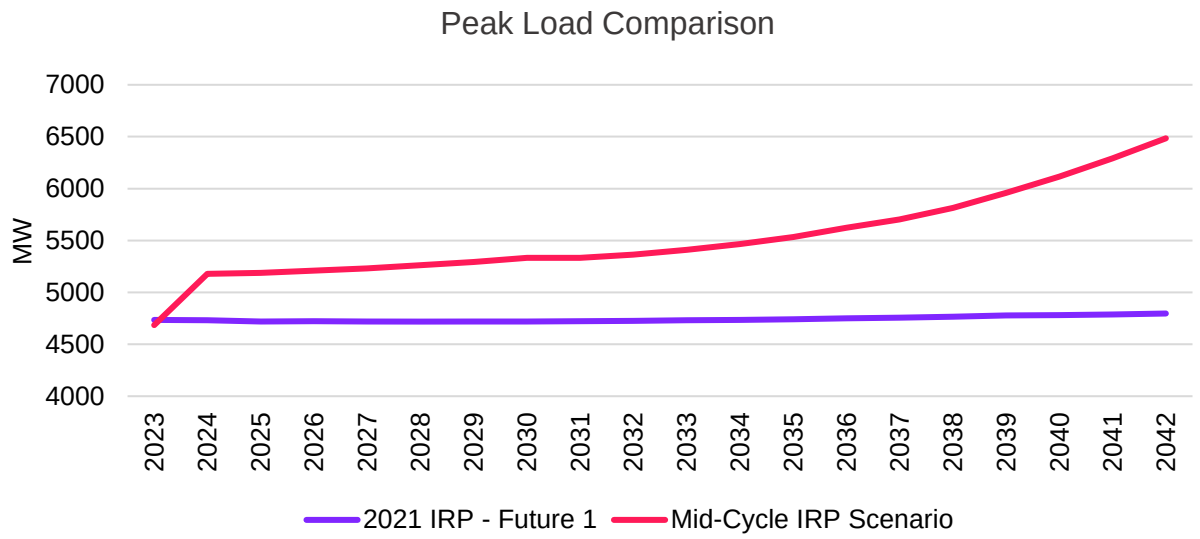
In total, the Mid-Cycle Scenario assumes significant growth over the planning period, primarily due to the incremental electrification opportunities. Early in the forecast period, there is also material growth due to known industrial customers locating in EAL's area. Over time, the annual energy consumption in this scenario grows from 22 TWh to nearly 35 TWh. As shown below, the energy mix by customer class changes only slightly over time as electrification growth affects all customer classes.



Comparison

The annual peaks from Future 1 of the 2021 IRP and from this Mid-Cycle Scenario are shown comparatively in the chart below. Future 1's estimated peaks were relatively flat through the end of the decade but start to tick upwards in the 2030s and beyond due to assumed levels of EV adoption. When shown alongside the Mid-Cycle Scenario, however, Future 1's peaks appear to have minimal change for the entire period.

The significant increases assumed for the Mid-Cycle Scenario are reflected in the chart below. The steep change by 2024 is due to the growth in known industrial projects mentioned above. Starting around 2025, the significant electrification load described above begins to appear and, along with the known industrial growth, increases the peak load by 35% or nearly 1,700MW to nearly 6,500MW by 2042.



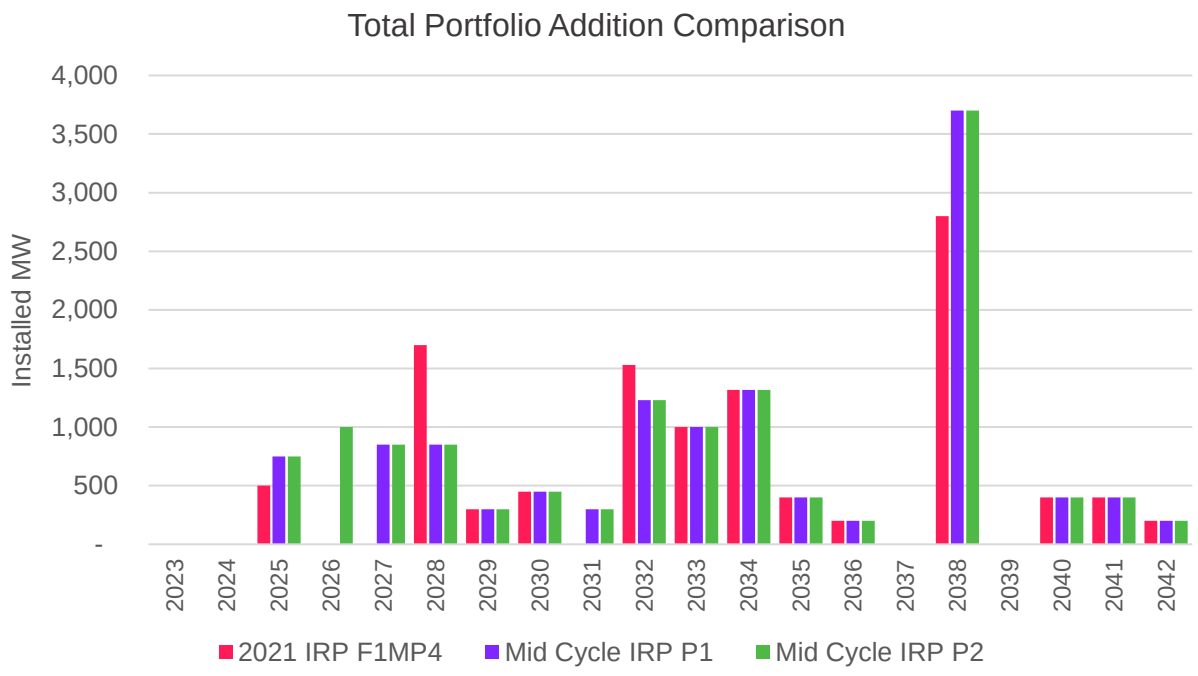
Model Inputs, Assumptions, and Framework

Key Changes to Input Assumptions

For the 2021 IRP Update portfolios, the hourly load forecast was updated as well as the Generation Verification Test Capacity ratings for all existing resources, Load Modifying Resource capacity ratings, and Purchase Power Agreement resources to align with the 22/23 MISO Planning Year assumptions. Two distinct portfolios were created with the following changes from Future 1 Manual Portfolio 4:

Portfolio	Change from F1MP4
P1 & P2	450 MW solar & 400 MW wind shifted from 2028 to 2027
P1 & P2	300 MW solar shifted from 2032 to 2031
P1 & P2	900 MW hybrid solar added in 2038
P2 only	500 MW solar & 500 MW wind added in 2026

The chart below compares the total portfolio additions between Future 1 Manual Portfolio 4 and Mid-Cycle IRP Portfolios 1 and 2:



The table below compares the installed and effective capacity additions of F1MP4, P1, and P2 by Technology Type:

Technology	F1MP4 Installed MW (ICAP)	F1MP4 Effective MW (UCAP)	P1 Installed MW (ICAP)	P1 Effective MW (UCAP)	P2 Installed MW (ICAP)	P2 Effective MW (UCAP)
2x1 CCGT	-	-	-	-	-	-
1x1 CCGT	667	650	667	650	667	650
CT	380	372	380	372	380	372
Single Axis Solar	2,700	810	2,950	885	3,450	1,035
Solar + Battery	2,400	1,440	3,300	1,980	3,300	1,980
Lithium-Ion Battery	650	650	650	650	650	650
On-shore Wind	4,400	730	4,400	682	4,900	760
Total Supply Side Additions	11,197	4,652	12,347	5,219	13,347	5,447
DR (average)	110	110	110	110	110	110

Capacity Resource Options

The capacity resource options were not refreshed for the 2021 IRP Update. Refer to Chapter 4 of the 2021 EAL IRP, pages 40-50, for the methodology and assumptions associated with the resource alternative options in the 2021 IRP.

Environmental

The assumptions around environmental regulations and emissions pricing were not refreshed for the 2021 IRP Update. Refer to Chapter 4 of the 2021 EAL IRP, pages 51-55, for the environmental assumptions in the 2021 IRP.

Fuel Price Forecasts

The fuel price forecast assumptions in the 2021 IRP were determined to be reasonable relative to recent pricing and, therefore, were also used in the 2021 IRP Update. Refer to Chapter 4 of the 2021 EAL IRP, pages 56-57, for the fuel price forecasts used in the 2021 IRP.

Modeling Framework

Market Modeling

The 2021 IRP Update Aurora model retained the same modeling structure as the 2021 IRP. The modeling assumptions for the market are aligned with IRP Future 1, which is defined by reference load growth, fuel prices, DSM additions, and CO2 reduction targets. Because the market assumptions were not adjusted, the Future 1 market supply projection produced through Aurora capacity expansion modeling described in the 2021 IRP also was modeled in the 2021 IRP Update. Refer to Chapter 5 of the 2021 EAL IRP, pages 58-59 and 61-62, for the market futures and market supply assumptions in the 2021 IRP.

Total Relevant Supply Cost Modeling

For the Input and Assumption changes, the Total Relevant Supply Cost in the 2021 IRP did not include Production Tax Credit (“PTC”) benefits or Renewable Energy Credits (“REC”) benefits, but the 2021 IRP Update includes the impact of the PTC under the Inflation Reduction Act and REC benefits. REC benefits are included in the portfolio Total Relevant Supply Cost evaluation to approximate the value to EAL customers of renewable resources’ contribution to meeting their sustainability goals.

Solar and Wind PTC: $26/MWh (2022$)

Solar REC Value: $4.49/MWh (2022$)

Wind REC Value: $3.26/MWh (2022$)

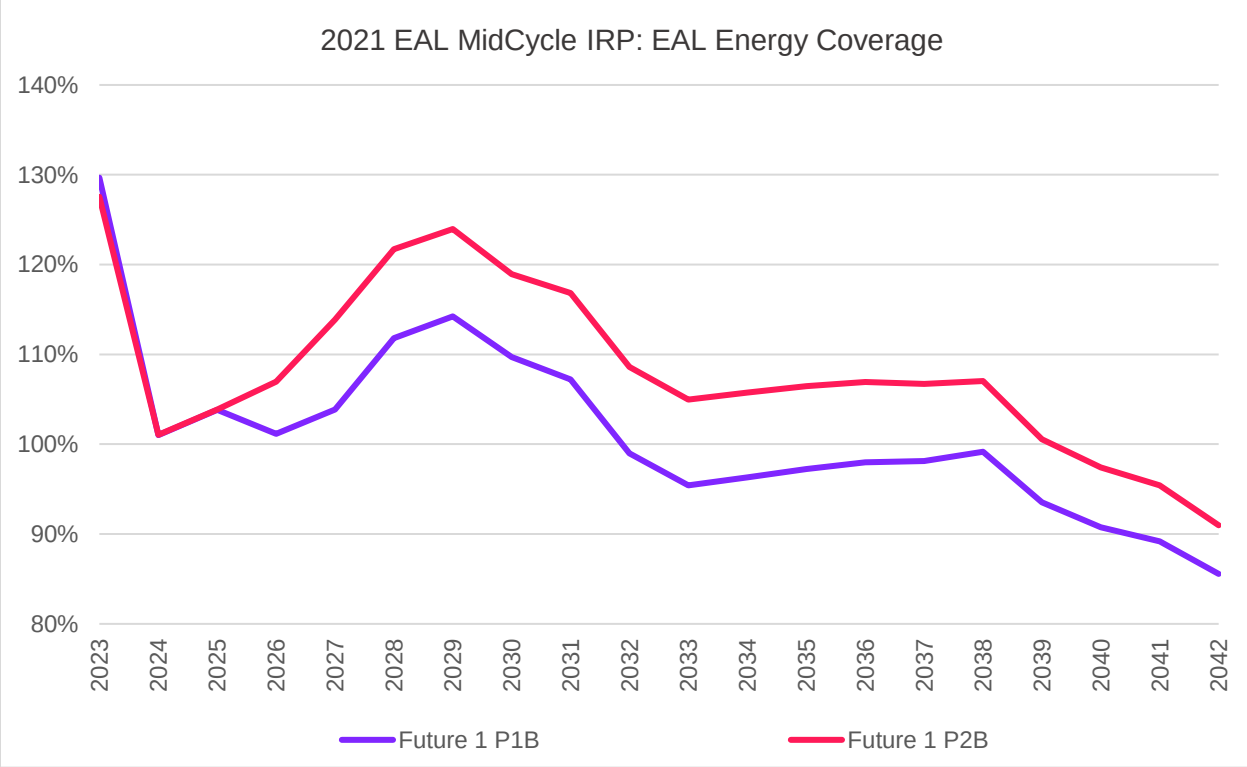
Modeling Results

Total Relevant Supply Cost

The two proposed EAL portfolios, P1 and P2, were modeled in and simulated with the Aurora production cost model along with Future 1 market assumptions and updated EAL load assumptions. The EAL variable supply cost projections from Aurora were combined with other spreadsheet-based cost components to produce the relevant supply cost. The results of the analysis are summarized below.

Portfolio Analysis

A number of factors are considered and evaluated in order to understand and determine how effectively the proposed portfolios meet EAL's needs and requirements:



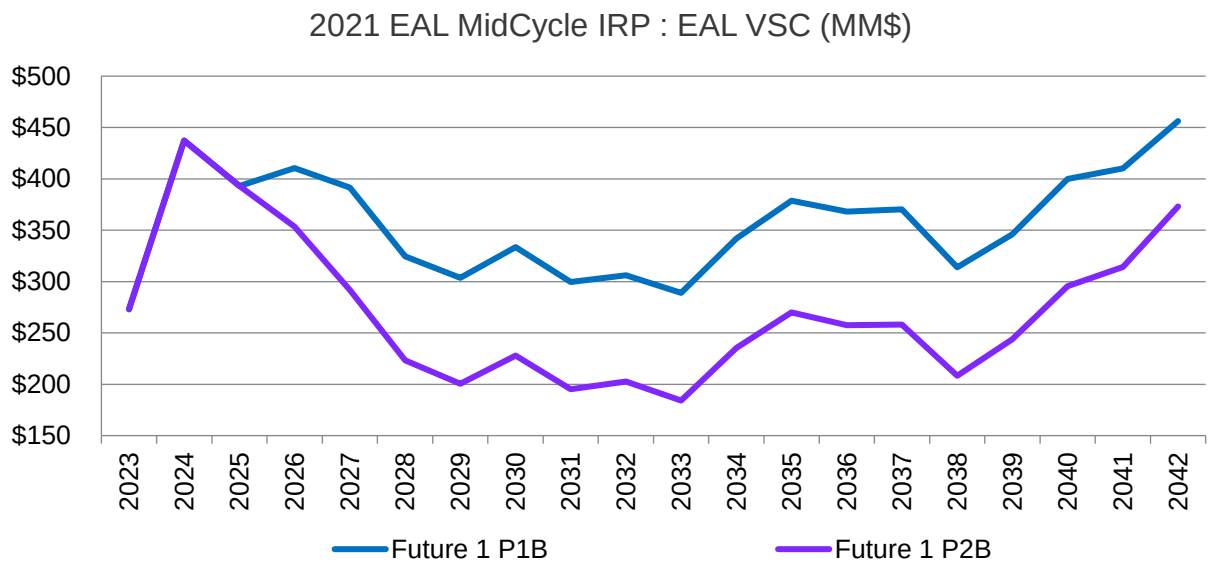
Energy Coverage - Reviewing market relative energy coverage within the MISO market metrics allows EAL to assess the level of exposure to market prices for a portfolio. A portfolio that is forecasted to generate less or more energy relative to its demand relies on the MISO energy market to make up its need, resulting in a higher energy price risk if LMPs are higher than anticipated, or higher fixed-cost risk if LMPs are lower than anticipated. The IRP should provide adequate resources to meet EAL's customer demands and expected contingency events in keeping with established reliability standards. The IRP should reflect baseload resources that provide stable long-term production costs and low operating costs to serve baseload energy requirements.

Based on the portfolios of P1 and P2, EAL is expected to be able to meets its near-term energy requirements effectively without having to relying on the MISO market. As deactivation assumptions are applied and as the load grows Portfolio P1 begins to fall short of being able to meet customer demand without having to import energy starting in year 2032. In Portfolio P2B, with the additional resources added in 2026, EAL maintains an energy surplus until year 2039. However, the amount of energy produced by owned generation is subject to change based on fuel prices, market conditions, and unit operations.

Through the technology assessment and the IRP analytics, EAL evaluates energy-producing resources like renewable energy and dispatchable natural gas resources to meet both capacity and energy requirements over the long-term planning horizon. As resources deactivate and capacity requirements increase, EAL will look to balance energy producing and peaking generation to meet customer requirements effectively and efficiently.

Sustainability Goals – Building on its longtime legacy of environmental stewardship, Entergy has enhanced its climate action strategy with a near-term goal to reduce the utility emission rate by 50 percent by 2030 in comparison to Entergy's emission rate from its baseline year of 2000, and a longer-term commitment: Entergy will work over the next three decades to reduce carbon emissions from its operations to net-zero by 2050. EAL intends to contribute to these goals by working with its regulators and other stakeholders to balance reliability, affordability, and sustainability.

The IRP should provide a generation portfolio that over time will realize the efficiency and emissions benefits of technology improvements and that avoids an over-reliance on aging resources. The IRP should consider and seek to mitigate the risk exposure to major supply disruptions such as outages at a single generation facility or the source of fuel supply. Analyzing the relative CO_2 emissions impact of a portfolio allows EAL to understand the risks associated with changing laws, regulations, and environmental market pressures. In the two portfolios evaluated, the CO2 emission rate decreases year by year as EAL becomes less reliant on thermal units as new non-emitting resources are added to their portfolios.



Variable Supply Cost - The variable supply cost projections from the Aurora model for each portfolio include fuel costs, variable O&M costs, emission costs, startup costs, energy revenue, make-whole payments, and uplift charges. In the chart above, you can see that the additional renewables added in 2026 decrease EAL's VSC and further minimize EAL's risk to changing fuel prices.

TRSC Results Compared to Lowest Cost Portfolio

	Cost [$MM, 2021$ NPV]	Variance to P2 [$MM, 2021$ NPV]
P1	$8,849	$762
P2	$8,087	$--

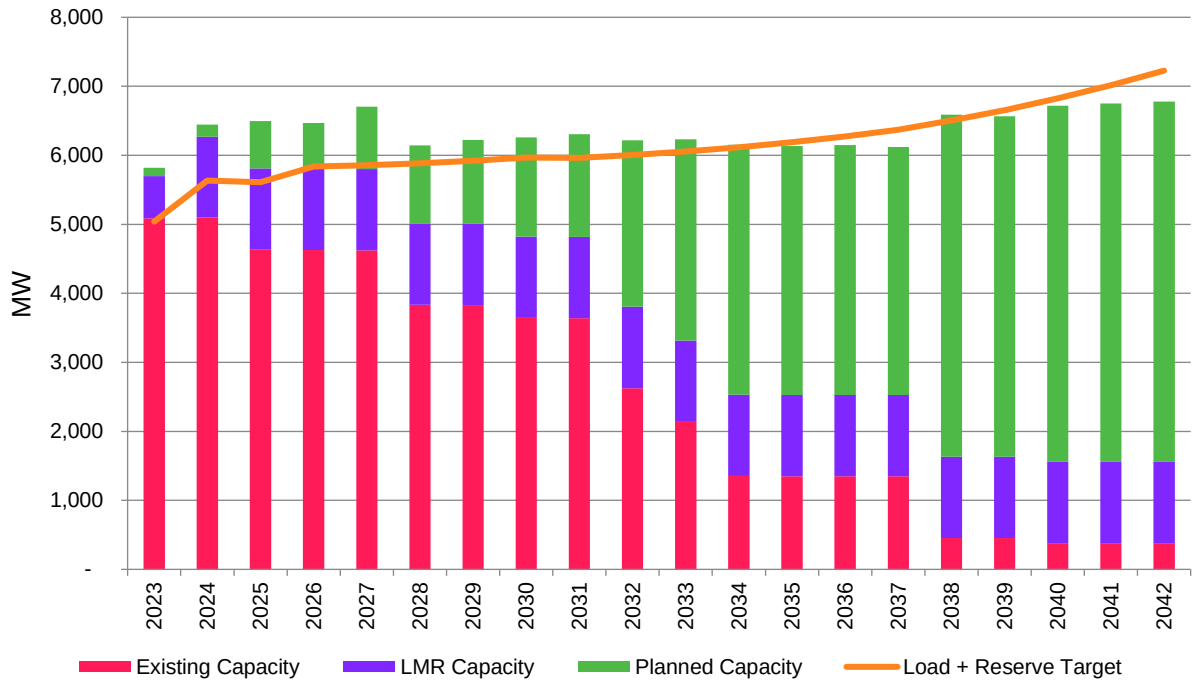
The Total Relevant Supply Cost results above include the impact of the PTCs under the Inflation Reduction Act. The current analysis assumes that the $26/MWh PTC will be achieved through compliance with the prevailing wage and apprenticeship requirements of the IRA. This does not factor in the additional effects of the domestic content and energy community provisions under the IRA, nor does it factor in the effects of the book minimum tax. We continue to assess these impacts and as such, the final value of the PTCs may be higher or lower than estimated here. We are also valuing the impact of the REC Values in the Total Relevant Supply Cost Results above.

If we consider the PTC and REC benefits, the Total Relevant Supply cost decreases with the 1000MW renewable resource addition when comparing the P1 and P2 portfolios. These results do not include terminal value or higher PTC levels, which are both value drivers that would make the case for adding more renewable resources even more compelling.

2021 IRP Update Preferred Resource Plan

Based on the modeling, analysis and findings discussed above, the 2021 IRP Update supports the conclusion that EAL's future supply-side resources will be focused primarily on renewable energy resources with additions beginning in 2025. Based on the work conducted as part of the 2021 IRP Update analysis, it is also reasonable to add 1,000 MW of incremental renewable resources by 2026 to the Preferred Portfolio. In the near term, renewable resource additions will be made based on specific project proposals. Over the long-term, the amount of total capacity that will be needed and exactly when that capacity will be needed are uncertain.

EAL's updated preferred resource plan maintains the planning assumptions for existing units and begins adding renewable resources starting in 2025 consistent with Portfolio 2 though the exact amount of each type of renewable resource will be based on a market solicitation and may vary from the amounts in Portfolio 2. The revised Preferred Portfolio is shown below.



In order to progress toward the Preferred Portfolio, an additional item will be added to the Action Plan:

9. **Complete the 2022 Renewable RFP:** In June 2022, EAL issued its 2022 Request for Proposals for Renewable Resources and is expected to be completed in early 2023. The RFP is seeking to procure up to 1,000 MW of solar and/or wind resources with PPA deliveries starting and/or acquisitions starting in the 2025-26 timeframe.