SOUTHERN INDIANA GAS AND ELECTRIC COMPANY
d/b/a VECTREN ENERGY DELIVERY OF INDIANA, INC.
(VECTREN SOUTH)

IURC CAUSE NO. 44927

REBUTTAL TESTIMONY
OF
MATTHEW E. LIND
ASSOCIATE PROJECT MANAGER, BURNS & MCDONNELL

ON

ENERGY EFFICIENCY MODELING

SPONSORING PETITIONER'S EXHIBIT NO. 13,
ATTACHMENTS MEL-1 THROUGH MEL-2

VERIFIED REBUTTAL TESTIMONY OF MATTHEW E. LIND

I. INTRODUCTION

Q. Please state your name, title and business address.

A. My name is Matthew E. Lind. I am an Associate Project Manager within the Business & Technology Services global practice of Burns & McDonnell. I work at the following address: 9400 Ward Parkway, Kansas City, MO 64114.

Q. Did you provide direct testimony on behalf of Vectren South in this Cause?

A. Yes. I provided testimony to support how energy efficiency ("EE") programs were modeled and evaluated within Vectren South's 2016 Integrated Resource Plan ("IRP") through the use of the optimization software program Strategist.

Q. What is the purpose of your rebuttal testimony?

A. I will respond to criticisms made by Citizens Action Coalition, Inc. ("CAC") witnesses Sommer and Stanton regarding certain aspects of the modeling of EE programs within Vectren South's 2016 IRP.

Q. Are you sponsoring any attachments?

A. Yes. I am sponsoring the following attachments:

- Petitioner's Exhibit No. 13, Attachment MEL-1, which is a chart that shows NPV calculation comparisons for one block of energy efficiency ("EE") selected in 2018 versus 2034; and
- Petitioner's Exhibit No. 13, Attachment MEL-2, which is the file key and reference guide provided to the CAC as part of a data request, along with approximately 2600 modeling files.

II. EE MODELING IN VECTREN SOUTH'S 2016 IRP

Q. What criticisms did the CAC make regarding the modeling used in the 2016 IRP relevant to this case?

A. CAC witnesses Sommer and Stanton both asserted their belief that the 2016 IRP

does not provide an optimal balance of energy resources. Ms. Sommer testified that Vectren constrained Strategist from selecting certain resource options and had not given sufficient background information into the iterative process used to develop the 2016 IRP. She also complains that the methodology used to model EE costs in Strategist were "far more complicated" and "less transparent" than what she refers to as "standard methods" and that the method is inconsistent with the way in which most utilities recover energy efficiency costs. I will respond to each of these criticisms in turn and explain how the 2016 IRP was developed using a reasonable approach.

Q. How do you respond to Ms. Sommer's statements about the complicated nature of the methodology used to model EE costs in Strategist and its inconsistency with the manner in which energy efficiency costs are recovered?

A. The EE costs were modeled as levelized costs over the average program life (10 years). This allocates or spreads costs over the same period of time that the programs affect the customer sales forecast. This approach is comparable to how new supply side alternatives are modeled and evaluated. For EE selected in years 1-11 of the study period, the modeling of cost as levelized or "as spent" has no impact to the net present value ("NPV") of a portfolio because all costs are recognized within the 20 year study period. For example, four blocks selected in 2018, 2019, and 2020 would represent the same portfolio NPV regardless of whether the cost was modeled "as spent" or levelized. For EE selected in years 12-20 of the study period, the portfolio NPV over the study period is lower when costs are modeled as levelized rather than "as spent" because all costs are not recognized within the 20 year study period. See Petitioner's Exhibit No. 13, Attachment MEL-1 for an example of this NPV calculation comparison for one block of EE selected in 2018 versus 2034. By representing costs over the program life rather than an up front or "as spent" cost, it reduces model selection bias for selecting alternatives choices in the later years of the study period. This approach improves the likelihood of selecting EE as a resource.

Q. Ms. Sommer asserts that the 2016 IRP constrained Strategist from

selecting certain resource options, particularly renewable demand response and energy efficiency." What do you understand to be her support for this contention?

A. I believe Ms. Sommer simply relied on the wrong IRP files or too narrow of a set of files to make her conclusion. Based on her testimony (see CAC Exhibit 2, p. 7, lines 1-3), it appears that she is relying on a single portfolio file based on the portfolio letter in the report file names "e.g. "D" corresponds to the High Regulatory Scenario" to identify them as what "appear to correspond with the final version of each scenario".

The identification of a low cost, computer generated portfolio relied on eight (8) different optimization iterations that were performed for each of the seven (7) different scenarios. Each optimization iteration had a unique resource availability constraint set up and some resources were not available in every iteration. This was done recognizing that there were too many choices for Strategist to be able to fully consider every option simultaneously over a 20 year study period. Therefore, one must look at every optimization iteration before determining whether a resource was considered or not considered as part of the computer generated portfolio. In looking at or referencing only a single file/single resource constraint set up, you could mistakenly conclude that certain resources were not considered based on the constraint set up of that single file.

Anticipating some confusion, a file key and reference guide was provided as part of the data request package (see Petitioner's Exhibit No. 13, Attachment MEL-2); however, no further questions or clarifications were requested by the CAC/Ms. Sommer upon receipt of the more than 2,600 files provided as part of the response to their data request. Vectren South has updated Table 1 from CAC Exhibit 2 to show the actual year particular resources were first available to be selected within at least one of the 8 model optimization iterations performed for each scenario. The cells shown in orange indicate the incorrect dates in CAC Exhibit 2, Table 1. Vectren South struck through the incorrect years and added back the first year the identified resources were actually available for selection in each scenario.

Table MEL-1

Resource	Base	High Regulatory	Low Regulatory	High Technology	High Economy	Low Economy	Base + Large Load
200 MW Wind	~~2099~~ 2019	~~2030~~ 2019	~~2099~~ 2019	~~2099~~ 2019	~~2024~~ 2019	~~2099~~ 2019	~~2025~~ 2019
50 MW Solar	~~2099~~ 2019	~~2099~~ 2019	~~2099~~ 2019	~~2099~~ 2019	~~2099~~ 2019	~~2036~~ 2019	~~2024~~ 2019
50 MW Wind	2019	~~2099~~ 2019	~~2099~~ 2019	~~2099~~ 2019	~~2099~~ 2019	~~2099~~ 2019	~~2025~~ 2019
9 MW Solar	2019	~~2099~~ 2019	~~2099~~ 2019	~~2030~~ 2019	~~2024~~ 2019	~~2035~~ 2019	~~2025~~ 2019
4 MW DR	2020	~~2099~~ 2020	2020	~~2099~~ 2020	2020	2020	2020
EE	2018	2018	2018	~~2099~~ 2018	2018	~~2099~~ 2018	2018

Q. Ms. Sommer specifically raises three questions regarding the iterative process applied to each alternative she says Vectren has not answered: (1) why Vectren kept some resources but not others; (2) how and in what order each resource was evaluated, and (3) how one should interpret the results of any of these scenarios. Are you able to answer those questions?

A. With respect to Question (1) – As explained in previously submitted IRP Comments, by correcting CAC's table to indicate the first year where each resource alternative was considered shows that all resources were considered during one of the steps in the iterative analysis. Her misunderstanding of the files and this process led to a faulty conclusion regarding resource consideration.

With respect to Question (2) – As shown in Petitioner's Exhibit No. 13, Attachment MEL-2, page 3 (Process Flow), this iterative process was illustrated through a decision tree and was also described in the callout text on Petitioner's Exhibit No. 13, Attachment MEL-2, pages 1-2 (File Matrix). This file was provided to the CAC in January accompanying the Strategist reports. This provides an explanation as to the analytical focus of each iteration. CAC simply omitted reference to this information.

With respect to Question (3) – The iterations within each of these scenarios helps

inform the resource decisions and timing associated with the low cost computer generated portfolio identified for each scenario. For example, the iterations associated with the portfolio 'Coal Decision' include consideration of continuing to run the entire coal fleet[1] for the duration of the IRP study period, retiring the entire coal fleet at the earliest feasible date (2021), and retiring the entire coal fleet at a delayed date (2024). The NPV results of each of these three different iterations were compared to identify the low cost portfolio and related 'Coal Decision'. Further iterations of modeling locked in the 'Coal Decision' and then considered further 'Portfolio Refinements' that allowed the consideration of the modeled resources including EE. This approach was repeated for each of the seven different scenarios considered as part of Vectren's 2016 IRP. This methodical and rigorous approach resulted in portfolios that were carried forward into the risk analysis as part of a well-developed and reasoned IRP.

Q. Were there any other criticisms raised by the CAC about the EE modeling to which you wish to respond?

A. Yes. Ms. Sommer testified that there is very little difference in cost between adopting a 2% energy savings goal and the 1% goal Vectren adopted based on the Strategist annual cumulative present value of the selected portfolios. I would note this argument relies on the very cost modeling of EE programs that she challenged as flawed. By modeling the EE costs on a levelized basis, all costs reflecting EE in years 12-20 are not fully included because the costs are spread over the program life (10 years); years 12-20 only represent a partial portion of the program life and therefore a partial portion of the program cost on a levelized basis. If she were to model the EE blocks "as spent" rather than on a levelized basis, the NPV cost difference would increase as shown in Attachment MEL-1 when considering EE selected in the later years of the study period (see chart for selection of EE in 2034).

Additionally, Ms. Sommer's statement that it is "not the presence of additional EE on Vectren's system that forces the difference in cost between portfolios in the later years, but rather Vectren's assumptions about the types of supply-side

1 Note that Warrick 4's retirement date was fixed in all iterations.

resources that are added, their costs, and their impact on dispatch" (see CAC Exhibit 2, p. 14, lines 2-5) is made without any supporting evidence. Ms. Sommer offers a comparison of annual portfolio costs between Portfolios I, J, K, L, and M; each portfolio compared includes additional differences beyond EE. In its IRP, Vectren provided modeling results which focused on the incremental cost difference between a portfolio including no EE, four (4) blocks of EE, and eight (8) blocks of EE (see last paragraph on p. 91). These results show a correlation between increasing portfolio cost and increasing EE.

Q. The CAC witnesses attempt to use the recent announcement that Warrick Unit 4 would continue in service until the end of 2023 as a basis to discredit the IRP. Please respond.

A. The recent announcement regarding Warrick Unit 4 represents a change from the 2016 IRP modeling by extending that unit's operations by approximately 3 to 4 years. This is not a material change, and the IRP thoroughly addressed the uncertainties in 2016 related to this Unit given the joint ownership and operation with ALCOA which was in the midst of a corporate reorganization. Further, the timing of implementing the significant resource decision in terms of replacing both Brown and Warrick remains January 2024 and is unaffected by this Warrick 4 announcement. Fundamentally, every IRP is a snapshot in time with many things changing after its conclusion. Here, such a change was even anticipated in terms of the situation with Warrick 4 being identified as very fluid in nature.

Q. Ms. Sommer testified that Vectren did not take seriously decisions regarding whether to retire uneconomic units or whether to build renewables before the sunsetting of the renewable tax credits. Do you believe this is a fatal flaw with the 2016 IRP?

A. In its 2016 IRP, Vectren considered the earliest retirement dates for all of its coal facilities with the exception of Warrick Unit 4 based on the availability of replacement capacity and the time needed for transmission reliability upgrades that would be required with retirements. Further, resources that could take advantage of renewable tax credits were considered as early as possible based on construction timelines. Despite lower cost portfolios which did not include

renewable resources, Vectren introduced additional portfolios for consideration through the risk analysis that included early additions of renewable resources. Moreover, the preferred portfolio adds 54 MWs of solar resources early on in the resource plan.

III. CONCLUSION

Q. Does this conclude your rebuttal testimony in this proceeding?

A. Yes, it does, at this time.

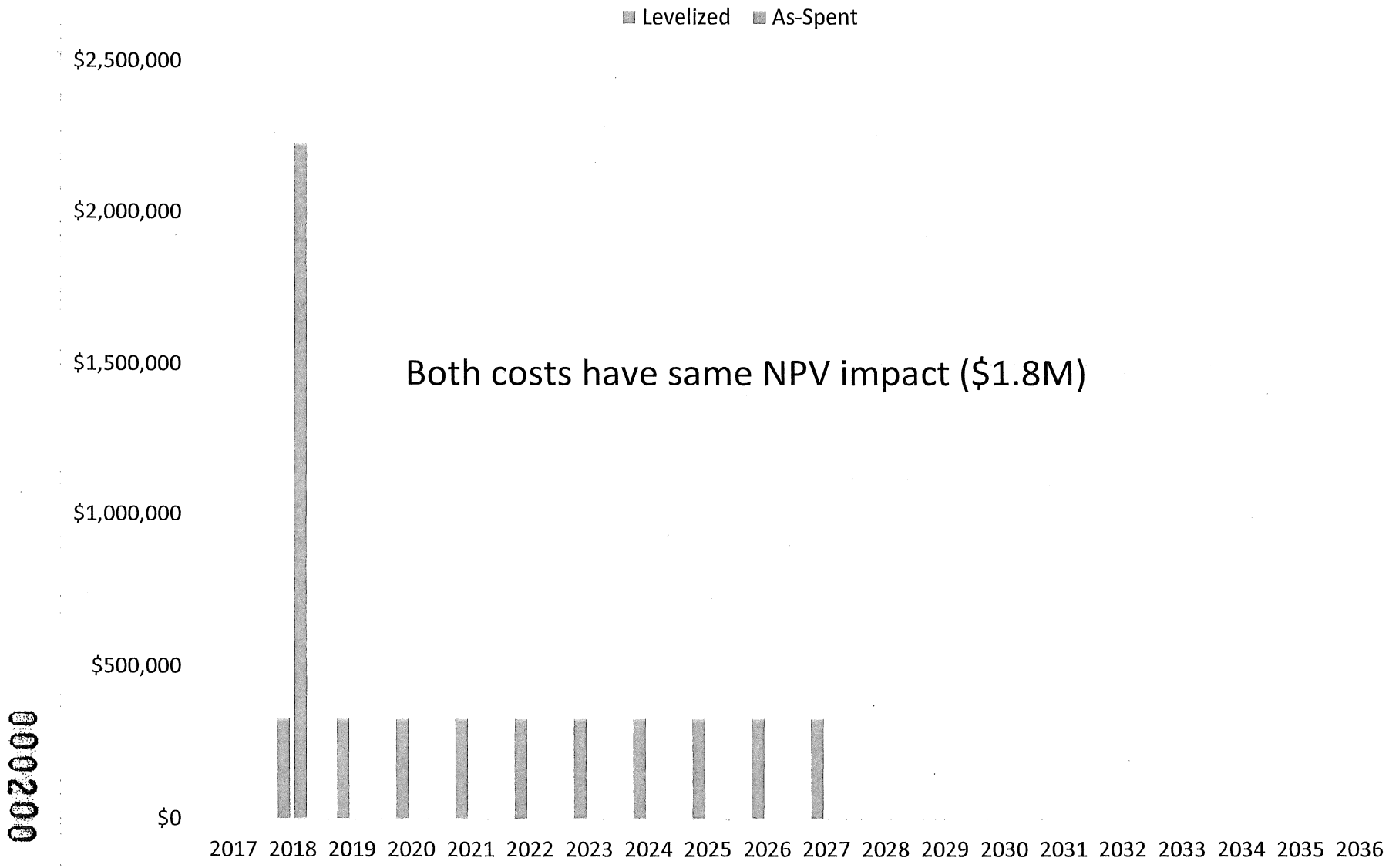
VERIFICATION

I, Matthew Lind, Associate Project Manager, Burns & McDonnell, affirm under penalties of perjury that the foregoing representations are true and correct to the best of my knowledge, information and belief.

Matthew Lind

Date: August 16, 2017

EE Block 1, 2018 Selection Costs



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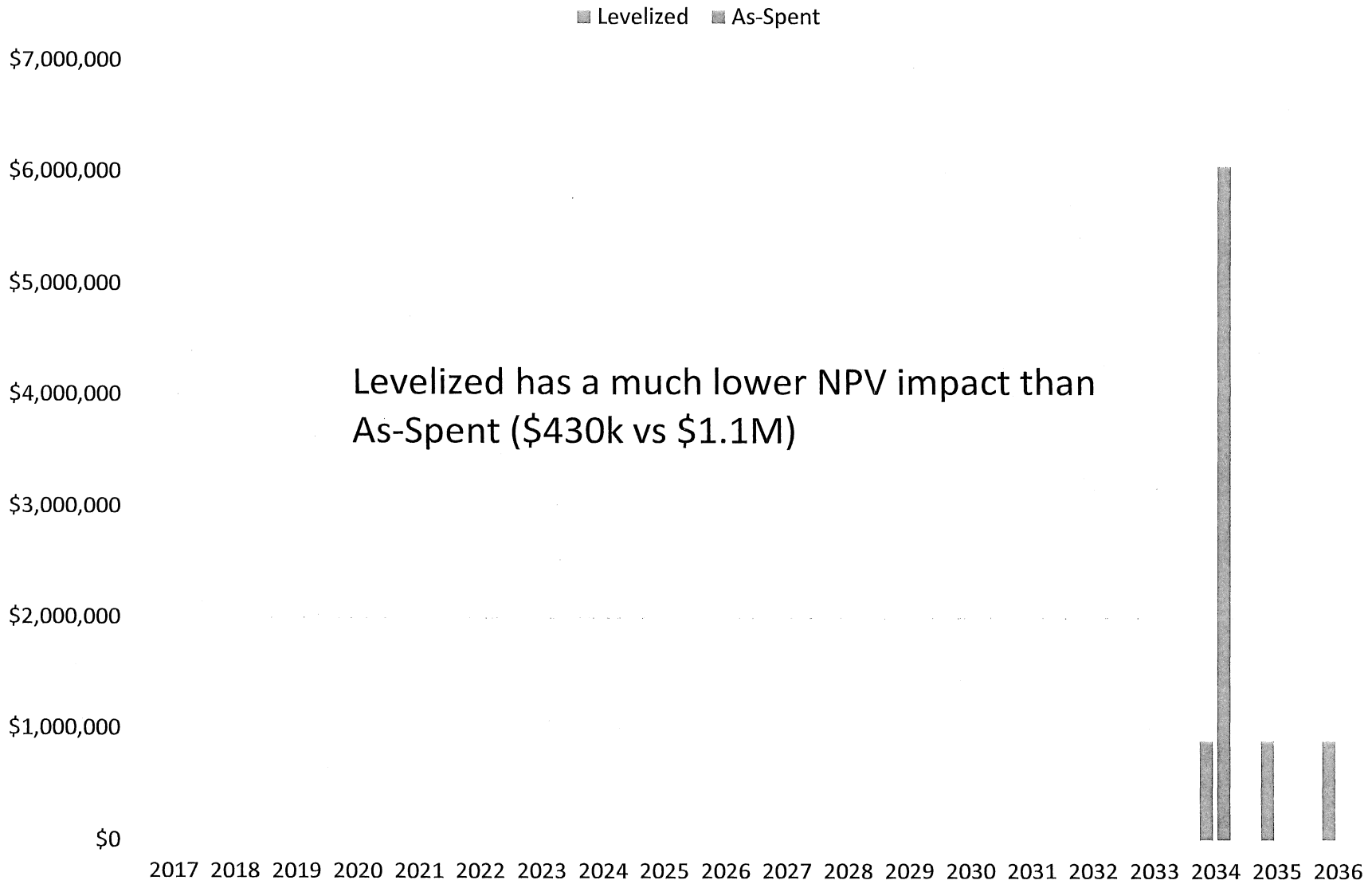
EE Block 1, 2034 Selection Costs



Strategist File Names	Coal Decision	Portfolio Refinement	Computer Generated Portfolio (Low Cost Portfolio)	Computer Generated Portfolio Under Base Scenario	Stakeholder Portfolio	Risk Analysis Portfolio
Base-Business As Usual (Continue Coal)-A	X					X
Base-Cease Coal 2021	X					
Base-Cease Coal 2024	X					
Base-Gas Portfolio with Renewables-O		X				X
Base-Base Scenario (aka Gas Heavy)-CGP-B		X	X			X
Base-Unfired Gas Heavy with 50 MW Solar in 2019-N		X				X
Base-Cease Coal 2024-Keep FB Culley 3		X				
Base-FB Culley 3, Fired Gas, & Renewables-K		X				X
Base-FB Culley 3, Fired Gas, Early Solar, & EE-L		X				X
Base-FB Culley 3, Unfired Gas, Early Solar, EE, & Renewables-M		X				X
Base-Cease Coal 2024-Gas Conversion		X				
Base-Cease Coal 2024-Renewables		X				
Base-Cease Coal 2024-SCGT		X				
High Economy-Continue Coal	X					
High Economy-Cease Coal 2021	X					
High Economy-Cease Coal 2024	X					
High Economy-Cease Coal 2024-CGP-F		X	X			
High Economy-Cease Coal 2024-Keep FB Culley 3		X				
High Economy-Cease Coal 2024-Gas Conversion		X				
High Economy-Cease Coal 2024-Renewables		X				
High Economy-Cease Coal 2024-SCGT		X				
High Reg-Continue Coal	X					
High Reg-Cease Coal 2021	X					
High Reg-Cease Coal 2024	X					
High Reg-Cease Coal 2024-CGP-D		X	X			
High Reg-Cease Coal 2024-Keep FB Culley 3		X				
High Reg-Cease Coal 2024-Gas Conversion		X				
High Reg-Cease Coal 2024-Renewables		X				
High Reg-Cease Coal 2024-SCGT		X				
High Tech-Continue Coal	X					
High Tech-Cease Coal 2021	X					
High Tech-Cease Coal 2024	X					
High Tech-Cease Coal 2024-CGP-H		X	X			
High Tech-Cease Coal 2024-Keep FB Culley 3		X				
High Tech-Cease Coal 2024-Gas Conversion		X				
High Tech-Cease Coal 2024-Renewables		X				
High Tech-Cease Coal 2024-SCGT		X				
Low Economy-Continue Coal	X					
Low Economy-Cease Coal 2021	X					
Low Economy-Cease Coal 2024	X					
Low Economy-Cease Coal 2024-CGP-G		X	X			
Low Economy-Cease Coal 2024-Keep FB Culley 3		X				
Low Economy-Cease Coal 2024-Gas Conversion		X				
Low Economy-Cease Coal 2024-Renewables		X				
Low Economy-Cease Coal 2024-SCGT		X				
Low Reg-Continue Coal	X					
Low Reg-Cease Coal 2021	X					
Low Reg-Cease Coal 2024	X					
Low Reg-Cease Coal 2024-CGP-E		X	X			
Low Reg-Cease Coal 2024-Keep FB Culley 3		X				
Low Reg-Cease Coal 2024-Gas Conversion		X				
Low Reg-Cease Coal 2024-Renewables		X				
Low Reg-Cease Coal 2024-SCGT		X				
Base + Large Load-Continue Coal	X					
Base + Large Load-Cease Coal 2021	X					
Base + Large Load-Cease Coal 2024	X					
Base + Large Load-CGP-C		X	X			X
Base + Large Load-Cease Coal 2024-Keep FB Culley 3		X				
Base + Large Load-Cease Coal 2024-Gas Conversion		X				
Base + Large Load-Cease Coal 2024-Renewables		X				
Base + Large Load-Cease Coal 2024-SCGT		X				
Base-High Economy Portfolio-F				X		X
Base-High Reg Portfolio-D				X		X
Base-High Tech Portfolio-H				X		X
Base-Low Economy Portfolio-G				X		X
Base-Low Reg Portfolio-E				X		X
Base-Stakeholder Portfolio-I					X	X
Base-Stakeholder Portfolio Cease Coal 2024-J					X	X
Base-Stakeholder EE Sensitivity					X	

Scenario Analysis - Key assumptions and drivers were varied in the modeling throughout the 20-year study period for seven scenarios (Base, High Reg, Low Reg, High Tech, High Economy, Low Economy, and Large Load)

Coal Decision - Three different operational assumptions for Vectren's existing coal fleet were evaluated for each scenario. These cases are used to determine low NPV cost decisions for Vectren's existing coal fleet. Comparing the different Coal Decision results guided the analysis to select between ceasing coal operations in 2021, ceasing coal operations in 2024, or continuing coal operations. By locking down these choices, the model was able to consider a wider variety of new options for further portfolio refinement.

Portfolio Refinement - After the Coal Decision is selected several portfolio refinement steps were performed to allow the model to simulate multiple alternatives within the chosen Coal Decision.

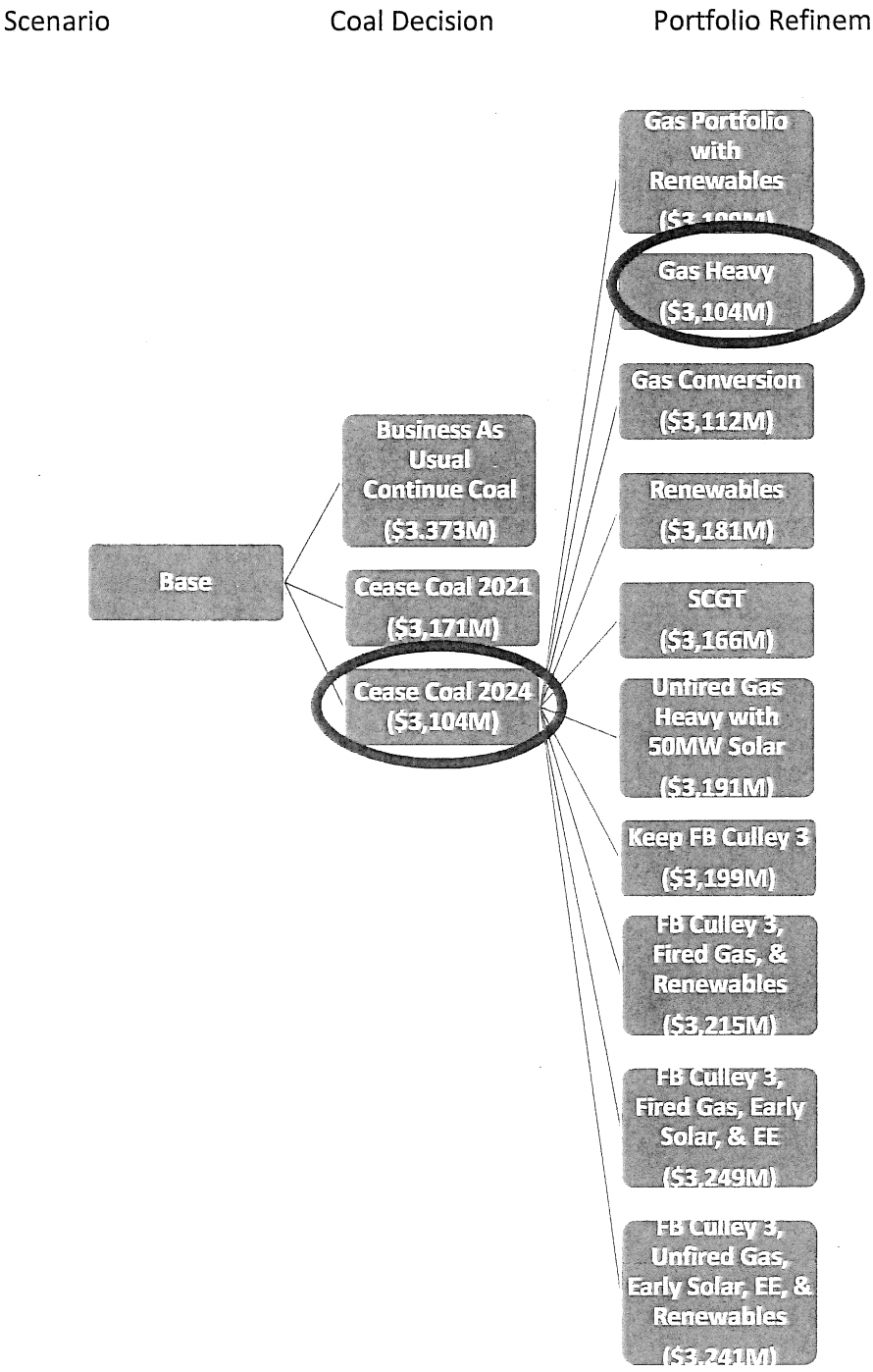
Computer Generated Portfolio - This portfolio had the lowest cost compared to the other portfolios in its respective scenario. These Computer Generated Portfolios were then included in the risk analysis process under base scenario assumptions (see Computer Generated Portfolio Under Base Scenario). Portfolio name has CGP (Computer Generated Portfolio) next to the letter corresponding to case A-O in risk analysis.

Computer Generated Portfolio Under Base Scenario - Some of the Computer Generated Portfolios ran with base scenario assumptions.

Stakeholder Portfolios - Vectren solicited input from stakeholders during the second public stakeholder meeting. Two portfolios were developed based on stakeholder's input and feedback.

Risk Analysis Portfolios - Final portfolios that were provided to PACE for risk analysis. These cases are labeled A-O as presented in the final stakeholder presentation.

Illustrative Example: Base Scenario



Process Flow

Continue Coal	Cease Coal 2021	Cease Coal 2024	Gas Portfolio with Renewables	Gas Heavy	Gas Conversion	Renewables	SCGT	Unfired Gas Heavy with 50MW Solar	Keep FB Culley 3	FB Culley 3 Fired Gas, & Renewables	FB Culley 3, Fired Gas, Early Solar, & EE	FB Culley 3, Unfired Gas, Early Solar, EE, & Renewables
$3,373,371	$3,170,851	$3,104,151	$3,198,582	$3,104,151	$3,111,693	$3,181,307	$3,166,428	$3,190,803	$3,198,832	$3,215,957	$3,249,398	$3,240,789
$3,373	$3,171	$3,104	$3,199	$3,104	$3,112	$3,181	$3,166	$3,191	$3,199	$3,216	$3,249	$3,241

Strategist Abbreviations	Descriptive Name
1FCC	1X1 F-Class .05 Combined Cycle Gas Turbine (Duct Fired)
2FCC	2x1 F-Class .05 Combined Cycle Gas Turbine (Duct Fired)
1FSC	1X1 F-Class Simple Cycle Gas Turbine
U1FC	1X1 F-Class .05 Combined Cycle Gas Turbine (Unfired)
U2FC	2X1 F-Class .05 Combined Cycle Gas Turbine (Unfired)
RPA1	Repower AB Brown 1
CHP	15 MW Combined Heat and Power
50W	50 MW Indiana Wind
9S	9 MW Solar PV
20 DR	Demand response. Adds 4 MW of DR each year for 5 consecutive years (January 1 of the year specified)
EE01	0.25% Energy Efficiency
EE02	0.25% Energy Efficiency
EE03	0.25% Energy Efficiency
EE04	0.25% Energy Efficiency
EE05	0.25% Energy Efficiency
EE06	0.25% Energy Efficiency
EE07	0.25% Energy Efficiency
EE08	0.25% Energy Efficiency
EE	2016-2017 Demand Side Management Plan
SW4	Shutdown Warrick 4 (January 1 of the specified year)
SAB1	Shutdown AB Brown 1 (January 1 of the specified year)
SAB2	Shutdown AB Brown 2 (January 1 of the specified year)
SABC	Shutdown AB Brown Common (January 1 of the specified year)
SFB2	Shutdown FB Culley 2 (January 1 of the specified year)
SFB3	Shutdown FB Culley 3 (January 1 of the specified year)
SFBC	Shutdown FB Culley Common (January 1 of the specified year)
GAB1	Convert AB Brown 1 to Natural Gas
GAB2	Convert AB Brown 2 to Natural Gas
GFB2	Convert FB Culley 3 to Natural Gas
GFB3	Convert FB Culley 2 to Natural Gas
RAB1	Capital spend change - must cease coal operations for AB Brown 1 by 1/1/2024
RAB2	Capital spend change - must cease coal operations for AB Brown 2 by 1/1/2024
RABC	Capital spend change - must cease coal operations for AB Brown Common by 1/1/2024
RFB2	Capital spend change - must cease coal operations for FB Culley 2 by 1/1/2024
RFB3	Capital spend change - must cease coal operations for FB Culley 3 by 1/1/2024
RFBC	Capital spend change - must cease coal operations for FB Culley Common by 1/1/2024
RW4	Capital spend change - must cease coal operations for Warrick 4 by 1/1/2024
TRAN	Incur the transmission costs for coal shutdown in this year
DEF	Market capacity purchased to serve load