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September 14, 2020

VIA OVERNIGHT MAIL

Mr. Joel H. Peck, Clerk
c/o Document Control Center
STATE CORPORATION COMMISSION
Tyler Building — First Floor
1300 East Main Street
Richmond, Virginia 23219

2020 SEP 15 A 10:12
STATE CLERK'S OFFICE
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RE: Commonwealth of Virginia *ex rel.* State Corporation Commission in re: Virginia Electric & Power Company's Integrated Resource Plan filing pursuant to Virginia Code § 56-597 *et seq.*

Case No. PUR-2020-00035

Dear Mr. Peck,

Please find enclosed for filing in the above-captioned case an original and one copy of the **Public Version** of the Direct Testimony of Rachel Wilson on Behalf of the Sierra Club.

Should you have any questions regarding the filing, please do not hesitate to contact me directly at (434) 738 - 1863.

Thank you,

Evan Dimond Johns
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Commission Staff

200920054

**COMMONWEALTH OF VIRGINIA
STATE CORPORATION COMMISSION**

APPLICATION OF

**VIRGINIA ELECTRIC
AND POWER COMPANY**

Case No. PUR-2020-00035

**In re: Virginia Electric and Power Company's
Integrated Resource Plan filing pursuant to
Virginia Code § 56-597 et seq.**

**DIRECT TESTIMONY OF
RACHEL WILSON**

**ON BEHALF OF
THE SIERRA CLUB**

**PUBLIC
VERSION**

September 15, 2020

Summary of the Direct Testimony of Rachel Wilson

Dominion's 2020 Integrated Resource Plan is the first plan put forth by the Company that attempts to model compliance with the Virginia Clean Economy Act (VCEA), which mandates zero emissions from the electric sector by 2045. Dominion's resulting resource plans add sizable volumes of renewable energy resources and retires certain fossil-emitting resources over the course of the planning period. Dominion's preferred plan, however, fixes unit additions—including 970 MW of new gas combustion turbines—and retirements in place in its modeling software rather than fully utilizing its optimization capabilities. As a result, four of Dominion's coal units and most of its gas units operate until at least 2043, and many do not retire until 2045, when the VCEA mandates the retirement of carbon-emitting resources.

My independent modeling examines two scenarios: 1) the Dominion Preferred scenario, which fixes the resources from Dominion's preferred Plan B; and 2) the Synapse Optimization scenario, which optimizes resource additions and the retirement dates for the Virginia City Hybrid Energy Center (VCHEC) and the Mt. Storm coal units. I find that Dominion is unnecessarily keeping its remaining coal units online through the analysis period. Retirement of these units prior to 2035, along with accelerated deployment of solar resources in the next five years, could result in both lower CO₂ emissions and ratepayer savings of up to \$3.3 billion over the 15-year analysis period.

I recommend that the Commission require Dominion to revise its 2020 IRP to allow the PLEXOS model to endogenously retire the VCHEC and Mt. Storm Units 1-3 and to remove the 970 MW of new gas combustion turbines, allowing the model to make an optimal decision from amongst different clean energy resources that could meet Dominion's purported reliability need.

With respect to Dominion's assertion of future probable system reliability issues, I recommend the following: (1) that when Dominion's reliability study become available, the Company holds a technical conference to solicit feedback from stakeholders on its methodology and conclusions; and (2) any future CPCN proceeding for the new combustion turbines described in the IRP should be informed by an all-source RFP that allows for bids from battery storage resources.

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1. INTRODUCTION AND QUALIFICATIONS

1 Q. Please state your name, business address, and position.

2 A. My name is Rachel Wilson and I am a Principal Associate with Synapse Energy
3 Economics, Incorporated ("Synapse"). My business address is 485 Massachusetts
4 Avenue, Suite 3, Cambridge, Massachusetts 02139.

5 Q. Please describe Synapse Energy Economics.

6 A. Synapse is a research and consulting firm specializing in energy and
7 environmental issues, including electric generation, transmission and distribution
8 system reliability, ratemaking and rate design, electric industry restructuring and
9 market power, electricity market prices, stranded costs, efficiency, renewable
10 energy, environmental quality, and nuclear power.

11 Synapse's clients include state consumer advocates, public utilities commission
12 staff, attorneys general, environmental organizations, federal government
13 agencies, and utilities.

14 Q. Please summarize your work experience and educational background.

15 A. At Synapse, I conduct analysis and write testimony and publications that focus on
16 a variety of issues relating to electric utilities, including: integrated resource
17 planning; federal and state clean air policies; emissions from electricity
18 generation; environmental compliance technologies, strategies, and costs;

1 electrical system dispatch; and valuation of environmental externalities from
2 power plants.

3 I also perform modeling analyses of electric power systems. I am proficient in the
4 use of spreadsheet analysis tools, as well as optimization and electricity dispatch
5 models to conduct analyses of utility service territories and regional energy
6 markets. I have direct experience running the Strategist, PROMOD IV,
7 PROSYM/Market Analytics, PLEXOS, EnCompass, and PCI GenTrader models,
8 and have reviewed input and output data for several other industry models.

9 Prior to joining Synapse in 2008, I worked for the Analysis Group, Inc., an
10 economic and business consulting firm, where I provided litigation support in the
11 form of research and quantitative analyses on a variety of issues relating to the
12 electric industry.

13 I hold a Master of Environmental Management from Yale University and a
14 Bachelor of Arts in Environment, Economics, and Politics from Claremont
15 McKenna College in Claremont, California.

16 A copy of my current resume is attached as Exhibit RW-1.

17 **Q. On whose behalf are you testifying in this case?**

18 **A. I am testifying on behalf of Sierra Club.**

1 **Q. Have you testified previously before the State Corporation Commission of**
2 **Virginia?**

3 A. Yes, in Case No. PUE-2015-00075, Case No. PUR-2018-00065, and Case No
4 PUR-2020-00015.

5 **Q. What is the purpose of your testimony in this proceeding?**

6 A. The purpose of my testimony is to evaluate various components of Dominion's
7 2020 Integrated Resource Plan (2020 Plan) and present the results of an
8 alternative modeling analysis. The Synapse modeling analysis produced a
9 resource plan that retires additional fossil units during the analysis period to 2035,
10 complies with the Virginia Clean Economy Act, and has lower carbon dioxide
11 (CO₂) emissions than in the Dominion 2020 IRP. The Synapse resource plan also
12 had a lower cost than Dominion's preferred resource plan, resulting in savings to
13 the Company's ratepayers.

14 **Q. Please identify the documents and filings on which you base your opinions.**

15 A. My findings rely primarily upon the testimony, exhibits, and discovery responses
16 of Dominion and its witnesses. I also rely to a limited extent on certain industry
17 publications.

1 Q. Are you sponsoring any exhibits?

2 A. Yes. I am sponsoring the following exhibits:

Exhibit Number	Description of Exhibit	Protected Status
Exhibit RW-1	Resume of Rachel S. Wilson	Non-Confidential
Exhibit RW-2	Dominion's response to Appalachian Voices 1-29	Non-Confidential
Exhibit RW-3	Dominion's response to Appalachian Voices 1-30	Non-Confidential
Exhibit RW-4	Dominion's response to Staff 1-5	Non-Confidential
Exhibit RW-5	Dominion's responses to Sierra Club 2-6 and 2-8	Non-Confidential
Exhibit RW-6	Dominion response to Staff 1-17(a), Supplemental Attachment Staff 1-17(a) page 3	Non-Confidential
Exhibit RW-7	Dominion response to Staff 1-17(a), Supplemental Attachment Staff 1-17(a)	Extraordinarily Sensitive
Exhibit RW-8	Dominion response to Staff Set 01-02, Corrected Attachment Staff Set 01-02 (BMH) CONF	Confidential
Exhibit RW-9	Dominion response to Appalachian Voices 1-11	Non-Confidential
Exhibit RW-10	Dominion response to Appalachian Voices 3-4	Non-Confidential
Exhibit RW-11	Dominion response to Appalachian Voices 2-9	Non-Confidential

2. OVERVIEW OF TESTIMONY AND CONCLUSIONS

3 Q. Please summarize your primary conclusions.

4 A. Dominion's 2020 Plan is the first plan put forth by the Company that attempts to
5 model compliance with the Virginia Clean Economy Act, adding sizable volumes
6 of renewable energy resources and retiring certain fossil-emitting resources over
7 the course of the planning period. Dominion's preferred plan, however, continues
8 to operate certain of the Company's coal units, and the majority of its gas units,

1 until the last years of the extended analysis period to 2045, which is also the point
2 at which the VCEA mandates the retirement of carbon-emitting resources.

3 My independent modeling indicates that Dominion is unnecessarily keeping the
4 VCHEC and Mt. Storm units online, and that retiring them earlier would result in
5 benefits to the Company's ratepayers. Retirement of these units prior to 2035,
6 along with accelerated deployment of solar resources in the next five years, could
7 result in both lower CO₂ emissions and ratepayer savings of up to \$3.3 billion
8 over the 15-year analysis period. A summary of the resource additions,
9 retirements, and net present of revenue retirements between Dominion's preferred
10 plan, as modeled by Synapse, and the Synapse Optimization scenario is shown in
11 Table 1.

**Table 1. Summary of results, Dominion
Preferred versus Synapse Optimization (2035)**

	Dominion Preferred	Synapse Optimization
NPV (2021-2035)	\$54.9	\$51.6
CO ₂ Emissions (million tons)	12.4	6.4
Solar (MW)	15,920	12,800
Offshore Wind (MW)	5,112	5,112
Storage (MW)	2,714	2,700
Gas (MW)	970	0
Import/Export Capability (MW)	5,200	5,200
Retirements (MW)	3,183	5,422

12 **Q. Please summarize your primary recommendations.**

13 **A. Based on my findings, I offer the following recommendations:**

- 1 1. Dominion should be required to develop a robust estimate of the sustaining
2 capital costs necessary to maintain the Virginia City Hybrid Energy Center
3 (VCHEC) and Mt. Storm Units 1-3 through Dominion's planned retirement
4 date, and then submit a revised IRP that allows the PLEXOS model to
5 endogenously retire them. These sustaining capital costs should be included in
6 the PLEXOS model for the purposes of determining an economic retirement
7 date for these remaining coal-fired units.
- 8 2. In its revised IRP, Dominion should also be required to remove the 970 MW
9 of new gas combustion turbines, allowing the model to make an optimal
10 decision from amongst different clean energy resources that could meet
11 Dominion's purported reliability need.
- 12 3. The Commission should require Dominion to hold a technical conference and
13 stakeholder meeting when its gas reliability study becomes available in order
14 to solicit feedback from stakeholders on its methodology and conclusions; and
- 15 4. Any future CPCN proceeding for the new combustion turbines described in
16 the IRP should be informed by an all-source RFP that allows for bids from
17 battery storage resources.

3. DOMINION'S PREFERRED RESOURCE PORTFOLIO

1 Q. Does Dominion's 2020 Plan differ substantially from previous IRPs filed by
2 the Company?

3 A. Yes. Dominion's 2020 Plan is the first document created by the Company and
4 filed with the Commission that considers the requirements of the Virginia Clean
5 Economy Act (VCEA), which became law on July 1, 2020. The VCEA mandates
6 100 percent carbon-free energy from Dominion's generating fleet by 2045 and the
7 development of solar, wind, storage, and energy efficiency resources. It also
8 mandates the retirement of carbon-emitting resources unless specific retirements
9 would threaten grid reliability or security.

10 Q. Which of Dominion's alternative resources plans do you focus on in your
11 analysis?

12 A. Dominion presents four alternative resource plans labeled A through D. My
13 testimony focuses on Dominion's Plan B for comparison with the Synapse
14 modeling analysis because it is the Company's recommended plan.¹ Dominion
15 notes, however, that Plans B through D look very similar over the first 15 years,
16 with the primary difference being the amount of existing gas generation that
17 retires by 2045.²

1 Dominion 2020 Integrated Resource Plan. Executive Summary at 8.

2 *Id.* at 7.

1 Q. Which of its carbon-emitting resources does Dominion retire in its 2020
2 Plan?

3 A. Dominion retires over 3,000 MW of oil- and coal-fired capacity by 2035, as
4 shown in Table 2, below.

Table 2. Unit retirements from Dominion's Preferred Plan B

Year	Unit	Capacity (MW)
2021	Possum Point 5	623
2022		
	Yorktown 3	790
2023	Chesterfield 5 and 6	1,014
2024		
2025	Clover 1 and 2	439
2026		
2027	Rosemary	165
	Altavista	51
	Hopewell	51
2028	Southampton	51
2029		
2030		
2031		
2032		
2033		
2034		
2035		
Total		3,184

1 **Q. What does the 2020 Plan indicate are Dominion's plans for its remaining**
2 **carbon-emitting resources in its preferred plan?**

3 A. With respect to its coal-fired resources, it appears as though Dominion retires the
4 Mt. Storm Units 1-3 at the end of 2043³ and the VCHEC at the end of 2044.⁴

5 With respect to its gas-fired resources, Dominion states that it preserves 9,700
6 MW of gas-fired generation in Plan B to "address future system reliability,
7 stability, and energy independence issues."⁵

8 **Q. What kind of resources are added in Preferred Plan B?**

9 In terms of unit additions, Dominion directed the PLEXOS model to add specific
10 amounts of offshore wind, solar, and storage resources consistent with the
11 requirements of the VCEA.⁶ Annual additions for each of these resources were
12 determined separately by the Company and input into PLEXOS.⁷

13 Plan B also adds 485 MW of gas-fired combustion turbines in both 2023 and
14 2024. Again, this 970 MW of new gas capacity was hardcoded into the PLEXOS
15 model by Dominion as "a placeholder to address probable system reliability

3 See Dominion's response to Appalachian Voices 1-29, attached as Exhibit RW-2.

4 See Dominion's response to Appalachian Voices 1-30, attached as Exhibit RW-3.
5 2020 Plan at 29.

6 See Dominion's response to Staff 1-5, attached as Exhibit RW-4.

7 See Dominion's responses to Sierra Club 2-6 and 2-8, attached as Exhibit RW-5.

issues resulting from the addition of significant renewable energy resources and the retirement of coal-fired facilities.”⁸ Annual resource additions through 2035 are shown in Table 3.

Table 3. Capacity additions in Dominion Plan B (nameplate MW)

Year	Utility PV	Solar DER	OSW	Battery Storage	Pumped Storage	Gas CT
2021						
2022	780	220				
2023	960			14		485
2024	960	220				485
2025	960					
2026	960	220	852	400		
2027	960		1,704	500		
2028	1,080	220				
2029	1,440			500		
2030	1,320	220			300	
2031	1,080					
2032	1,080			500		
2033	1,080					
2034	1,080		2,556	500		
2035	1,080					
Total	14,820	1,100	5,112	2,414	300	970

Q. How did Dominion arrive at its preferred resource portfolio with unit retirements and resource additions?

A. Dominion states that it directed PLEXOS, a model designed for capacity optimization and dispatch, to select specific resources over the analysis period,

⁸ See Exhibit RW-4.

1 which include storage, solar, offshore wind, and new combustion turbines.⁹ This
2 number of resource additions in a year was determined separately and then input
3 into PLEXOS.¹⁰ Unit retirements were also input into PLEXOS per the
4 requirements of the VCEA. It appears as though the only optimal resource that
5 PLEXOS was allowed to select was the volume of imports and exports in a given
6 year.

7 **Q. What is the implication of Dominion's methodology in which it hardcodes**
8 **unit additions into the PLEXOS model in specific years?**

9 A. PLEXOS is a capacity expansion and dispatch model designed to select the
10 optimal (least-cost) resource mix to meet load, plus a required reserve margin,
11 over a specified time period. The implication of hardcoding the various supply-
12 side resources into PLEXOS is that the resulting resource portfolio is unlikely to
13 be the least-cost portfolio from the ratepayer perspective.

4. SYNAPSE MODELED RESOURCE PORTFOLIO

14 **Q. Do you present an alternative to Dominion's modeling analysis?**

15 A. Yes, and I describe that alternative modeling analysis in this section.

9 See Exhibit RW-4.

10 See Exhibit RW-5.

1 **Q. Which model did you use to perform your analysis?**

2 A. The Synapse analysis uses the EnCompass capacity optimization and dispatch
3 model to simulate resource choice impacts in Dominion's service territory.
4 Developed by Anchor Power Solutions, EnCompass covers all facets of power
5 system planning, including:

- 6 • Short-term scheduling, including detailed unit commitment and economic
7 dispatch, with modeling of load shaping and shifting capabilities;
- 8 • Mid-term energy budgeting analysis, including maintenance scheduling and
9 risk analysis;
- 10 • Long-term integrated resource planning, including capital project
11 optimization, economic generating unit retirements, and environmental
12 compliance; and
- 13 • Market price forecasting for energy, ancillary services, capacity, and
14 environmental programs.

15 **Q. Is EnCompass a widely accepted industry model?**

16 A. Yes. EnCompass was released in 2016 and already several major utilities have
17 made the transition to the model. For example, the three investor-owned utilities
18 (IOUs) in Minnesota (Minnesota Power, Otter Tail Power, and Xcel Energy)
19 adopted the EnCompass model in 2019, along with Great River Energy, the

1 largest of the state's electric cooperatives.¹¹ Duke Energy announced in 2020 that
2 it had implemented EnCompass to expand its capabilities in resource planning.¹²
3 Public Service New Mexico and Public Service Company of Colorado are two
4 other IOUs that have adopted EnCompass in recent years.

5 **Q. What did Synapse model in its analysis?**

6 **A.** Synapse modeled two scenarios:

- 7 • **Dominion Preferred**, which fixes all of Dominion's Plan B resource
8 additions and retirements in the year in which they are modeled by the
9 Company. This scenario was run in order to compare the resulting revenue
10 requirement of the Company's preferred resource portfolio to that produced
11 by the Synapse Optimization portfolio.¹³

11 Anchor Power Solutions. December 2019. Available at: <https://anchor-power.com/news/minnesota-plans-for-its-energy-future-with-encompass/>

12 Anchor Power Solutions. May 2020. Available at: <https://anchor-power.com/news/duke-energy-implemented-encompass-software/>

13 Because the PLEXOS model uses different optimization and dispatch algorithm than the EnCompass model, using the Dominion revenue requirement for Plan B does not provide an apples-to-apples comparison. In addition, the Synapse modeling and resulting revenue requirement includes resource additions and system dispatch only and does not include the additional elements shown in Figure 2.4.1 of the 2020 IRP.

- 1 • **Synapse Optimization**, which fixes the addition of offshore wind, pursuant to
- 2 the requirements of the VCEA, and distributed solar according to Dominion's
- 3 forecast. It sets the retirements of the oil, biomass, and coal units shown in
- 4 Table 2, but allows Chesterfield and Clover to retire before their 2023 and
- 5 2025 retirement dates if EnCompass finds earlier retirement to be economic.
- 6 The EnCompass model optimizes the remaining resource additions and
- 7 retirements, subject to the requirements of the VCEA.

8 **Q. Do the input assumptions used in the Synapse analysis conform to**
 9 **Dominion's assumptions?**

10 A. Yes. To ensure a valid comparison, the Synapse analysis uses Dominion's
 11 assumptions for peak and annual energy, load shape, reserve margin, unit
 12 retirements (those shown in Table 2 as well as the CT retirements found in
 13 Appendix 5J of the 2020 Plan), offshore wind unit additions, distributed solar
 14 additions, commodity prices (fuel, CO₂, and hourly energy market prices),
 15 resource capacity values, resource capital costs, and sustaining capital costs at
 16 specific Dominion thermal units.^{14 15}

14 This data is contained in numerous discovery request responses and represents thousands of pages: Dominion's response to Appalachian Voices 1-20, 2-11, 3-2(b); Sierra Club Set 2-15, 2-16, 3-2 and Staff 1-2. Sierra Club can provide the Commission or participants with copies of this information for the record prior to the hearing if it would be helpful.

15 In both Synapse modeled scenarios—the Dominion Preferred and Synapse Optimization—Synapse inadvertently used the solar profile for the PJM-DOM zone

1 **Q. Are there any of Dominion's input values that you believe to be inflated?**

2 A. Yes. At a minimum, I believe that Dominion's near-term load is inflated as it does
3 not consider the effects of the current Covid-19 pandemic. Dominion has also
4 overstated the capital costs for solar and battery storage technologies. Each of
5 these criticisms is described below in my testimony; however, I used Dominion's
6 numbers in my analysis in order to make a valid comparison between the two
7 models.

8 **Q. How does the resulting Synapse Optimization scenario compare to the**
9 **Dominion Preferred scenario in terms of unit retirements?**

10 A. The Synapse Optimization scenario chooses to endogenously retire early all of
11 Dominion's coal units, except for Clover 1 and 2, which remains in 2025.
12 Chesterfield 5 and 6 retire in 2021 rather than the scheduled date of 2023.
13 VCHEC retires in 2031, more than 10 years earlier than in Dominion's 2020 Plan.
14 Mt. Storm Units 1 and 2 retire in 2034, while Unit 3 retires in 2035. A
15 comparison of the Dominion retirement dates versus those determined in the
16 Synapse modeling is shown in Table 4.

contained in our existing EnCompass database, which results in a capacity factor for
utility scale solar of 22 percent.

Table 4. Comparison of coal unit retirement dates

Unit	Dominion Retirement Date	Synapse Retirement Date
Chesterfield 5-6	2023	2021
Clover 1-2	2025	2025
Virginia City	2044	2031
Mt. Storm Unit 1	2043	2034
Mt. Storm Unit 2	2043	2034
Mt. Storm Unit 3	2043	2035

1 **Q. Are there other data that indicate that the early retirements of the VCHEC**
2 **and Mt. Storm plants is reasonable?**

3 **A.** Yes. Dominion did a unit retirement analysis for Chesterfield, Clover, VCHEC,
4 Mt. Storm, and Yorktown 3 and presented the results of that study from March
5 2020.¹⁶ The Company forecasted the costs and revenues for each unit's operation
6 between 2020 and 2029, calculating the net present value of revenues over the
7 combined period under a Base case and six sensitivity cases. Dominion's results
8 show that Mt. Storm was the only plant to have a positive NPV in the Base case
9 over the Company's analysis period. Those results are shown in Table 5.

16 Dominion response to Staff Set 01-17(a), Supplemental Attachment Staff Set 01-17(a), page 3, attached as Exhibit RW-6.

Table 5. Dominion 10-year NPV results, 2020-2029

Unit	NPV (\$Million)
Chesterfield 5-6	(\$78)
Clover	(\$21)
Mount Storm	\$100
Virginia City	(\$472)
Yorktown 3	(\$18)

1 **Q.** Table 5 shows that VCHEC is the worst performing unit by a wide margin.
2 Why does the Synapse analysis not retire that plant until 2031 if the
3 economics are so bad?

4 **A.** There are two primary reasons that the Synapse analysis may not retire VCHEC
5 until 2031. First, the Chesterfield and Clover plants must retire by certain dates in
6 order to comply with the VCEA, and in fact the Synapse analysis accelerates the
7 retirement of Chesterfield Units 5 and 6. The retirement of these units changes the
8 economics of the remaining units in the fleet, potentially making them more
9 profitable. Second, Dominion's analysis does not include a value for replacement
10 capacity that may be needed if certain units retire. The Synapse modeling study
11 builds new capacity when needed to meet system load, determining the date at
12 which units can economically retire and be replaced. Dominion should, however,
13 do a stacked retirement analysis that examines the unit retirements in combination
14 with each other.

1 Q. In contrast, Table 5 shows that Dominion found a net benefit to keeping the
2 Mt. Storm units online. Why does the Synapse analysis retire them?

3 A. The study period for Dominion's unit analysis only goes through 2029. The
4 Synapse analysis retires the Mt. Storm units in 2034 and 2035, respectively,
5 which falls outside of Dominion's analysis period. In the latter part of that
6 analysis period, the Mt. Storm plant operates at capacity factors ranging from

7 [BEGIN EXTRAORDINARILY SENSITIVE INFORMATION] [REDACTED]

8 [REDACTED]

9 [REDACTED]

10 [REDACTED]

11 [END EXTRAORDINARILY SENSITIVE INFORMATION] These
12 increased costs are not included in either the Dominion or the Synapse analysis,
13 and so it is very possible that the optimal retirement dates for the Mt. Storm units
14 are even *earlier* than in the Synapse modeling.

15 Q. What are the risks of keeping the VCHC and Mt. Storm units online until
16 Dominion's retirement dates of 2044 and 2043, respectively?

17 A. There are risks to reliability of continued coal operation. When units operate at
18 lower capacity factors and increase the amount of cycling required, the increased

17 Dominion response to Staff Set 01-17(a), Attachment Staff Set 01-17(a) ES,
attached as Exhibit RW-7.

1 degradation can lead to higher forced outage rates.¹⁸ A forced outage at even one
2 coal unit represents the loss of hundreds of MW of capacity, increasing reliability
3 risk on the system. Solar and battery storage resources are more modular and can
4 be distributed across Dominion's service territory, offering greater flexibility and
5 reducing reliability risk.

6 **Q. How does the resulting Synapse Optimization scenario compare to the**
7 **Dominion Preferred scenario in terms of resource additions?**

8 A. Generally, in comparison to the Dominion Preferred scenario, the Synapse
9 Optimization scenario adds fewer total resources over the analysis period to 2035,
10 while also retiring additional coal capacity. Total capacity as of 2035 is shown in
11 **Table 6** for both the Dominion Preferred and Synapse Optimization scenarios.

18 National Renewable Energy Laboratory. 2012. *Power Plant Cycling Costs*.
Available at: <https://www.nrel.gov/docs/fy12osti/55433.pdf>.

Table 6. Comparison of total capacity in the Synapse modeled scenarios, 2035

Resource Type	Dominion Preferred (MW)	Synapse Optimization (MW)
Nuclear	3,701	3,701
Coal	2,239	0
Gas	9,552	8,582
Hydro	289	289
Biomass	157	157
Landfill	0	0
Utility Solar	16,446	13,326
DG Solar	1,100	1,100
Pumped Hydro	2,108	2,108
Offshore Wind	5,124	5,124
Onshore Wind	77	77
Battery Storage	2,414	2,400
Total	43,207	36,864

1 Notably, EnCompass does not select any new gas capacity in the Synapse
2 Optimization scenario and does not show any resulting loss of load hours in the
3 absence of these gas units. The model selects fewer utility-scale solar resources
4 over the entirety of the planning period but selects solar resources well above
5 those modeled by Dominion in the first seven years of the analysis period.

6 **Q. Are there any annual incremental differences in the resources selected by**
7 **EnCompass in the Synapse Optimization scenario?**

8 **A. Yes. Cumulative capacity, by year, is shown in Table 7 for those resources for**
9 **which there is a notable difference between scenarios.**

Table 7. Annual cumulative capacity (MW), by resource type

Year	Gas	Utility Solar	Battery Storage	Gas	Utility Solar	Battery Storage
2021	-	-	-	-	2,380	-
2022	-	780	-	-	3,180	-
2023	485	1,740	14	-	4,360	-
2024	970	2,700	14	-	5,500	-
2025	970	3,660	14	-	6,500	-
2026	970	4,620	414	-	6,500	-
2027	970	5,580	914	-	6,500	-
2028	970	6,660	914	-	6,500	-
2029	970	8,100	1,414	-	6,500	-
2030	970	9,420	1,414	-	7,340	-
2031	970	10,500	1,414	-	10,020	-
2032	970	11,580	1,914	-	10,140	-
2033	970	12,660	1,914	-	11,700	432
2034	970	13,740	2,414	-	11,700	1,416
2035	970	14,820	2,414	-	11,700	2,700

1 First, the Synapse Optimization scenario adds utility-scale solar capacity at a
2 much faster rate over the first seven years of the analysis period, indicating that
3 solar is a more economic resource at the beginning of the analysis period than in
4 Dominion's plan, even at the Company's assumed capital costs. Battery storage
5 resources are not selected until close to the end of the analysis period, which may
6 be due to overstated capital cost assumptions.

1 Q. Is it your opinion that Dominion's cost assumptions for solar resources are
2 too high?

3 A. Yes. When compared to the *2020 Advanced Technology Baseline* (ATB) released
4 by the National Renewable Energy Laboratory (NREL),¹⁹ Dominion's assumed
5 cost for solar is shown to be higher than industry projections, as shown in
6 Confidential Figure 1. In contrast to the NREL forecast, which declines through
7 2030, Dominion's increases steadily between 2022 and 2045.

**Confidential Figure 1. Dominion overnight
solar costs versus NREL's ATB²⁰**



8 Dominion predicted solar cost increases in previous IRPs²¹ and has been proven
9 wrong, as prices have continued to decline. Technology innovations in solar

19 National Renewable Energy Laboratory. 2020. *Advanced Technology Baseline*. Available at: <https://atb.nrel.gov/>

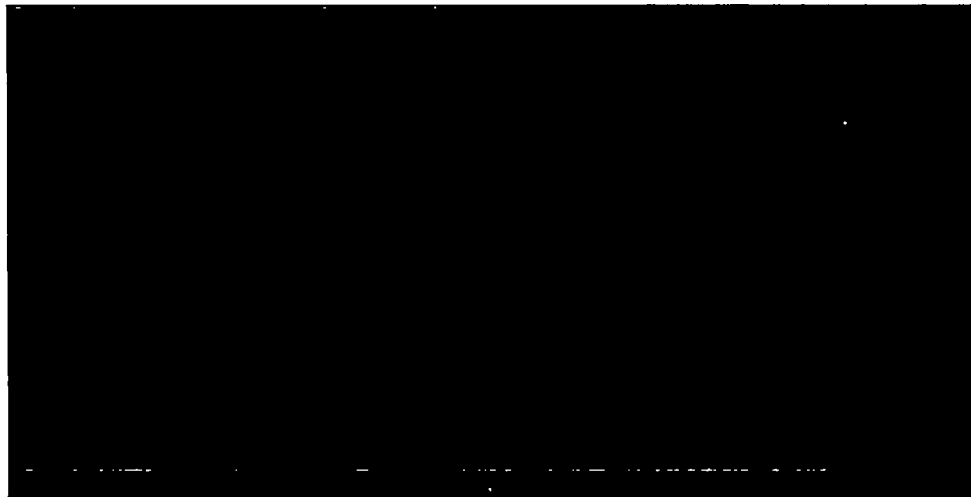
20 Dominion response to Staff Set 01-02, Corrected Attachment Staff Set 01-02 (BMH) CONF, attached as Exhibit RW-8.

1 wafers, cells, and modules are expected to increase solar panel power output
 2 without the same proportional increase in manufacturing costs, resulting in a
 3 lower cost for solar technologies in dollars per watt through the 2020s.²²

4 **Q. Is it your opinion that Dominion's cost assumptions for battery storage**
 5 **resources are too high?**

6 **A.** Yes. Again, when we compare Dominion's forecast to that from NREL's ATB, as
 7 shown in Confidential Figure 2, we see that NREL's forecast for battery costs is
 8 substantially lower than that used by Dominion in the 2020 IRP.

Confidential Figure 2. Dominion battery storage costs versus NREL ATB²³



21 Direct Testimony of Rachel Wilson before the Virginia Corporation Commission. Docket No. PUR-2018-00065. 2019. Page 20, line 1.

22 Sun, Xiaojing. December 17, 2019. *Solar Technology Got Cheaper and Better in the 2010s. Now What?* GreenTech Media. Available at: <https://www.greentechmedia.com/articles/read/solar-pv-has-become-cheaper-and-better-in-the-2010s-now-what>

23 See Exhibit RW-8.

1 **Q. Is it realistic to think that Dominion could add 2,380 MW of solar generation**
2 **in 2021?**

3 A. It would be extremely challenging for Dominion to add 2,380 MW of solar in
4 2021. Solar resources were made available to the EnCompass model for selection
5 beginning in 2021, and the model made its selection in order to develop the least-
6 cost resource portfolio, replacing the energy and a portion of the capacity from the
7 early retirement of Chesterfield Units 5 and 6.

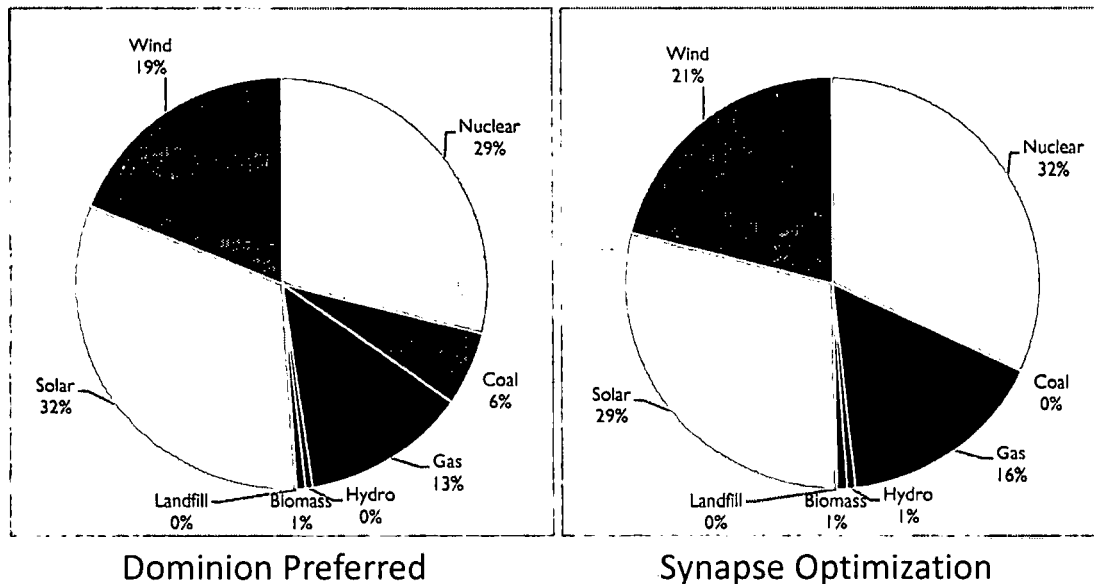
8 In contrast, Dominion adds zero MW of new solar in 2021 in its IRP. The
9 Company can almost certainly add more than zero MW. Even at the costs
10 assumed by Dominion, optimization modeling shows that solar has benefits to
11 ratepayers as early as 2021, and Dominion should make every effort to help
12 ratepayers realize those benefits.

13 **Q. Describe the differences in the amount of generation from different resource**
14 **types between the two modeled scenarios.**

15 A. Generation between the Dominion Preferred and Synapse Optimization scenarios
16 is quite similar. The amount of solar generation is lower in the Synapse
17 Optimization scenario because there is less solar capacity in the mix. Because
18 coal generation drops to zero by 2035 in the Synapse Optimization scenario, there
19 is slightly more gas generation than in the Dominion Preferred scenario. The fuel
20 mix in 2035 is shown for both scenarios in Figure 3. Battery storage and pumped

- 1 hydro are not shown in Figure 3 because they do not generate electricity, but
 2 discharge generation from other fuel sources.

Figure 3. Comparison of generation mix between modeled scenarios



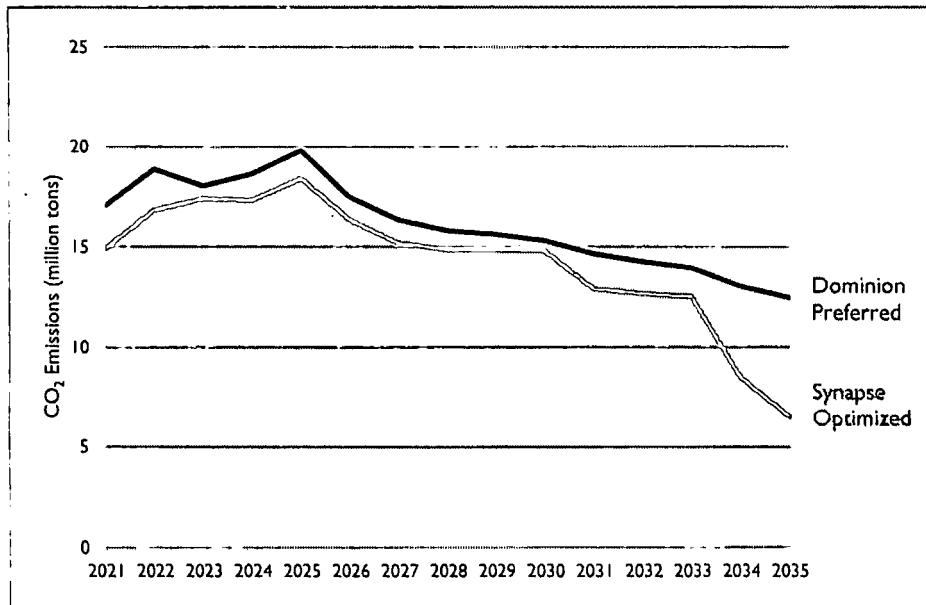
- 3 The biggest difference in fuel mix between the two scenarios is in the amount of
 4 net imports, which are larger in the Synapse Optimization scenario as a result of
 5 both fewer market sales and additional market purchases.

6 **Q. How do CO₂ emissions compare between the Dominion Preferred and**
 7 **Synapse Optimization scenarios?**

- 8 **A.** Emissions of CO₂ in the Synapse Optimization scenario are lower than in the
 9 Dominion Preferred, as shown in Figure 4. Emissions are immediately lower due
 10 to the early retirement of Chesterfield Units 5 and 6 and the addition of new solar

1 resources and drop further at the end of the analysis period because of the
 2 retirements of VCHEC and Mt. Storm Units 1-3.

**Figure 4. Comparison of CO₂ emissions
 in the Synapse modeled scenarios**



3 **Q. Does the Synapse Optimization portfolio result in lower costs to Dominion**
 4 **ratepayers?**

5 **A.** Yes. The Net Present Value of Revenue Requirements (NVPRR) totals just under
 6 \$51.6 billion for Synapse Optimization portfolio compared to \$54.9 billion for the
 7 Dominion Preferred portfolio for the analysis period through 2035, resulting in

1 cost savings to Dominion customers of approximately \$3.3 billion.²⁴ The
 2 breakdown of costs by category is shown in
 3 Table 8.

Table 8. NPVRR of the Synapse modeled scenarios

Cost Category	Dominion Preferred (\$B)	Synapse Optimization (\$B)
Fuel Costs	\$10.2	\$9.6
Fixed Costs	\$11.7	\$11.6
Non-Fuel Variable Costs	\$3.0	\$2.9
Program Costs	\$0.9	\$0.8
Net Purchases	\$4.2	\$4.7
Commitment Costs	\$0.7	\$0.7
Capital Costs	\$24.3	\$21.4
Total	\$54.9	\$51.6

4 **Q. What should the Commission conclude from the Synapse modeling analysis?**

5 A. There are several important takeaways from the Synapse modeling analysis. First,
 6 the Commission should note that it is in the economic interest of Dominion's
 7 ratepayers to integrate additional solar capacity at a faster pace than what is
 8 included in Dominion's resource plans. Increased generation from solar in the
 9 short-term displaces more expensive fossil generation and results in savings to
 10 ratepayers. Second, accelerated retirement of Mt. Storm Units 1-3 and the
 11 VCHEC are also in the best interest of ratepayers. When given the choice to retire

24 The Synapse modeling and resulting revenue requirement includes resource additions and system dispatch only and does not include the additional elements shown in Figure 2.4.1 of the 2020 Plan.

1 these units or keep them online for the duration of the analysis period, the
2 EnCompass model chose to retire all four prior to 2035. This is in stark contrast to
3 Dominion's plans, which keeps Mt. Storm online until 2043 and the VCHEC
4 online until 2044.

5 **Q. What are the factors that the EnCompass model considers when deciding**
6 **whether to retire a unit?**

7 A. The Synapse modeling analysis uses the EnCompass model to optimize resource
8 builds and retirements over the entire analysis period from 2021 to 2035, meaning
9 the model can anticipate future conditions and respond accordingly. In the
10 instance of coal retirements, EnCompass takes into consideration future capital
11 expenditures at the units and variables that increase dispatch costs, like an
12 allowance price for CO₂. The model also sees the capital cost trajectories for
13 replacement resources and makes a retirement decision at the point in time that
14 optimizes avoided unit costs and expenditures with cost of replacement capacity
15 and energy.

16 **Q. What are your recommendations to the Commission with regard to the**
17 **resource mix in Dominion's Preferred Plan B?**

18 A. Dominion's 2020 Plan does not include any scenarios in which alternative
19 retirement dates are considered for the Mt. Storm and VCHEC plants. I
20 recommend that the Commission require Dominion to submit a revised 2020 IRP
21 that allows the PLEXOS model to endogenously retire the VCHEC and Mt. Storm

1 Units 1-3, after the development of a robust estimate of the sustaining capital
 2 costs necessary to maintain the plants through the current retirement dates of 2044
 3 and 2043, respectively. These sustaining capital costs should be included in the
 4 PLEXOS model for the purposes of determining an economic retirement date for
 5 these remaining coal-fired units.

6. DOMINION HAS NOT DEMONSTRATED A RELIABILITY-RELATED NEED FOR NEW GAS COMBUSTION TURBINES

6 **Q. Your Synapse Optimization scenario shows that the least-cost resource**
 7 **portfolio, which is also compliant with the VCEA, does not add new gas-fired**
 8 **combustion turbines. Why does Dominion include 970 MW of new gas in its**
 9 **Preferred Plan B?**

10 A. Dominion states that it has added this 970 MW of new gas capacity “as a
 11 placeholder to address probable system reliability issues resulting from the
 12 addition of significant renewable energy resources and the retirement of coal-fired
 13 facilities.”²⁵

14 **Q. Does Dominion specify the nature of those probable system reliability issues?**

15 A. No. The Company only states that “Based on its knowledge of planning and
 16 operating its transmission system, the Company knows that the loss of stored
 17 kinetic energy resulting from the additional (sic) of significant inverter-based

25 2020 Plan at 30.

1 generation and the retirement of traditional turbine generation will cause technical
2 issues for the grid that warrant further analysis.”²⁶

3 **Q. Does Dominion say when it will better understand the nature of these**
4 **probable system reliability issues?**

5 A. Dominion has only stated that an analysis is underway to evaluate these probable
6 system reliability issues.²⁷ The Company has not shared its expectation as to the
7 date at which this study will be complete.²⁸

8 **Q. Did you evaluate Dominion’s claims around probable system reliability**
9 **issues in your analysis?**

10 A. No. While EnCompass does perform its optimization and dispatch analysis while
11 considering certain reliability metrics, it does not do the kind of detailed analysis
12 that I assume Dominion has undertaken or plans to undertake. I will note,
13 however, that the Synapse Optimization scenario did not show any loss of load
14 hours for any of the years in the planning period.

26 See Dominion response to Appalachian Voices 1-11, attached as Exhibit RW-9.

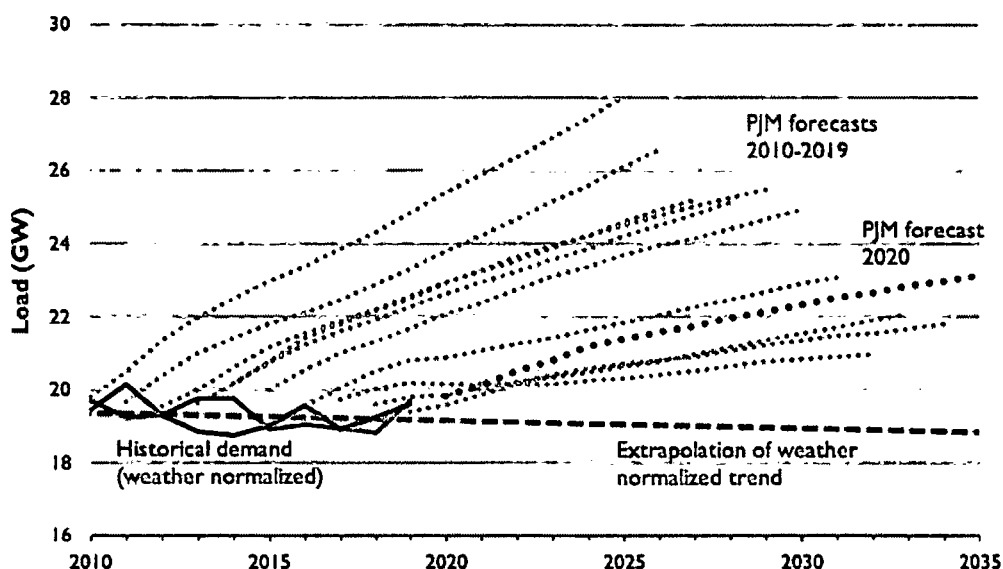
27 See Exhibit RW-9.

28 See Dominion response to Appalachian Voices 3-4, attached as exhibit RW-10.

1 Q. Without knowing the specifics around Dominion's "probable system
2 reliability issues," are there any mitigation measures that might be
3 undertaken rather than assuming the need for placeholder gas CTs?

4 A. Yes. The first is related to forecasted load growth. In its 2020 Plan, Dominion
5 starts with the PJM load forecast for the DOM zone as the basis for its own load
6 forecast. PJM's forecast grows at a compound annual rate of 1.0 percent. As
7 shown in Figure 5, below, historical load growth has been closer to flat.

**Figure 5. Actual versus forecasted peak demand in
the PJM DOM zone (weather normalized)**

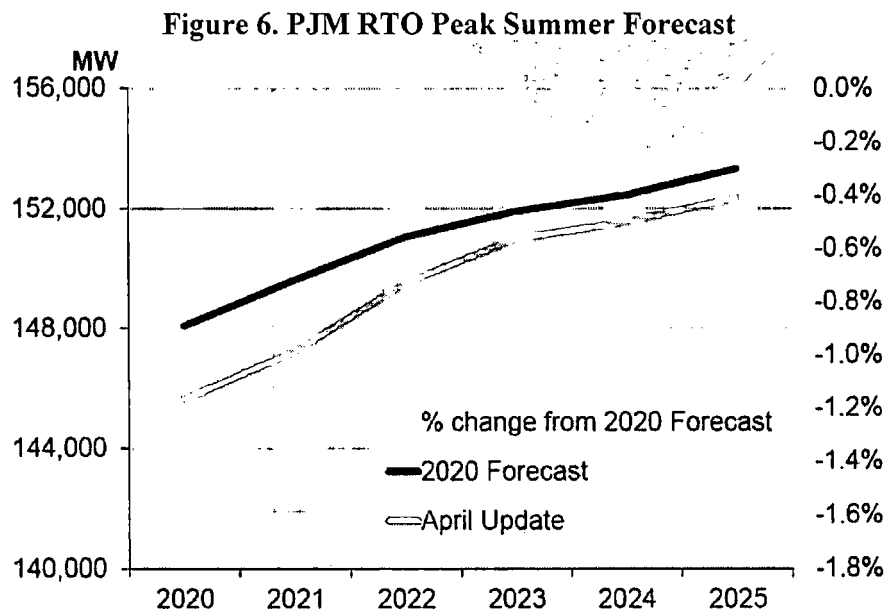


Source: Synapse Energy Economics. 2020. Alternatives to the Surry-Skiffes Creek 500 kV Transmission Line. Prepared for National Parks Conservation Association.²⁹

29 Available at: [https://www.synapse-energy.com/sites/default/files/Synapse-James town-Report-20-003.pdf](https://www.synapse-energy.com/sites/default/files/Synapse-James%20town-Report-20-003.pdf)

1 The PJM load forecast used by Dominion was created prior to Covid-19 and does
 2 not account for any effects on load due to the pandemic. Dominion did not make
 3 any adjustments to its load forecast, nor assessed the long-term effects of Covid-
 4 19 on the Company's load forecast.³⁰

5 PJM released an "April Update" to its load forecast that uses the same modeling
 6 as the 2020 Forecast but utilizes the *April 2020 Economic Forecast* from Moody's
 7 Analytics as its basis. The load forecast for PJM in the April Update is lower than
 8 the 2020 Forecast by 1.6 percent in 2021 and 0.6 percent lower from 2023 to
 9 2025, as shown in Figure 6.



Source: PJM Planning Committee. June 20, 2020. *Update of COVID-19 Load Impacts*³¹.

30 See Dominion response to Appalachian Voices 2-9, attached as Exhibit RW-111.

31 Available at: <https://www.pjm.com/-/media/committees-groups/committees/pc/2020/20200602/20200602-item-07-covid-19-impacts-and-load-forecast.ashx>

1 It is possible that anticipated reductions to peak load would mitigate some of
2 Dominion's anticipated reliability issues as they relate to capacity and/or resource
3 adequacy.

4 **Q. Are there supply-side resources other than gas-fired combustion turbines**
5 **that could mitigate reliability issues?**

6 A. Yes, certainly. One option would be to convert retiring steam plants to
7 synchronous condensers to provide voltage support. A second option would be to
8 add battery storage in 2023/2024 in place of the combustion turbines. The
9 Yorktown, Chesterfield, and Clover locations would likely be suitable for siting
10 battery installations and would provide reliability support that might be needed,
11 particularly for transmission-related reliability issues. The comparison between
12 Dominion's projected cost of storage and industry projections shown in
13 Confidential Figure 2, on page 23, indicate that battery storage capacity could be
14 a more economical solution than combustion turbines.

15 **Q. Is there evidence from other jurisdictions that battery storage can fulfill**
16 **reliability needs in a similar way to gas-fired combustion turbines?**

17 A. Yes. Southern California Edison recently selected several battery storage projects
18 totaling 195 MW to meet local capacity needs, after the California Independent

1 System Operator determined that storage could fulfill the reliability need. The
2 project replaced the 262 MW gas peaking unit that had previously been chosen.³²

3 **Q. Do you have any recommendations regarding Dominion's assertion of future**
4 **probable system reliability issues?**

5 A. I have two recommendations with respect to Dominion's assertion of future
6 probable system reliability issues: (1) when Dominion's reliability study become
7 available, the Company holds a technical conference to solicit feedback from
8 stakeholders on its methodology and conclusions; and (2) The Commission
9 should require the Company satisfy the requirement in § 56-585.1 A 6 for
10 considering and weighing alternative options (including energy storage options)
11 by presenting, among other things, the results of an all-source RFP that allows for
12 bids from battery storage resources in any future CPCN proceeding for the 970
13 MW of new combustion turbines described in the IRP.

7. CONCLUSIONS AND RECOMMENDATIONS

14 **Q. Please summarize your conclusions.**

15 A. Dominion's 2020 Plan is the first plan put forth by the Company that attempts to
16 model compliance with the Virginia Clean Economy Act, adding sizable volumes

32 Spector, J. 2019. "Southern California Edison Picks 195 MW Battery Portfolio in Place of Puente Gas Plant." *Greentech Media*. Available at: <https://www.greentechmedia.com/articles/read/sce-picks-major-battery-portfolio-in-place-of-puente-gas-plant>.

1 of renewable energy resources and retiring certain fossil-emitting resources over
2 the course of the planning period. Dominion's preferred plan, however, continues
3 to operate certain of the Company's coal units, and the majority of its gas units,
4 until the last years of the extended analysis period to 2045, which is also the point
5 at which the VCEA mandates the retirement of carbon-emitting resources.

6 My independent modeling indicates that Dominion is unnecessarily keeping the
7 VCHEC and Mt. Storm units online, and that retiring them earlier would result in
8 benefits to the Company's ratepayers. Retirement of these units prior to 2035,
9 along with accelerated deployment of solar resources in the next five years, could
10 result in both lower CO₂ emissions and ratepayer savings of up to \$3.3 billion
11 over the 15-year analysis period.

12 **Q. Please summarize your recommendations.**

13 **A.** I recommend that the Commission require that Dominion revise its 2020 Plan to
14 allow the PLEXOS model to endogenously retire the VCHEC and Mt. Storm
15 Units 1-3, after the development of a robust estimate of the sustaining capital
16 costs necessary to maintain the plants through Dominion's current retirement
17 dates of 2044 and 2043, respectively. Dominion should also be required to
18 remove the 970 MW of new gas combustion turbines, allowing the model to make
19 an optimal decision from amongst different resources that could meet Dominion's
20 purported reliability need.

1 I have two recommendations with respect to Dominion's assertion of future
2 probable system reliability issues: (1) that when Dominion's reliability study
3 become available, the Company holds a technical conference to solicit feedback
4 from stakeholders on its methodology and conclusions; and (2) any future CPCN
5 proceeding for the new combustion turbines described in the IRP should be
6 informed by an all-source RFP that allows for bids from battery storage resources.

7 **Q. Does this conclude your direct testimony?**

8 **A. Yes.**

INDEX OF EXHIBITS

Exhibit No.	Description of Exhibit	Confidential or Non-Confidential
Exhibit RW-1	Resume of Rachel S. Wilson	Non-Confidential
Exhibit RW-2	Dominion's Response to Appalachian Voices 1-29	Non-Confidential
Exhibit RW-3	Dominion's Response to Appalachian Voices 1-30	Non-Confidential
Exhibit RW-4	Dominion's Response to Staff 1-5	Non-Confidential
Exhibit RW-5	Dominion's Responses to Sierra Club 2-6 and 2-8	Non-Confidential
Exhibit RW-6	Dominion Response to Staff 1-17(a), Supplemental Attachment Staff 1-17(a) page 3	Non-Confidential
Exhibit RW-7	Dominion Response to Staff 1-17(a), Supplemental Attachment Staff 1-17(a)	Extraordinarily Sensitive
Exhibit RW-8	Dominion Response to Staff Set 01-02, Corrected Attachment Staff Set 01-02 (BMH) CONF	Confidential
Exhibit RW-9	Dominion Response to Appalachian Voices 1-11	Non-Confidential
Exhibit RW-10	Dominion Response to Appalachian Voices 3-4	Non-Confidential
Exhibit RW-11	Dominion Response to Appalachian Voices 2-9	Non-Confidential

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EXHIBIT RW-1:

RESUME OF RACHEL WILSON



Synapse
Energy Economics, Inc.

Rachel Wilson, Principal Associate

Synapse Energy Economics | 485 Massachusetts Avenue, Suite 2 | Cambridge, MA 02139 | 617-453-7044

rwilson@synapse-energy.com

PROFESSIONAL EXPERIENCE

Synapse Energy Economics Inc., Cambridge, MA. *Principal Associate*, April 2019 – present, *Senior Associate*, 2013 – 2019, *Associate*, 2010 – 2013, *Research Associate*, 2008 – 2010.

Provides consulting services and expert analysis on a wide range of issues relating to the electricity and natural gas sectors including: integrated resource planning; federal and state clean air policies; emissions from electricity generation; electric system dispatch; and environmental compliance technologies, strategies, and costs. Uses optimization and electricity dispatch models, including Strategist, PLEXOS, EnCompass, PROMOD, and PROSYM/Market Analytics to conduct analyses of utility service territories and regional energy markets.

Analysis Group, Inc., Boston, MA.

Associate, 2007 – 2008, *Senior Analyst Intern*, 2006 – 2007.

Provided litigation support and performed data analysis on various topics in the electric sector, including tradeable emissions permitting, coal production and contractual royalties, and utility financing and rate structures. Contributed to policy research, reports, and presentations relating to domestic and international cap-and-trade systems and linkage of international tradeable permit systems. Managed analysts' work processes and evaluated work products.

Yale Center for Environmental Law and Policy, New Haven, CT. *Research Assistant*, 2005 – 2007.

Gathered and managed data for the Environmental Performance Index, presented at the 2006 World Economic Forum. Interpreted statistical output, wrote critical analyses of results, and edited report drafts. Member of the team that produced *Green to Gold*, an award-winning book on corporate environmental management and strategy. Managed data, conducted research, and implemented marketing strategy.

Marsh Risk and Insurance Services, Inc., Los Angeles, CA. *Risk Analyst*, Casualty Department, 2003 – 2005.

Evaluated Fortune 500 clients' risk management programs/requirements and formulated strategic plans and recommendations for customized risk solutions. Supported the placement of \$2 million in insurance premiums in the first year and \$3 million in the second year. Utilized quantitative models to create loss forecasts, cash flow analyses and benchmarking reports. Completed a year-long Graduate Training Program in risk management; ranked #1 in the western region of the US and shared #1 national ranking in a class of 200 young professionals.

EDUCATION

Yale School of Forestry & Environmental Studies, New Haven, CT

Masters of Environmental Management, concentration in Law, Economics, and Policy with a focus on energy issues and markets, 2007

Claremont McKenna College, Claremont, California

Bachelor of Arts in Environment, Economics, Politics (EEP), 2003. *Cum laude* and EEP departmental honors.

School for International Training, Quito, Ecuador

Semester abroad studying Comparative Ecology. Microfinance Intern – Viviendas del Hogar de Cristo in Guayaquil, Ecuador, Spring 2002.

ADDITIONAL SKILLS AND ACCOMPLISHMENTS

- Microsoft Office Suite, Lexis-Nexis, Platts Energy Database, Strategist, PROMOD, PROSYM/Market Analytics, EnCompass, and PLEXOS, some SAS and STATA.
- Competent in oral and written Spanish.
- Hold the Associate in Risk Management (ARM) professional designation.

PUBLICATIONS

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Texas Public Utilities Commission (SOAH Docket No. 473-17-1764, PUC Docket No. 46449): Direct testimony evaluating Southwestern Electric Power Company's application for authority to change rates to recover the costs of investments in pollution control equipment. On behalf of Sierra Club and Dr. Lawrence Brough. April 25, 2017.

Virginia State Corporation Commission (Case No. PUE-2015-00075): Direct testimony evaluating the petition for a Certificate of Public Convenience and Necessity filed by Virginia Electric and Power Company to construct and operate the Greenville County Power Station and to increase electric rates to recover the cost of the project. On behalf of Environmental Respondents. November 5, 2015.

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Oklahoma Corporation Commission (Cause No. PUD 201400229): Direct testimony evaluating the modeling of Oklahoma Gas & Electric supporting its request for approval and cost recovery of a Clean Air Act compliance plan and Mustang modernization, and presenting results of independent Gentrader modeling analysis. On behalf of Sierra Club. December 16, 2014.

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Indiana Utility Regulatory Commission (Cause No. 44217): Direct testimony before the Commission discussing PROSYM/Market Analytics modeling relating to the application of Duke Energy Indiana for Certificates of Public Convenience and Necessity. On behalf of Citizens Action Coalition, Sierra Club, Save the Valley, and Valley Watch. November 29, 2012.

Kentucky Public Service Commission (Case No. 2012-00063): Direct testimony before the Commission discussing upcoming environmental regulations and electric system modeling relating to the application of Big Rivers Electric Corporation for a Certificate of Public Convenience and Necessity and for approval of its 2012 environmental compliance plan. On behalf of Sierra Club. July 23, 2012.

Kentucky Public Service Commission (Case No. 2011-00401): Direct testimony before the Commission discussing STRATEGIST modeling relating to the application of Kentucky Power Company for a Certificate of Public Convenience and Necessity, and for approval of its 2011 environmental compliance plan and amended environmental cost recovery surcharge. On behalf of Sierra Club. March 12, 2012.

Kentucky Public Service Commission (Case No. 2011-00161 and Case No. 2011-00162): Direct testimony before the Commission discussing STRATEGIST modeling relating to the applications of Kentucky Utilities Company, and Louisville Gas and Electric Company for Certificates of Public Convenience and Necessity, and approval of its 2011 compliance plan for recovery by environmental surcharge. On behalf of Sierra Club and Natural Resources Defense Council (NRDC). September 16, 2011.

Minnesota Public Utilities Commission (OAH Docket No. 8-2500-22094-2 and MPUC Docket No. E-017/M-10-1082): Rebuttal testimony before the Commission describing STRATEGIST modeling performed in the docket considering Otter Tail Power's application for an Advanced Determination of Prudence for BART retrofits at its Big Stone plant. On behalf of Izaak Walton League of America, Fresh Energy, Sierra Club, and Minnesota Center for Environmental Advocacy. September 7, 2011.

PRESENTATIONS

Wilson, R. 2017. "Integrated Resource Planning: Past, Present, and Future." Presentation for the Michigan State University Institute of Public Utilities Grid School. March 29, 2017.

Wilson, R. 2015. "Best Practices in Clean Power Plan Planning." NASEO/ACEEE Webinar. June 29, 2015.

Wilson, R. 2009. "The Energy-Water Nexus: Interactions, Challenges, and Policy Solutions." Presentation for the National Drinking Water Symposium. October 13, 2009.

Resume dated April 2019

EXHIBIT RW-2:

DOMINION'S RESPONSE TO APPALACHIAN VOICES 1-29

Virginia Electric and Power Company
Case No. PUR-2020-00035
Appalachian Voices
Set 1

The following response to Question No. 29 of the First Set of Interrogatories and Requests for Production of Documents Propounded by Appalachian Voices received on May 12, 2020, was prepared by or under the supervision of:

Arthur Berberich
Financial Analyst
Virginia Electric and Power Company

Question No. 29

For each Alternative Plan and each year of study period provide the following for Mt. Storm:

- a) projected CO2 emissions
- b) projected MWs generated
- c) cost per MWh generated

Response:

See the tables below for the requested data for each alternative plan.

29a: Mt. Storm CO ₂ Emissions, short tons					
Year	Plan A	Plan B	Plan B ₁₉	Plan C	Plan D
2020	5,121,681	5,274,405	5,290,475	5,274,405	5,274,405
2021	5,423,975	5,917,468	5,947,361	5,917,468	5,917,468
2022	5,727,234	5,912,345	5,977,746	5,912,345	5,952,897
2023	4,824,746	4,739,185	4,882,985	4,739,185	4,849,266
2024	4,717,795	4,494,058	4,628,413	4,494,058	4,604,929
2025	5,748,537	5,337,759	5,577,780	5,337,759	5,543,984
2026	6,195,096	1,671,966	1,749,909	1,671,966	1,736,593
2027	6,123,704	1,488,812	1,542,475	1,488,812	1,533,860
2028	5,968,973	1,547,233	1,613,498	1,547,233	1,605,148
2029	6,067,491	1,726,440	1,815,629	1,726,440	1,806,735
2030	6,356,991	1,976,025	2,079,728	1,976,025	2,070,531
2031	6,045,957	1,863,398	2,027,065	1,863,398	2,013,423
2032	5,641,269	1,506,731	1,612,883	1,506,731	1,599,597
2033	5,756,956	1,321,826	1,412,498	1,321,826	1,403,187
2034	5,789,368	897,475	999,376	897,475	990,766
2035	5,023,873	713,366	810,920	713,366	801,647
2036	5,432,512	837,517	946,568	800,221	907,973
2037	5,631,768	988,649	1,075,121	949,960	1,034,868
2038	5,539,898	1,060,014	1,043,583	1,435,997	1,420,600
2039	7,286,425	1,356,814	1,342,254	2,086,321	2,045,914
2040	6,962,187	1,209,936	1,192,040	1,871,016	1,852,540
2041	6,903,951	1,065,235	1,071,212	1,694,166	1,694,548
2042	6,798,078	1,093,654	1,100,775	1,646,545	1,650,346
2043	6,779,334	1,192,611	1,201,321	1,655,921	1,663,739
2044	-	-	-	-	-
2045	-	-	-	-	-

Year	29b: Mt. Storm Generation, MWh				
	Plan A	Plan B	Plan B ₁₉	Plan C	Plan D
2020	5,032,850	5,182,100	5,197,730	5,182,100	5,182,100
2021	5,322,170	5,808,440	5,837,630	5,808,440	5,808,440
2022	5,628,020	5,810,790	5,874,990	5,810,790	5,850,660
2023	4,743,850	4,660,120	4,801,210	4,660,120	4,768,050
2024	4,639,880	4,418,330	4,550,450	4,418,330	4,527,400
2025	5,649,380	5,242,840	5,478,600	5,242,840	5,445,380
2026	6,088,560	1,644,920	1,721,910	1,644,920	1,708,840
2027	6,020,900	1,465,180	1,518,010	1,465,180	1,509,510
2028	5,865,590	1,522,480	1,587,710	1,522,480	1,579,470
2029	5,960,600	1,699,100	1,786,930	1,699,100	1,778,210
2030	6,244,720	1,944,110	2,046,040	1,944,110	2,037,010
2031	5,936,880	1,835,370	1,996,080	1,835,370	1,982,670
2032	5,541,030	1,483,450	1,588,150	1,483,450	1,575,030
2033	5,655,000	1,301,540	1,390,670	1,301,540	1,381,530
2034	5,689,920	883,970	984,030	883,970	975,640
2035	4,937,040	702,610	798,510	702,610	789,390
2036	5,336,590	824,900	931,920	788,150	894,060
2037	5,535,000	972,760	1,057,520	935,040	1,018,270
2038	5,441,770	1,043,690	1,027,480	1,412,930	1,397,810
2039	7,155,680	1,336,360	1,322,070	2,052,170	2,012,230
2040	6,836,850	1,190,640	1,173,070	1,839,510	1,821,320
2041	6,779,450	1,048,660	1,054,520	1,665,650	1,666,020
2042	6,675,100	1,077,640	1,084,670	1,620,170	1,623,910
2043	6,659,020	1,174,290	1,182,800	1,628,920	1,636,640
2044	-	-	-	-	-
2045	-	-	-	-	-

Year	29c: Mt. Storm cost (\$) per MWh				
	Plan A	Plan B	Plan B ₁₉	Plan C	Plan D
2020	22.9	22.9	22.9	22.9	22.9
2021	24.1	24.1	24.1	24.1	24.1
2022	27.1	27.1	27.1	27.1	27.1
2023	29.3	29.3	29.3	29.3	29.3
2024	29.9	30.0	30.0	30.0	30.0
2025	30.7	30.7	30.7	30.7	30.7
2026	31.4	41.1	41.1	41.1	41.1
2027	32.2	41.6	41.6	41.6	41.6
2028	33.0	42.2	42.2	42.2	42.2
2029	33.7	42.7	42.7	42.7	42.7
2030	34.6	43.5	43.5	43.5	43.5
2031	35.4	44.7	44.7	44.7	44.7
2032	36.3	46.0	46.0	46.0	46.0
2033	37.1	47.4	47.4	47.4	47.4
2034	38.0	48.8	48.8	48.8	48.8
2035	38.9	50.3	50.3	50.3	50.3
2036	39.8	51.8	51.9	51.8	51.8
2037	40.7	53.5	53.5	53.5	53.5
2038	41.7	55.1	55.1	55.1	55.1
2039	42.7	56.7	56.7	56.8	56.9
2040	43.6	58.5	58.5	58.6	58.6
2041	44.5	60.2	60.2	60.3	60.3
2042	45.4	61.3	61.3	61.5	61.5
2043	46.2	62.2	62.2	62.3	62.3
2044	-	-	-	-	-
2045	-	-	-	-	-

Notes:

Cost above reflect total costs per MWh generated

EXHIBIT RW-3:

DOMINION'S RESPONSE TO APPALACHIAN VOICES 1-30

Virginia Electric and Power Company
Case No. PUR-2020-00035
Appalachian Voices
Set 1

The following response to Question No. 30 of the First Set of Interrogatories and Requests for Production of Documents Propounded by Appalachian Voices received on May 12, 2020, was prepared by or under the supervision of:

Arthur Berberich
 Financial Analyst
 Virginia Electric and Power Company

Question No. 30

For each Alternative Plan and each year of the study period, provide the following for the Virginia City Hybrid Energy Center:

- a) projected CO2 emissions
- b) projected CO2 emissions from burning biomass
- c) assumed heat rate for burning biomass
- d) projected quantities of biomass burned and MWh generated from biomass
- e) assumed heat rate for burning coal
- f) projected quantities of coal burned and resulting MWh generated
- g) projected costs of biomass per MWh generated
- h) projected costs of coal per MWh generated
- i) projected emissions of particulates from biomass
- j) projected emissions of particulates from coal

Response:

- a) See the table below
- b) The Company does not model CO₂ emissions for biomass. Biomass is assumed to be carbon neutral.
- c) See Appendix 5E for the average heat rate in mmbtu/MWh for VCHEC.
- d) See the table below
- e) See Appendix 5E for the average heat rate in mmbtu/MWh for VCHEC.
- f) See the table below
- g) See the table below. The Company does not model individual costs of biomass and coal on a MWh basis.
- h) See the table below. The Company does not model individual costs of biomass and coal on a MWh basis.
- i) The Company did not model the particulates from biomass
- j) The Company did not model the particulates from coal

30a: VCHEC CO ₂ Emissions, short tons					
Year	Plan A	Plan B	Plan B ₁₉	Plan C	Plan D
2020	341,497	270,721	271,477	270,721	270,721
2021	701,823	324,482	326,915	324,482	324,482
2022	903,801	349,108	356,192	349,108	353,754
2023	793,251	349,738	355,839	349,738	354,036
2024	839,880	377,947	387,436	377,947	386,342
2025	1,232,413	512,855	540,972	512,855	535,808
2026	1,402,225	375,963	392,725	375,963	389,919
2027	1,368,917	317,678	333,530	317,678	331,764
2028	1,331,625	339,488	347,009	339,488	346,771
2029	1,336,192	371,320	398,840	371,320	393,680
2030	1,354,785	444,356	462,050	444,356	460,537
2031	1,350,521	391,153	428,217	391,153	422,020
2032	1,261,417	319,822	344,594	319,822	341,098
2033	1,292,583	292,559	322,407	292,559	318,596
2034	1,292,358	198,098	227,394	198,098	221,964
2035	1,160,794	153,670	173,063	153,670	170,460
2036	1,285,200	183,552	219,797	174,534	199,556
2037	1,281,655	231,443	259,467	220,977	247,824
2038	1,278,370	234,409	227,461	347,577	343,011
2039	1,787,748	316,349	315,404	534,991	527,010
2040	1,698,750	288,873	288,389	477,623	471,358
2041	1,662,639	244,830	246,725	421,499	421,534
2042	1,612,308	233,789	235,050	404,485	405,909
2043	1,542,538	251,590	255,677	412,889	414,293
2044	1,691,441	337,594	338,936	391,906	394,100
2045	1,649,839	-	-	-	-

Notes:

Biomass is assumed to be carbon neutral

30d: VCHEC Biomass burned & Generation										
Year	Plan A		Plan B		Plan B ₁₉		Plan C		Plan D	
	GBTU	MWh	GBTU	MWh	GBTU	MWh	GBTU	MWh	GBTU	MWh
2020	349	37,190	277	29,490	278	29,570	277	29,490	277	29,490
2021	760	80,910	351	37,410	354	37,690	351	37,410	351	37,410
2022	979	104,200	378	40,250	386	41,060	378	40,250	383	40,780
2023	859	91,450	379	40,320	385	41,020	379	40,320	383	40,820
2024	909	96,830	409	43,570	420	44,670	409	43,570	418	44,540
2025	1,335	142,080	555	59,130	586	62,370	555	59,130	580	61,770
2026	1,518	161,660	407	43,340	425	45,280	407	43,340	422	44,950
2027	1,482	157,820	344	36,620	361	38,450	344	36,620	359	38,250
2028	1,442	153,520	368	39,140	376	40,010	368	39,140	376	39,980
2029	1,447	154,040	402	42,810	432	45,980	402	42,810	426	45,390
2030	1,467	156,190	481	51,230	500	53,270	481	51,230	499	53,090
2031	1,462	155,700	424	45,090	464	49,370	424	45,090	457	48,650
2032	1,366	145,420	346	36,870	373	39,730	346	36,870	369	39,320
2033	1,400	149,020	317	33,730	349	37,170	317	33,730	345	36,730
2034	1,399	148,990	215	22,840	246	26,220	215	22,840	240	25,590
2035	1,257	133,820	166	17,720	187	19,950	166	17,720	185	19,650
2036	1,392	148,170	199	21,160	238	25,340	189	20,120	216	23,010
2037	1,388	147,760	251	26,680	281	29,910	239	25,480	268	28,570
2038	1,384	147,380	254	27,020	246	26,220	376	40,070	371	39,540
2039	1,936	206,100	343	36,470	342	36,360	579	61,680	571	60,760
2040	1,840	195,840	313	33,300	312	33,250	517	55,060	510	54,340
2041	1,800	191,680	265	28,230	267	28,440	456	48,590	456	48,600
2042	1,746	185,880	253	26,950	255	27,100	438	46,630	440	46,800
2043	1,670	177,830	272	29,000	277	29,480	447	47,600	449	47,760
2044	1,832	195,000	366	38,920	367	39,070	424	45,180	427	45,430
2045	1,787	190,200	-	-	-	-	-	-	-	-

30f: VCHEC Coal Burned & Generation										
Year	Plan A		Plan B		Plan B ₁₉		Plan C		Plan D	
	GBTU	MWh	GBTU	MWh	GBTU	MWh	GBTU	MWh	GBTU	MWh
2020	3,328	354,330	2,638	280,890	2,646	281,680	2,638	280,890	2,638	280,890
2021	6,840	728,200	3,162	336,680	3,186	339,200	3,162	336,680	3,162	336,680
2022	8,808	937,760	3,402	362,230	3,471	369,580	3,402	362,230	3,448	367,050
2023	7,731	823,060	3,408	362,880	3,468	369,210	3,408	362,880	3,450	367,340
2024	8,185	871,440	3,683	392,150	3,776	401,990	3,683	392,150	3,765	400,860
2025	12,011	1,278,720	4,998	532,130	5,272	561,300	4,998	532,130	5,222	555,940
2026	13,666	1,454,920	3,664	390,090	3,827	407,480	3,664	390,090	3,800	404,570
2027	13,341	1,420,360	3,096	329,620	3,251	346,060	3,096	329,620	3,233	344,230
2028	12,978	1,381,660	3,309	352,240	3,382	360,050	3,309	352,240	3,380	359,800
2029	13,022	1,386,400	3,619	385,270	3,887	413,830	3,619	385,270	3,837	408,470
2030	13,204	1,405,700	4,331	461,050	4,503	479,410	4,331	461,050	4,488	477,840
2031	13,162	1,401,270	3,812	405,850	4,173	444,310	3,812	405,850	4,113	437,880
2032	12,294	1,308,820	3,117	331,840	3,358	357,540	3,117	331,840	3,324	353,920
2033	12,597	1,341,160	2,851	303,550	3,142	334,520	2,851	303,550	3,105	330,570
2034	12,595	1,340,920	1,931	205,540	2,216	235,940	1,931	205,540	2,163	230,310
2035	11,313	1,204,410	1,498	159,440	1,687	179,570	1,498	159,440	1,661	176,870
2036	12,525	1,333,500	1,789	190,450	2,142	228,060	1,701	181,090	1,945	207,050
2037	12,491	1,329,820	2,256	240,140	2,529	269,220	2,154	229,280	2,415	257,140
2038	12,459	1,326,410	2,285	243,220	2,217	236,010	3,387	360,640	3,343	355,900
2039	17,423	1,854,930	3,083	328,240	3,074	327,260	5,214	555,090	5,136	546,810
2040	16,556	1,762,590	2,815	299,730	2,811	299,230	4,655	495,570	4,594	489,070
2041	16,204	1,725,120	2,386	254,030	2,405	256,000	4,108	437,340	4,108	437,370
2042	15,713	1,672,900	2,278	242,570	2,291	243,880	3,942	419,690	3,956	421,160
2043	15,033	1,600,500	2,452	261,040	2,492	265,290	4,024	428,400	4,038	429,860
2044	16,484	1,755,000	3,290	350,280	3,303	351,670	3,819	406,630	3,841	408,910
2045	16,079	1,711,840	-	-	-	-	-	-	-	-

Year	30g&h: VCHEC cost (\$) per MWh				
	Plan A	Plan B	Plan B ₁₉	Plan C	Plan D
2020	27.68	28.42	28.42	28.42	28.42
2021	27.88	33.05	33.05	33.05	33.05
2022	29.29	34.60	34.60	34.60	34.60
2023	30.96	36.61	36.61	36.61	36.61
2024	31.55	37.54	37.54	37.54	37.54
2025	32.05	38.52	38.52	38.52	38.52
2026	32.54	42.31	42.31	42.31	42.31
2027	33.42	42.80	42.81	42.80	42.81
2028	34.29	43.38	43.38	43.38	43.38
2029	35.22	44.00	44.00	44.00	44.00
2030	36.74	44.76	44.76	44.76	44.76
2031	37.45	46.03	46.03	46.03	46.03
2032	38.16	47.35	47.35	47.35	47.35
2033	38.89	48.72	48.72	48.72	48.72
2034	39.63	50.13	50.13	50.13	50.13
2035	40.36	51.57	51.57	51.57	51.57
2036	41.36	53.06	53.06	53.06	53.06
2037	42.39	54.60	54.60	54.59	54.59
2038	43.41	56.16	56.17	56.17	56.17
2039	44.46	57.76	57.76	57.77	57.77
2040	45.52	59.41	59.41	59.42	59.42
2041	46.59	61.14	61.14	61.15	61.15
2042	47.68	62.55	62.55	62.56	62.56
2043	48.79	63.59	63.59	63.61	63.61
2044	49.90	64.65	64.65	64.66	64.66
2045	51.03	-	-	-	-

Notes:

Cost above reflect total costs per MWh generated for biomass and coal

EXHIBIT RW-4:

DOMINION'S RESPONSE TO STAFF 1-5

Virginia Electric and Power Company
Case No. PUR-2020-00035
Virginia State Corporation Commission Staff
Staff Set 1

The following response to Question No. 5 of the First Set of Interrogatories and Requests for Production of Documents Propounded by the Virginia State Corporation Commission Staff received on May 11, 2020, was prepared by or under the supervision of:

Kevin Cross
Senior Financial Specialist – Strategic Planning VA/NC
Virginia Electric and Power Company

Question No. 5

For all plans, please identify all generation/storage resources, not yet approved by the Commission, that the Company instructed the PLEXOS model to select as must run resources.

Response:

All generation/storage resources selected in Plan A were selected optimally. For the 15-year planning period for Plans B, C, D, and B₁₉, the Company directed the model to select the 2.7 GW of storage, 15.9 GW of solar, and 2.6 GW of offshore wind to comply with new resource requirements in the VCEA. The model was also directed to select 970 MW as a placeholder to address probable system reliability issues resulting from the addition of significant renewable energy resources and the retirement of coal-fired facilities. Finally, as noted in Section 4.5, the Company made simplifying assumptions related to the mandatory RPS established by the VCEA, including the assumption that the Company could construct or purchase renewable resources at less than the \$45/MWh deficiency payment in the VCEA. To that end, for Plans D and B₁₉, the model was directed to build an additional 2.9 GW of solar by 2035; for Plans B, C, D, and B₁₉, the model was also directed to build an additional 2.6 GW of offshore wind by 2034.

EXHIBIT RW-5:

DOMINION'S RESPONSES TO SIERRA CLUB 2-6 AND 2-8

Virginia Electric and Power Company
Case No. PUR-2020-00035
Sierra Club
Set 2

The following response to Question No. 6 of the Second Set of Interrogatories and Requests for Production of Documents Propounded by Sierra Club received on July 9, 2020, was prepared by or under the supervision of:

Daria Adamenko
Senior Energy Market Analyst
Dominion Energy Services, Inc.

Question No. 6

For each of the Alternative Plans B, B₁₉, C, and D:

- a. Was the PLEXOS model allowed to select the optimal number of solar resources (Solar cost of service ("COS") and Solar power purchase agreement ("PPA")) in each year of the study period, from 2021-2035 and also through 2045?
 - i. If yes, were any limits placed on the annual number of Solar COS and Solar PPA resources that could be chosen in a given year?
 - ii. If limits were placed on the annual number of Solar COS and Solar PPA resources, please provide those limits for each year.
 - iii. If no, how was the annual number of Solar COS and Solar PPA resources determined?
- b. Were any limits placed on the cumulative maximum number of Solar COS and Solar PPA resources that could be chosen through 2035 or 2045?
 - i. If yes, please provide those limits.

Response:

- a. No. For modeling purposes in Alternative Plans B, B₁₉, C, and D, the annual amounts of Solar COS and Solar PPA resources were determined separately and then input to PLEXOS. See the Company's response to Staff Set 1-5 and Section 4.6.2 of the 2020 Plan.
- b. Yes. See the Company's response to Staff Set 1-5.

Virginia Electric and Power Company
Case No. PUR-2020-00035
Sierra Club
Set 2

The following response to Question No. 8 of the Second Set of Interrogatories and Requests for Production of Documents Propounded by Sierra Club received on July 9, 2020, was prepared by or under the supervision of:

Daria Adamenko
Senior Energy Market Analyst
Dominion Energy Services, Inc.

Question No. 8

For each of the Alternative Plans B, B19, C, and D:

- a. Was the PLEXOS model allowed to select the optimal number of battery storage resources in each year of the study period, from 2021-2035 and also through 2045?
 - i. If yes, were any limits placed on the annual number of battery storage resources that could be chosen in a given year?
 - ii. If limits were placed on the annual number of battery storage resources, please provide those limits.
 - iii. If no, how was the annual number of battery storage resources determined?
- b. Were any limits placed on the cumulative maximum number of battery storage resources that could be chosen through 2035 or 2045?
 - i. If yes, please provide those limits.
- c. What was the first year that battery storage resources were available to the PLEXOS model?

Response:

- a. No. For modeling purposes in Alternative Plans B, B19, C, and D, the annual amounts of battery storage resources were determined separately and then input to PLEXOS. For the 15-year period through 2035, the model was directed to select 2.7 GW of energy storage to comply with the new resource requirements in the VCEA. Given the 10-year battery energy storage life and forecasted fossil unit retirements, the Company made a high-level

assumption that an additional 2.4 GW of battery energy storage would be needed in 2036 to 2045 to replace energy storage units built prior to 2036 in the Alternative Plans B and B₁₉, and that an additional 7.2 GW of battery energy storage would be needed in 2036 to 2045 in the Alternative Plan C and D to replace energy storage units built prior to 2036 and to account for forecasted fossil unit retirements.

- b. Yes. See subpart (a).
- c. See the Company's response to Staff Set 1-2.

EXHIBIT RW-6:

**DOMINION RESPONSE TO STAFF 1-17(A),
SUPPLEMENTAL ATTACHMENT STAFF 1-17(A) PAGE 3**

Virginia Electric and Power Company
Case No. PUR-2020-00035
Virginia State Corporation Commission Staff
Staff Set 1

As it pertains to generation planning, the following **supplemental** response (dated September 9, 2020) to Question No. 17 of the First Set of Interrogatories and Requests for Production of Documents Propounded by the Virginia State Corporation Commission Staff received on May 11, 2020, was prepared by or under the supervision of:

Daria Adamenko
Senior Financial Analyst
Virginia Electric and Power Company

As it pertains to estimated transmission and distribution impacts, the following **supplemental** response (dated September 9, 2020) to Question No. 17 of the First Set of Interrogatories and Requests for Production of Documents Propounded by the Virginia State Corporation Commission Staff received on May 11, 2020, was prepared by or under the supervision of:

Robert G. Thomas
Director, Corporate Strategy
Corporate Planning and Fuel Management
Dominion Energy Services, Inc.

Question No. 17

Please provide the retirement analysis performed for each of the Company's existing coal units including Mount Storm and the Virginia City Hybrid Energy Center ("VCHEC"). Provide the economic analysis performed for each coal unit as an executable excel spreadsheet with all formulae intact. Provide all underlying assumptions used in performing this economic analysis.

Supplemental Response (dated Sept. 9, 2020):

Subject to the Hearing Examiner's Ruling dated September 2, 2020, the Company provides the following supplemental response:

See Supplemental Attachment Staff Set 01-17(a) ES. Supplemental Attachment Staff Set 01-17(a) ES contains extraordinarily sensitive information as indicated, and is being provided pursuant to the protections set forth in 5 VAC 5-20-170, the Hearing Examiner's Protective Ruling and Additional Protective Treatment for Extraordinarily Sensitive Information dated May 6, 2020, any other protective order or ruling that may be issued for confidential or extraordinarily sensitive information in this proceeding, and the Agreements to Adhere executed pursuant to any such orders or rulings.

10-year NPV Results

2020-2029 (\$ Million)

Unit	Base	Sensitivities						Est. T&D Impact
	Fed Mid RGI VA	Low Capacity \$	High Capacity \$	VA RGI	Federal Mid CO ₂	Federal High CO ₂	No CO ₂ Tax	
Chesterfield 5-6	(\$78)	(\$297)	(\$18)	(\$77)	(\$56)	(\$55)	(\$48)	\$100
Clover	(\$21)	(\$116)	\$5	(\$21)	(\$11)	(\$11)	(\$8)	\$0
Mount Storm	\$100	(\$318)	\$217	\$226	\$93	\$93	\$138	*\$60
Virginia City	(\$472)	(\$624)	(\$429)	(\$473)	(\$437)	(\$440)	(\$423)	\$30
Yorktown 3	(\$18)	(\$190)	\$30	(\$17)	(\$14)	(\$20)	(\$13)	\$0

*T&D cost at Mount Storm is applicable if the station retires after Chesterfield 5-6 and Clover

Notes:

- 1) Positive NPV indicates customer benefit
- 2) Unit NPVs include property taxes and 15% allocated overhead, but exclude est. T&D cost
- 3) MWs assume UCAP
- 4) Mount Storm NPVs include \$10M annual B&O tax
- 5) Clover station is modeled @50% ownership

EXHIBIT RW-9:

DOMINION RESPONSE TO APPALACHIAN VOICES 1-11

Virginia Electric and Power Company
Case No. PUR-2020-00035
Appalachian Voices
Set 1

The following response to Question No. 11(a)-(c) and (f) of the First Set of Interrogatories and Requests for Production of Documents Propounded by Appalachian Voices received on May 12, 2020, was prepared by or under the supervision of:

Peter Nedwick
Principal Engineer ET Planning & Strategic Initiatives
Dominion Energy Virginia

Question No. 11(a)-(c) and (f)

Please reference page 30 of the 2020 IRP which states that “Alternative Plans B, C, and D include 970 MW of natural gas-fired generation as a placeholder to address probable system reliability issues from the addition of significant renewable energy resources and the retirement of coal-fired facilities.”

- a) Please explain what the Company means by “placeholder.” Specifically, did the model select these CTs or were they forced by the Company?
- b) Please provide the analysis or study supporting the claim that the Company has “probably [sic] reliability issues from the addition of significant renewable energy resources and the retirement of coal-fired facilities.”
- c) Please provide the analysis or study showing whether and how a new 485 MW CT coming online in 2023 addresses system reliability.
- f) Please provide the analysis or study showing whether and how a new 485 MW CT coming online in 2024 addresses system reliability.

Response:

- a) “Placeholder” means something used or included temporarily or as a substitute for something that is not known or must remain generic; that which holds, denotes, or reserves a place for something to come later. The Company described the 970 MW of CTs shown in Alternative Plans B, B₁₉, C, and D as a placeholder because analysis is underway to evaluate the probable system reliability issues resulting from the addition of significant renewable energy resources and the retirement of coal-fired facilities, as well as options to address those issues, as noted in Section 3.3 of the 2020 Plan. The

Company used CTs as the placeholder because of the known attributes of CT resources. The results of the analysis will guide the actual solutions that the Company pursues for system reliability issues.

- b) Based on its knowledge of planning and operating its transmission system, the Company knows that the loss of stored kinetic energy resulting from the additional of significant inverter-based generation and the retirement of traditional turbine generation will cause technical issues for the grid that warrant further analysis. Section 7.5 of the 2020 Plan discusses several area of study that have not historically been necessary to consider during traditional transmission system planning studies and analyses, but that will be essential going forward. This analysis has not been completed and is currently underway. See the Company's response to subpart (a).
- c) This analysis is underway. See the Company's response to subpart (b).
- f) This analysis is underway. See the Company's response to subpart (b).

Virginia Electric and Power Company
Case No. PUR-2020-00035
Appalachian Voices
Set 1

The following response to Question No. 11(d) of the First Set of Interrogatories and Requests for Production of Documents Propounded by Appalachian Voices received on May 12, 2020, was prepared by or under the supervision of:

Kevin Cross
Senior Financial Specialist
Virginia Electric and Power Company

Question No. 11(d)

Please reference page 30 of the 2020 IRP which states that "Alternative Plans B, C, and D include 970 MW of natural gas-fired generation as a placeholder to address probable system reliability issues from the addition of significant renewable energy resources and the retirement of coal-fired facilities."

d) What is the specific in-service date in 2023 for this 485 MW CT?

Response:

For modeling purposes, the in-service date is Jan 1, 2023.

Virginia Electric and Power Company
Case No. PUR-2020-00035
Appalachian Voices
Set 1

The following response to Question No. 11(e) of the First Set of Interrogatories and Requests for Production of Documents Propounded by Appalachian Voices received on May 12, 2020, was prepared by or under the supervision of:

Bradley M. Hanks
Manager – Construction Services
Dominion Energy Services, Inc.

Question No. 11(e)

Please reference page 30 of the 2020 IRP which states that “Alternative Plans B, C, and D include 970 MW of natural gas-fired generation as a placeholder to address probable system reliability issues from the addition of significant renewable energy resources and the retirement of coal-fired facilities.”

e) How far in advance of that specific service date does the Company need to obtain CPCNs and other approval from the Commission in order to meet that in-service date?

Response:

If the Company decided to move forward with a certificate of public convenience and necessity for one or more CTs, it would need approximately 16 to 18 months from final order to in-service date.

EXHIBIT RW-10:

DOMINION RESPONSE TO APPALACHIAN VOICES 3-4

Virginia Electric and Power Company
Case No. PUR-2020-00035
Appalachian Voices
Set 3

The following response to Question No. 4 of the Third Set of Interrogatories and Requests for Production of Documents Propounded by Appalachian Voices received on May 27, 2020, was prepared by or under the supervision of:

Peter Nedwick
Principal Engineer ET Planning & Strategic Initiatives
Dominion Energy Virginia

Question No. 4

Reference the response to Appalachian Voices Set 1-11(b), which states that “analysis is underway to evaluate the probable system reliability issues resulting from the addition of significant renewable energy resources and the retirement of coal-fired facilities.” When does the Company expect to complete that analysis?

Response:

As noted in the Company’s response to Appalachian Voices Set 1-11(b), the Company’s system reliability analyses are ongoing and have been iterative. The Company does not have an estimated completion date for all the system reliability issues it intends to study.

EXHIBIT RW-11:

DOMINION RESPONSE TO APPALACHIAN VOICES 2-9

200920054

Virginia Electric and Power Company
Case No. PUR-2020-00035
Appalachian Voices
Set 2

The following response to Question No. 9 of the Second Set of Interrogatories and Requests for Production of Documents Propounded by Appalachian Voices received on May 15, 2020, was prepared by or under the supervision of:

Karim Siamer
Lead Economist,
Load Research and Forecast
Dominion Energy Services, Inc.

As it pertains to legal matters, the following response to Question No. 9 of the Second Set of Interrogatories and Requests for Production of Documents Propounded by Appalachian Voices received on May 15, 2020, was prepared by or under the supervision of:

Sarah R. Bennett
McGuireWoods LLP

Question No. 9

Reference IRP page 39: "Notably, neither the 2020 PJM Load Forecast nor the Company Load Forecast incorporates any effects on load of the ongoing public health emergency related to the spread of COVID-19."

- a) Has PJM prepared any updated load forecasts that incorporate any effects on load of the ongoing public health emergency? Provide all such forecasts in the Company's custody, control, or possession.
- b) Has the Company performed a sensitivity analysis showing the impact on the Company's load forecast of the latest available economic and demographic assumptions?
- c) If not, is the Company willing to provide such analysis in this proceeding? If not, please explain why not.

Response:

a) The Company objects to this request to the extent it asks the Company for information from other entities that are equally accessible to Appalachian Voices as it would be for the Company. Notwithstanding and subject to this objection, the Company provides the following response:

The Company is not aware of updated PJM load forecasts that incorporate the long-term effects on load of the ongoing public health emergency. For more information, consult the planning committee agenda at www.pjm.com.

b) No, the Company has not prepared an analysis to assess the long-term effects of the COVID-19 public health emergency on the Company's load forecast.

c) As noted in Section 1.9 of the 2020 Plan, the Company believes it is too early to predict the long-term effects of the COVID-19 public health emergency, including the effect on customer load. The Company will continue to monitor the effects of this ongoing public health emergency and will incorporate any long-term effects as needed in future Plans and update filings.