October 16, 2018

VIA HAND DELIVERY

Mr. Joel H. Peck, Clerk
c/o Document Control Center
State Corporation Commission
Tyler Building – First Floor
1300 East Main Street
Richmond, Virginia 23219

RE: Virginia Electric and Power Company – For approval of a plan for
electric distribution grid transformation projects pursuant to § 56-585.1 A 6 of the Code of Virginia.

Case No. PUR-2018-00100

Dear Mr. Peck:

Enclosed for filing in the above-captioned matter is the Direct Testimony and exhibits of
Caroline Golin, PhD on behalf of Appalachian Voices ("Environmental Respondents"). Pursuant
to 5 VAC 5-20-150 of the Commission’s Rules of Practice and Procedure, this filing is being
completed by hand delivery.

If you should have any questions regarding this filing, please do not hesitate to contact
me at (434) 977-4090.

Regards,

William C. Cleveland

cc: Parties on Service List
Commission Staff
COMMONWEALTH OF VIRGINIA
STATE CORPORATION COMMISSION

PETITION OF VIRGINIA ELECTRIC AND POWER COMPANY

For approval of a plan for electric distribution grid transformation projects pursuant to § 56-585.1 A 6 of the Code of Virginia

Case No. PUR-2018-00100

Summary of Direct Testimony of
Caroline Golin, PhD, VoteSolar

On Behalf of
Environmental Respondents

October 16, 2018
Summary of the Testimony of Caroline Golin, PhD

The purpose of my testimony is to appraise the Grid Transformation Plan (herein "GT Plan") put forth by Virginia Electric and Power Company (herein the "Company") and the Company's request to recover spending related to the GT Plan. The GT Plan is a ten-year, $3.5 billion grid investment proposal. The Company is seeking approval for spending related to Phase I investments of the GT Plan, spanning from 2019-2021, totaling $918 million.

Based on my analysis, I conclude that the GT Plan is not cost-effective and will result in an economic loss for all customers. The Company has failed to produce the needed analysis to justify these expenditures, including those related to the supposed need for reliability improvements, integration of distributed energy resources ("DERs"), and improved situational awareness. The Company's approach also fails to recognize how rate optionality, energy efficiency, demand response, and the utilization of DERs can improve reliability and provide cost-effective grid services. Finally, the GT Plan does not reflect any of the best practices emerging in other jurisdictions.

Despite the Company's failure to justify the proposed GT Plan as a whole, there are a select number of investments that support improved customer engagement, integration of DERs, and grid operations. With revisions to the GT Plan, these specific investments could provide net benefits to customers.

I recommend that the Commission:

1) Reject all proposed investments in Intelligent Grid Devices, Operational and Automated Control Systems, and the Supportive Data analytics and Telecommunications investments.

2) Approve Advanced Metering Infrastructure ("AMI"), the Customer Information Portal, and the NEM Interconnection Application Software on the condition that the following amendments are made:
   - Investment in AMI and Meter Data Management System should be functionalized to provide grid services as well as improved metering operations;
   - the Customer Information Portal should adhere to the Green Button Standard;
   - the NEM Interconnection Application should be integrated with the Customer Information Portal, supported with hosting capacity analysis; and
   - the Company should submit a full plan, including cost-benefit analysis, for rate optionality, demand response, and energy efficiency programs to justify the deployment of AMI.

3) Order the Company to develop a planning process that includes the following elements: integrated distribution resource planning, stakeholder engagement, setting clear and measurable goals, and robust cost/benefit analyses. Without such a process and planning elements, the Commission cannot adequately assess the prudence or purpose of the GT Plan.
COMMONWEALTH OF VIRGINIA  
STATE CORPORATION COMMISSION

PETITION OF VIRGINIA ELECTRIC AND POWER COMPANY

For approval of a plan for electric distribution grid transformation projects pursuant to § 56-585.1 A 6 of the Code of Virginia  

Case No. PUR-2018-00100

Direct Testimony of
Caroline Golin, PhD, VoteSolar

On Behalf of
Environmental Respondents

October 16, 2018
INTRODUCTION

Q. PLEASE STATE YOUR NAME, TITLE, AND EMPLOYER.
A. My name is Caroline Golin. I am the Southeast Regulatory Director for Vote Solar.

Q. PLEASE STATE YOUR EDUCATIONAL AND OCCUPATIONAL EXPERIENCE.
A. I received my PhD in Energy Policy and Masters in Civil Engineering both from the Georgia Institute of Technology. I have authored over thirty research papers and reports related to the use of distributed resources to achieve localized distribution planning objectives, renewable energy policy, resource planning, and rate design strategies to incentivize efficiency and effective distributed energy resource use. I have also testified or prepared reports relating to distributed energy resource planning, grid modernization, utility financial analysis, and the costs and benefits of renewable energy, in or related to cases before public utility commissions in North Carolina, Georgia, South Carolina, Ohio, Florida, Kansas, and North Carolina. My full CV is provided as Attachment CG-1 to this testimony.

Q. ON WHOSE BEHALF ARE YOU TESTIFYING?
A. I am testifying on behalf of Appalachian Voices (the “Environmental Respondents”), an intervenor in this proceeding.

Q. HAVE YOU TESTIFIED PREVIOUSLY BEFORE THE STATE CORPORATION COMMISSION (THE “SCC” OR THE “COMMISSION”)?
A. No.
Q. HAVE YOU TESTIFIED PREVIOUSLY BEFORE OTHER PUBLIC UTILITY COMMISSIONS REGARDING GRID MODERNIZATION EFFORTS?

A. Yes. I have testified before the Public Service Commission of North Carolina, Massachusetts, and the Rhode Island Public Utilities Commission regarding grid modernization efforts.

Q. WHAT INFORMATION DID YOU REVIEW IN PREPARING THIS TESTIMONY?

A. I reviewed relevant pre-filed testimony of Virginia Electric and Power Company ("Dominion" or the "Company") witnesses and relevant Company responses to information requests submitted by Environmental Respondents and other intervening parties. Additionally, I reviewed grid modernization initiatives and integrated distribution planning processes in several other jurisdictions.

Q. WHAT IS THE PURPOSE OF YOUR TESTIMONY?

A. I was asked to objectively review the Company's petition in this proceeding (the "Petition") and analyze whether the proposals were a cost-effective way of transforming the Company's distribution grid.

Q. IS IT NECESSARY TO TRANSFORM THE COMPANY'S DISTRIBUTION GRID?

A. That was part of my analysis. Generally speaking, as distributed energy resources ("DERs"), energy storage technologies, and demand side management ("DSM") programs become lower in cost and more widely available, the benefits they offer customers increase. To maximize those benefits, many utility distribution systems need upgrading. That does not mean, however, that all distribution system investments provide
equal value to ratepayers. Part of my task was to evaluate whether the specific proposals in the Company's Petition are cost-effective given the real world state of the Company's distribution system and the existing and foreseeable penetrations of DERs, energy storage, and DSM across the Company's system.

Q. WHAT ELEMENTS OF THE GRID TRANSFORMATION PLAN (THE "GT PLAN" OR THE "PLAN") DO YOU REVIEW IN YOUR TESTIMONY?

A. In my testimony, I review proposed investments in Advanced Metering Infrastructure, Grid Hardening Activities, Intelligent Grid Devices, Operational and Automated Control Systems, the Customer Information Portal, and the NEM Application Software. My review of Telecommunications and Predictive Analytics proposals are limited, as I treat those investments as supportive investments to investments made in Intelligent Grid Devices and Operational and Automated Control Systems. I do not put forward testimony on Street Light Sensors, supportive Control systems, or Physical or Cyber Security investments.

Q. IS YOUR REVIEW OF THE PLAN LIMITED TO PHASE I INVESTMENTS?

A. No. While the Company is only seeking approval for Phase I investments, I reviewed the strength of the entire GT Plan proposed by the Company. Phase I investments will form the basis for any long-term spending proposal. As the Company stated in the Petition, the Company "envisions the Plan to proceed in interdependent phases, with each phase building upon the last."¹ It is imperative that this Phase I proposal provide a well-reasoned, prudent, and sound building block for future proposals.

¹ Petition of Virginia Electric and Power Company for approval of a plan for electric distribution grid transformation projects pursuant to § 56-585.1 A 6 of the Code of Virginia, Case No. PUR-2018-00100 at Cover Letter 1 (July 24, 2018) (the "Petition").
Therefore, I do not limit my review to just Phase I investments. However, my specific recommendations to the Commission are limited to Phase I requests.

Q. PLEASE SUMMARIZE YOUR EVALUATIONS & CONCLUSIONS REGARDING THE GT PLAN.

A. They are as follows:

• As a complete package, the GT Plan is not cost-effective and will result in an economic loss for all customers.

• The analysis used by the Company to justify the GT Plan is deeply flawed and indefensible.

• Although the Company claims that the GT Plan is needed to facilitate necessary improvements in reliability, the Company has failed to produce the required analysis showing that improvements in reliability are necessary. Instead, the data shows that the proposed GT Plan investments are not cost-effective measures for improving reliability, nor are the measures in the customers’ best interest.

• The Company claims that the GT Plan is needed as it provides the necessary situational awareness and control to integrate Distributed Energy Resource (“DERs”). The Company, however, has presented no plan or purpose for investments in increased situational awareness. The Company adopts the faulty posture that the grid needs to be safeguarded against DERs, yet fails to show any reliability or operational issues related to DERs either currently or in the near future. The investments made towards improving situational awareness are unnecessary and premature and will not support additional DER integration.
• The Company's approach to grid investment fails to recognize how rate
optionality, energy efficiency, demand response, and the utilization of DERs can
improve reliability and provide cost-effective grid services.

• The Company's approach to grid investment conflicts with best practices
emerging in other jurisdictions. Specifically, the Company has failed to justify its
investments through robust cost benefit analysis, failed to include any stakeholder
or ratepayer input, and neglected to conduct integrated distribution resource
planning.

• Despite the Company's failure to justify the proposed GT Plan as a whole, there
are a select number of investments that, if implemented properly, will help move
the Company towards improved customer engagement, integration of DERs, and
grid operations. With revisions to the GT Plan, these investments can provide net
benefits to customers.

Q. HOW IS YOUR TESTIMONY STRUCTURED?

A. My testimony is comprised of four sections. First, I provide a brief overview of
the GT Plan as a package before reviewing the engineering and economic analysis used
to justify its scope and value. I focus my review on investments in Reliability and
Resilience, as these investments account for 58% of the total GT Plan spend and account
for 80% of the total proposed benefits.² On their face, these relative levels of investment
are highly questionable and unlikely to be in the interest of ratepayers.

Second, I evaluate the individual components of the Company's proposal in terms
of efficacy and cost-effectiveness. I catalog the proposed investments into three groups:

---
² Spreadsheets attached to Company Response to OAG Set 1-2.
(1) investments that may enable more energy efficiency, demand side management and the smarter integration of DERs, while also providing utilities with enhanced grid operations and reduced grid costs;

(2) investments that could provide benefits for grid operations, but are premature and not cost-effective as proposed given current grid conditions and, if made now, would be wasteful and could result in stranded assets; and

(3) investments that I find unjustified as proposed.

My review of each group of proposed investments is underscored by a recognition that two key components are currently missing from the Company's Plan. First, the Company needs to engage in the proper planning process, as outlined in Section III of my testimony. Without the proper planning, engineering, and economic analyses, the Company cannot make cost-effective investments. Second, the Company needs to focus on improving existing mechanisms including rate optionality, energy efficiency ("EE"), demand response, valuation and integration of DERs, and transparency, before investing heavily in technologies that are not currently justified and not cost-effective. As proposed, the plan safeguards against a dynamic, multi-directional, modernized grid, rather than incentivizing progress towards customer engagement, improved demand side management, and stronger utilization of distributed energy resources.

In the third section, I outline the planning practices that I recommend the Company engage in moving forward to rewrite the GT Plan and ensure cost-effective and constructive investments towards a modernized grid. These planning practices are based on a thorough review of current regulatory proceedings throughout the country and the leading subject literature.
In the fourth section I offer my final conclusions and recommendations. I am aware that the Governor recently released a Virginia Commonwealth 2018 Energy Plan. In the Plan the Governor states that:

To ensure that utility investments align with long-term policy objectives and market shifts, Virginia should reform its regulatory process to include distribution system level planning in Virginia's ongoing Integrated Resource Planning requirement. Such a process should include a full evaluation of distributed energy resources, and new investments in data management and data collection should be utilized to provide more detail as part of this evaluation...New data sources should offer a greater understanding of the various attributes of distributed energy resources, including resiliency, reliability, avoided new capacity, generation portfolio diversification, pollutant reduction, and impacts on peak loads. Importantly, a comprehensive planning process that includes better access to data will help to provide a forward-looking view of Virginia's energy systems that more closely aligns with the energy transformations that are underway.³

I recommend that the Company follow the Governor's recommendations and commit to the proper planning process, as outlined in Section III of my testimony, and as endorsed by the 2018 Energy Plan.

Q. PLEASE SUMMARIZE YOUR RECOMMENDATIONS TO THE COMMISSION?

A. Based on my review of the evidence in this case, I make the following conclusions and recommendations:

(1) The SCC should reject all proposed investments in Grid Hardening Activities, Intelligent Grid Devices, Operational and Automated Control Systems, and the Level 1 and 2 of the Telecommunications investments. In addition to the recommended planning process (outlined here in recommendation 3), the SCC should order the

Company to develop a scope of work for using DERs as non-wire alternatives (as defined later in my testimony).

(2) The SCC should approve the proposed Advanced Metering Infrastructure, the Customer Information Portal, and the NEM Application Software on the condition that the following amendments are made:

- Investment in Advanced Metering Infrastructure and Meter Data Management Systems should be functionalized to provide grid services as well as improved metering operations and be supported with plans for demand response and rate optionality.

- The Customer Information Portal should adhere to the Green Button Standard (as defined in Section II of my testimony) and allow Customers to download in csv. format their electricity usage.

- The Telecommunication Level 3 investments should be updated if necessary to account for an expanded scope of Advanced Metering Infrastructure.

- The NEM Interconnection Application software should be integrated with the Customer Information Portal, supported with hosting capacity analysis, and include Heat Maps, which show the areas of the grid that are best suited for DERs and which areas may result in operational challenges if DERs are added.

- The Company should submit a full plan, including cost-benefit analysis, for maximizing gains from rate optionality, demand response, and energy efficiency programs to justify the deployment of Advanced Metering Infrastructure.

(3) Finally, the SCC should order the Company to work with stakeholders to develop a cost-effective and need-driven planning process, informed by robust analysis and
modeling, for all distribution system investments. As proposed, the Company has failed to apply any of the "best practices" of grid modernization planning in the GT Plan. The planning process should include the following elements: integrated distribution resource planning, stakeholder engagement, setting clear and measurable goals, and robust cost/benefit analyses. Without such a process and planning elements, the Company cannot assess the prudence or purpose of the GT Plan.

SECTION I:

OVERVIEW OF GT PLAN AND REVIEW OF THE ECONOMIC AND ENGINEERING ANALYSIS USED TO JUSTIFY THE PURPOSE OF THE PLAN

Q. PLEASE PROVIDE A BRIEF SUMMARY OF THE PROPOSED GT PLAN.

A. According to the Company’s Petition, the GT Plan is a plan for electric distribution grid transformation projects, as defined in the Grid Transformation and Security Act of 2018 (the “GTSA”). I am not an attorney, but my understanding is that as required by statute, the plan “shall include both measures to facilitate integration of distributed energy resources” and “enhance the physical electric distribution grid reliability and security.” The Company’s proposed GT Plan proposes investment in seven components:

i. advanced metering infrastructure;

ii. a new customer information platform;

---

4 Petition at Cover Letter 1.
5 Va. Code § 56-585.1 A 6; Petition at 2.
6 Petition at 4.
iii. intelligent grid devices, control systems, and grid hardening for reliability and resilience (shortened to ‘reliability and resilience’);

iv. a new, multi-layered telecommunications infrastructure;

v. measures for cyber and physical security;

vi. predictive analytics capabilities; and

vii. ongoing investment in ‘emerging technologies’ (see Table 1 below for capital and O&M costs for each component).

The GT Plan’s entire scope spans 10 years, but the current Petition seeks approval only for Phase I, which encompasses the first three years of the GT Plan and establishes the broad trajectory of grid investments.

Table 1.

<table>
<thead>
<tr>
<th>Plan Component</th>
<th>Phase I Investment (Million $)</th>
<th>Total Plan Investment (Million $)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Capital</td>
<td>O&amp;M</td>
</tr>
<tr>
<td>Advanced Infrastructure Metering</td>
<td>$314</td>
<td>$27.6</td>
</tr>
<tr>
<td>New Customer Information Platform</td>
<td>$82.5</td>
<td>$25.3</td>
</tr>
<tr>
<td>Reliability and Resilience</td>
<td>$313.1</td>
<td>$43.4</td>
</tr>
<tr>
<td>Telecommunications Infrastructure</td>
<td>$69.9</td>
<td>$1.9</td>
</tr>
<tr>
<td>Cyber and Physical Security</td>
<td>$16.8</td>
<td>$2.5</td>
</tr>
<tr>
<td>Predictive Analytics</td>
<td>$122.9</td>
<td>$0.8</td>
</tr>
<tr>
<td>Emerging Technology</td>
<td>$7.2</td>
<td>$0.1</td>
</tr>
<tr>
<td>Total</td>
<td>$816.3</td>
<td>$101.5</td>
</tr>
</tbody>
</table>

*Grid hardening elements of the Reliability and Resilience component represent $1.5 billion of the total plan investment over 10 years, 80% of resilience and reliability costs

7 Spreadsheet attached to Company Response to Staff Set 2-40; Spreadsheet attached to Company Response to Staff Set 2-44(b); Spreadsheets attached to Company Response to Staff Set 2-44(c).
or over 50% of the plan’s total costs. Grid hardening for Phase I represent $267.7 million, or 85% of the total Phase I investment in reliability and resiliency.\(^8\)

Q. WHAT DOES THE COMPANY CLAIM IS THE PURPOSE OF THE GT PLAN?

A. From my review, the Company has offered four primary purposes of the GT Plan: (i) to facilitate necessary improvements to reliability; (ii) to provide an improved customer experience; (iii) to provide the necessary situational awareness and control to integrates DERs; and (iv) to reduce components of cost of service, measured as reductions in O&M.\(^9\) The multiple, claimed purposes of the $3.5 billion\(^10\) GT Plan are not consistent, however, making it difficult to assess the cost-effectiveness of the proposed investments.\(^11\)

Q. HAS THE COMPANY CONDUCTED COST-BENEFIT ANALYSIS TO SUPPORT THE GT PLAN?

A. No. The Company has not conducted a thorough cost-benefit analysis.\(^12\) Moreover, the Company does not believe that a cost-benefit analysis is a reasonable exercise for the GT Plan.\(^13\) To date, the Company has provided limited estimates of the benefits that could be achieved from reduced O&M costs through investments in Smart Meters, Telecommunications and Reliability and Resilience investments, and benefits

---

\(^8\) Spreadsheets attached to Company Response to OAG Set 1-2.

\(^9\) Petition at 6; Direct Testimony of Company Witness Edward H. Baine, Petition at 5-6.

\(^10\) Spreadsheet attached to Company Response to Staff Set 2-44(b).

\(^11\) Direct Testimony of Company Witness Edward H. Baine, Petition at 5-6, 18-21; see also, Spreadsheets attached to Company Response to OAG Set 1-2; Company Confidential Response to Set OAG 1-7; Company Response to OAG Set 2-49, included as Attachment CG-2; Company Response to Staff Set 2-19, included as Attachment CG-3; Company Response to Staff Set 2-20, included as Attachment CG-4; Company Response to Staff Set 2-45, included as Attachment CG-5.

\(^12\) Direct Testimony of Company Witness Edward H. Baine, Petition at 18-19

\(^13\) Id.
from improved reliability, as measured by SAIDI and SAIFI score improvements, through Reliability and Resilience investments.\(^{14}\)

Q. WHAT ARE SAIDI AND SAIFI SCORES AND WHY ARE THEY IMPORTANT?

A. SAIDI (System Average Interruption Duration Index) is a system index for the average duration of interruption in the power supply indicated in minutes per customer (\textit{i.e.}, how long is the average outage?). A SAIDI score is the ratio of the total duration of interruptions (measured in minutes) to the total number of customers. SAIFI (System Average Interruption Frequency Index) is a system index for average frequency of interruptions in power supply (\textit{i.e.}, how often do outages occur?). A SAIFI score is the ratio of the total number of interruptions to the total number of customers. SAIDI and SAIFI scores are metrics used by utilities to judge the reliability of service. Essentially SAIFI and SAIDI scores tell utilities how frequently their customers experience an outage and how long an outage lasts.

Q. WHAT CLAIMS DOES THE COMPANY MAKE REGARDING IMPROVEMENTS IN SAIDI AND SAIFI SCORES RESULTING FROM THE GT PLAN AND WHAT DOES THIS MEAN FOR THE AVERAGE CUSTOMER?

A. For Phase I, the Company claims that the GT Plan’s Reliability and Resilience investments will result in an expected reduction in SAIDI (Excl. ME) of 1 to 4 minutes and SAIFI (Excl. ME) of .02-.06.\(^{15}\) In other words, the average number of outages will decrease by 2-6% and those outages will be 1-4 minutes shorter. To achieve this, the

\(^{14}\) Corrected spreadsheet attached to Company Response to OAG Set 1-12.

\(^{15}\) Direct Testimony of Company Witness Robert S. Wright, Jr., Petition at 26:12-15
Company proposes to spend $356.5 million. However, the Company provides no projections of what future SAIDI and SAIFI scores would be absent the GT Plan making it impossible to assess whether any gains to SAIDI and SAIFI are necessary or what relationship the GT Plan has to reliability scores overall.

In practical terms, this means that the Company could spend $356.5 million dollars to shorten the average outage duration that any given customer could experience, or the average restoration time, by 1-2 minutes. As a result, the average customer will pay $142 a year for 1-2 minutes of additional electricity for the next three years. By comparison, the average cost, per minute of electricity, for residential customers is less than 1 cent, so residential customers will pay $142 per year for $0.02 worth of electricity. It is difficult to conceive of a scenario where a typical ratepayer would choose one minute of service over $142 per year.

Q. HOW DO THE COMPANY’S CLAIMED BENEFITS COMPARE TO THE COST?

A. In Attachment CG-8, I provide a chart that compares the benefits and costs of the GT Plan, as proposed by the Company. A review of the corrected and supplemental spreadsheets attached to the Company’s response to OAG Set 1-12, shows that Investments in Resiliency and Reliability account for 80% of the total proposed benefits.

16 Spreadsheets attached to Company Response to OAG Set 1-2.
17 Company Response to ER Set 1-23, included as Attachment CG-6; Company Response to OAG Set 1-22, included as Attachment CG-7.
18 Spreadsheets attached to Company Response to OAG Set 1-2.
19 A practical measure for assessing outage duration or restoration time is system CAIDI. CAIDI is the ratio of SAIDI to SAIFI scores. This analysis assesses the CAIDI scores to provide a practical measurement for customers in terms of improved experience.
20 Summary of Cost Benefit Analyses from the following sources: spreadsheet attached to Company Response to Staff Set 2-40; Spreadsheet attached to Company Response to Staff Set 2-44(b); Spreadsheets attached to Company Response to Staff Set 2-44(c), included as Attachment CG-8.
of the GT proposal, of which 93% are a result of improved reliability metrics,\textsuperscript{21} as measured by SADDI and SAIFI scores and valued by Department of Energy Interruption Cost Estimate calculator (the “ICE Calculator”) results.\textsuperscript{22} Essentially, the benefits of the GT Plan are highly dependent on the economic gains produced from the proposed Resiliency and Reliability investments.\textsuperscript{23}

Q. ARE THE PROJECTED RELIABILITY GAINS NEEDED OR JUSTIFIED?

A. The Company continually argues that by making Reliability and Resiliency investments, customers will receive improvements in reliability, as measured by improved SADDI and SAIFI scores.\textsuperscript{24} The Company states that “it is clear that the type of targeted grid hardening activities proposed and the deployment of intelligent grid devices and automated control systems will result in improved reliability performance, which can be measured through the SADDI and SAIFI metrics.”\textsuperscript{25}

However, the Company puts forward no analysis that shows that current or projected SADDI and SAIFI scores need to be improved.\textsuperscript{26} While the Company’s historical SADDI and SAIFI scores have experienced minor fluctuations over the past ten years, the Company has not provided any evidence to support the claim that current reliability metrics are insufficient or that improvements are needed.

\textsuperscript{21} Corrected and Supplemental spreadsheets attached to Company Response to OAG Set 1-12.
\textsuperscript{22} The Interruption Cost Estimate (“ICE”) Calculator is a tool designed for electric reliability planners at utilities, government organizations or other entities that are interested in estimating interruption costs and/or the benefits associated with reliability improvements. See www.icecalculator.com.
\textsuperscript{23} See Corrected and Supplemental spreadsheets attached to Company Response to OAG Set 1-12.
\textsuperscript{24} Direct Testimony of Company Witness Edward H. Baine, Petition at 18:9-12; Direct Testimony of Company Witness Edward H. Baine, Petition, Exhibit No. _ EHB Schedule 1; Company Response to ER Set 1-12, included as Attachment CG-9; Company Response to Staff Set 2-31, included as Attachment CG-10 and corresponding spreadsheet; Company Response to ER Set 2-30, included as Attachment CG-11.
\textsuperscript{25} Direct Testimony of Company Witness Edward H. Baine, Petition at 18:9-12.
\textsuperscript{26} Company Response to ER Set 2-6, included as Attachment CG-12; Company Response to ER Set 1-23(b), included as Attachment CG-6; Company Response to OAG Set 1-22, included as Attachment CG-7.
years, they have remained consistently better than the national averages, as shown in this chart (the lower the score, the better the utility’s performance).\textsuperscript{27}

<table>
<thead>
<tr>
<th>2017 SAIDI/SAIFI Scores</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>SAIDI (without ME)</strong></td>
</tr>
<tr>
<td>National Average\textsuperscript{28}</td>
</tr>
<tr>
<td>Dominion Energy\textsuperscript{29}</td>
</tr>
</tbody>
</table>

Clearly, Company customers experience fewer and shorter outages than the national average. In fact, national SAIDI and SAIFI scores improved from 2016 to 2017.\textsuperscript{30} From my review, any need for marginal improvement in SAIDI and SAIFI would really be a question of a customer’s willingness-to-pay, not a function of an operational concern. Furthermore, given that the Company’s only forecast of reliability metrics without the GT Plan is an assumption that reliability will maintain current levels,\textsuperscript{31} the question is not does reliability need to improve, but rather will gains in reliability improve the economic position of the customer. As I will show, the GT Plan under no circumstance improves the economic position of the customer.

Q. **DID THE COMPANY ENGAGE WITH CUSTOMERS BEFORE MAKING THE GT PLAN?**


\textsuperscript{29} Company Response to ER Set 1-23, included as Attachment CG-6 and corresponding spreadsheet.


\textsuperscript{31} Company Response to ER Set 1-23(b), included as Attachment CG-6.
A. No, the Company did not engage with customers or any other stakeholders before developing the GT Plan. When pressed, the Company referred respondents to general customer surveys that did not mention grid transformation or any potential investments by the Company.

Q. WHAT ANALYSIS HAS THE COMPANY PUT FORWARD TO SUPPORT INVESTMENTS IN RELIABILITY?

A. To support investments in reliability the Company puts forward two deeply flawed analyses. The first analysis attempts to show how Reliability and Resiliency Investments, specifically grid hardening and fault location, isolation, and service restoration ("FLISR") technologies, will improve reliability (as measured by SAIDI and SAIFI scores) over the course of the GT Plan.

In the first analysis, the Company works backward to justify proposed Reliability and Resilience investments and then forecasts those findings over the lifetime of the GT Plan. Instead of setting an operational reliability goal, such as a target SAIDI or SAIFI score, and then examining which technologies could meet that goal, the Company started with a predetermined list of technology investments (specifically grid hardening activities and FLISR) and then conducts a historical analyses on circuit performance to show how under different scenarios these predetermined investments could have improved historical reliability metrics. Once the Company showed that the proposed investments could

---

32 Company Response to OAG Set 2-55(d), included as Attachment CG-13.
33 Company Response to ER Set 1-5(d), included as Attachment CG-14.
34 Company Response to Staff Set 2-22, included as Attachment CG-15 and corresponding spreadsheet; Company Response to Staff Set 2-31, included as Attachment CG-16 and corresponding spreadsheet. In response to Interrogatory Staff 2-22 and 2-31 the Company provided analysis on expected SAIDI and SAIFI improvements from intelligent devices (FLISR) and grid hardening activities.
result in improved reliability, it forecasted that these SAIDI and SAIFI improvements would occur year over year, over the course of the GT Plan time horizon.

The second analysis attempts to quantify the value of improved reliability. In the second analysis, the Company takes the forecasted improvements in reliability and determines an economic value. To show the economic benefit of those forecasted SAIDI and SAIFI improvements, the Company derived a static value representing the economic cost of one minute of lost power and applied it to the projected total number of avoided minutes of interruptions. For example, the Company assumes that $29.3 million of investments in grid hardening in 2019 would reduce total interruptions to the residential customer class by 2,070,912 minutes in 2020. The Company estimated the value of reducing a single minute of outage to the entire residential customer class at $0.08. Therefore, the benefit of grid hardening investments for the entire residential customer class in 2019 is estimated at $165,672 ($0.08 x 2,070,912), or $0.07 per customer. The static monetary value used by the Company to estimate the value of reduced interruptions was generated using the ICE Calculator.

Q. DO YOU HAVE CONCERNS WITH THE ANALYSIS USED TO DETERMINE THE INVESTMENTS IN RELIABILITY AND JUSTIFY THEIR ECONOMIC VALUE?

---

32 Company Response to Staff Set 6-125, included as Attachment CG-17 and corresponding spreadsheet.  
34 Id.; Spreadsheets attached to Company Response to OAG Set 1-2; Corrected spreadsheet attached to Company Response to OAG Set 1-12.
A. Yes. Regarding the analysis put forward to show that Reliability and Resiliency investments, specifically grid hardening and FLISR, will result in reliability improvements, I have the following concerns:

First, the Company's failure to set a clear operational goal makes the entire analysis circular and largely meaningless. Essentially the Company determined what it wanted to spend money on and then conducted analysis to show that spending that money could result in marginal reliability improvements.

Second, to justify investments in FLISR and grid hardening, the Company conducted two isolated historical analyses against a historical baseline to show how historical SAIDI and SAIFI improvements could be achieved. But then, instead of integrating the two analyses and adjusting for future projections in SAIDI and SAIFI, the Company simply forecasted those historical improvements without any reference to a future baseline or without reference to each other. This is a major methodological flaw, and presents a misleading narrative of the future operational gains. The Company wrongly assumes that the historical SAIDI and SAIFI gains will carry over year to year with no regard for future baseline SAIDI or SAIFI projections or changes in grid dynamics. Instead of assuming that these gains are additive, the Company should integrate the two analyses as the operational gains achieved from the grid hardening analysis (which is supposed to avoid outages in the first place) should mitigate the need for operational gains from FLISR (which is supposed to mitigate outage duration).

Additionally, the Company's proposed approach fails to take into account how different

---

37 Company Response to Staff Set 2-22, included as Attachment CG-15 and corresponding spreadsheet; Company Response to Staff Set 2-31, included as Attachment CG-16 and corresponding spreadsheet.
investments in the grid, such as DERs, may impact grid operations, making it an incomplete analysis and unrepresentative of future grid dynamics.

Third, from my review of the Company’s response to Staff Set 2-22 and Staff Set 2-31, it appears that the Company is using historical ten year average gains and applying year over year moving forward. This completely disregards any current or future grid dynamics on the system, such as investments in DERs.

Fourth, the Company did not provide a sufficient explanation for any of the engineering inputs or methodological parameters used in the analysis, and from my review did not connect any historical root-cause analysis to future projections in operational concerns to justify why it assessed the specific grid hardening or FLISR investments. For example, the Company uses a cut point of limiting all outages to only 1,000 customers and determines the number of FLISR devices that need to be invested in to achieve this goal based on the 1,000 customer number. The Company provides no argument for why the 1,000 customer metric was chosen, if it is a cost-effective metric or if any customers on that line have DERs. This is yet another example caused by not starting with a clear operational goal and connecting root-cause analysis to the most cost-effective investment proposals. This type of analysis is wide-spread in the industry and considered a best practice by experts. Its absence from the Plan’s engineering underpinnings suggests a startling lack of analytical rigor.

38 Company Response to Staff Set 2-22, included as Attachment CG-15 and corresponding spreadsheet; Company Response to Staff Set 2-31, included as Attachment CG-16 and corresponding spreadsheet.
39 The Company was asked to provide all assumption used in their calculations but failed to provide any explanation for the assumption of using 2.5 sensors for each added recloser or their assumptions related the percentage of interruptions for each cause that will be avoided by reconductoring. Company Response to Staff Set 2-22, included as Attachment CG-15 and corresponding spreadsheet.
40 Company Response to Staff Set 2-22, included as Attachment CG-15 and corresponding spreadsheet.
Q. **DO YOU HAVE CONCERNS WITH THE ANALYSIS USED TO JUSTIFY THE ECONOMIC BENEFIT OF INVESTMENTS IN RELIABILITY?**

A. Yes. Regarding the analysis put forward to justify the economic benefit of the GT Plan’s investments in reliability, I have the following concerns:

First, the Company’s use of a static number for the economic value of the investments inflates the value of the proposal. The Company uses a constant $ per Customer Minute Interruption cost across all 20 years in their calculations to show how reduced interruption costs is a benefit to the customer. Specifically, they used the following corresponding to a SAIDI of 120 and SAIFI of 1.2: $0.08 for Residential, $9.10 for Small C&I, and $89.17 for Med-Large C&I. However, in reality, these $/CMI values actually decrease as SAIDI and SAIFI decrease according to ICE. For example, with a SAIDI of 95 and SAIFI of 0.66, the values are: $0.06 for Residential; $8.30 for Small C&I; $76.48 for Med-Large C&I. Essentially, the Company chose a static value to artificially inflate the economic value of their proposed investments.

Second, I find that the Company is grossly exaggerating the economic benefits of their artificially inflated estimates to the point of being misleading. For example, the Company estimates the total economic benefit resulting from the Reliability and Resiliency investments at $2.17 billion – comprised of a reduction in overtime and

---

42 Company Response to Staff Set 6-125, included as Attachment CG-17 and corresponding spreadsheet. The Company provided no reasoning as to why a SAIDI score of 120 was used, as it did not correspond to any historical SAIDI scores. A score of 120 is within range of the three year projection.

43 Company Response to Staff Set 6-125, included as Attachment CG-17 and corresponding spreadsheet. According to the ICE Calculator, $/CMI values can decrease as SAIDI and SAIFI scores decrease. To calculate these changes, I used the ICE Calculator and the same parameters provided in the spreadsheet attached to Company’s Response to Staff Set 6-125 to determine the Cost/Minute for a SAIDI of 95 and SAIFI of 0.66, which are within the range of estimate projected scores as provided by Company Exhibit No. RSW Schedule 1. Direct Testimony of Company Witness Robert S. Wright, Jr., Petition, Exhibit No. RSW Schedule 1.
contract labor of $146.9 million and a customer value of $2,078.1 million as a result of reduced outages. The benefits will take twenty years to fully materialize, and will do so only after a total of 295 minutes of expected outages are eliminated, assuming the average improvements in reliability produced from Reliability and Resiliency investments from 2019-2028, are maintained through 2038. Effectively, the Company is claiming that eliminating 295 minutes of outages over the next 20 years is worth $2 billion. I find this assumption to be absurd. To put this into perspective, in 2016, the Commonwealth’s Gross Domestic Product was $435 billion for the year, on average, this equates to $827,990 per minute. At $827,990 per minute, 295 minutes’ equals $244,257,305. Following the Company’s logic, the Company is claiming that the value of avoiding one minute lost power is 8 times greater than the entire economic activity of the Commonwealth in that minute.

Third, even with the disjointed analyses and the artificially inflated and exaggerated estimates, these numbers still do not add up to an economic justification. From the Company’s corrected response to OAG Set 1-12, the maximum annual customer benefit over the ten-year investment horizon from Reliability and Resilience Investments is only $138 million, and this benefit does not manifest until 2029. A very simple net present value (NPV) analysis (not accounting for taxes, depreciation, or

---

44 Corrected spreadsheet attached to Company Response to OAG Set 1-12.
45 Assuming the total saved minutes from Company’s Exhibit No. RSW Schedule 2 is achieved through 2028 and that the average savings year to year from 2019-2028 are carried through 2028-2038. This analysis does not assume that SAIDI and SAIFI scores are held constant from 2028-2038 solely do to Reliability and Resilience investments. Rather this analysis assumes that the average marginal improvement from Reliability and Resilience investments is maintained. Direct Testimony of Company Witness Robert S. Wright, Jr., Petition, Exhibit No. __ RSW Schedule 2.
47 Corrected spreadsheet attached to Company Response to OAG Set 1-12.
48 This analysis utilizes capital and O&M cost numbers from Schedule 1 to Company Witness Robert S. Wright, Jr.’s testimony and “Benefits” from OAG Set 1-12. Direct Testimony of Company Witness Robert
revenue requirement) shows that the Reliability and Resilience Investments produce a
negative $412 million NPV on a $2 billion investment over 20 years. When investments
in Smart Metering and Telecommunications (the only other investments areas with
benefits as calculated by the Company) are included in NPV analysis, the total calculated
net present value is negative $950 million.

In short, even with the grossly exaggerated and highly inflated assumed benefits
of the GT Plan, in no single year over the ten-year investment horizon are any of the GT
Plan's investments cost-effective, and the entire GT Plan is on its whole an economic loss
for the customer.

Q. DO YOU HAVE ANY OTHER CONCERNS REGARDING THE
ANALYSIS UTILIZED TO JUSTIFY THE GT PLAN?

A. Yes. I have fundamental concerns over the use of the ICE Model used to justify
the economics of reliability investments. The ICE model is an input-output model, with
the primary inputs being SAIDI and SAIFI scores. It is completely divorced from any
actual assessment of whether specific technology investments will result in improved
reliability scores and is dependent on survey responses, of which 50% are more than 15
years old as of 2015. Relying on outdated data presents an issue of statistical
significance. Relying on outdated data also means it fails to take into account how
customers with critical loads, high outage costs, and required uninterrupted service (e.g.,

S. Wright, Jr., Petition, Exhibit No. RSW Schedule 1; Corrected and supplemental spreadsheets attached
to Company Response to OAG Set 1-12. The analysis assumes that investments made between 2021 and
2028 are averaged over the difference between Phase I investments and total investments as detailed by
Company Witness Wright in Schedule 1 of his testimony. This analysis assumes that benefits from the GT
Plan will not begin materializing until 2020 as opposed to immediately, as Schedule 1 to Company Witness
Wright's testimony assumes.

49 MICHAEL J. SULLIVAN, JOSH SHELLENBERG, & MARSHALL BLUNDELL, ERNEST ORLANDO LAWRENCE
BERKELEY NAT'L LAB., UPDATED VALUE OF SERVICE RELIABILITY ESTIMATES FOR ELECTRIC UTILITY
CUSTOMERS IN THE UNITED STATES xiv (2015) available at http://eta-
publications.lbl.gov/sites/default/files/lbnl-6941e.pdf.
data centers, hospitals, some manufacturers, etc.) have been increasingly investing in backup power supplies or self-generation in Virginia.\textsuperscript{50} These customers will see minimal benefit from improvements to the Company’s system reliability even though the customer class that stands to receive the greatest benefits from improved reliability, according to ICE, are customer’s with critical loads. Given the critical flaws with the Company’s current analysis tying the proposed investments in the GT Plan to actual SAIDI and SAIFI score improvements, I cannot see how the Company can legitimately stand behind the ICE estimates. The term often used for this in econometric modeling is, ‘garbage in-garbage out.’

Q. FROM YOUR PERSPECTIVE, WOULD THE GT PLAN PASS THE CONVENTIONAL RATE MAKING TESTS OFTEN EMPLOYED BY UTILITIES TO ESTIMATE THE PRUDENCY OF AN INVESTMENT?

A. No. If assessed against a Ratepayer Impact Measure test, a Participant Cost Test, or even a Utility Cost Test, the GT Plan would not pass. This is because the GT Plan would put upward pressure on rates without offering any tangible benefits to the customer, and also increasing the overall expenditure for the utility. Furthermore, the Company continually points to the GT Plan as producing ‘non-quantifiable’ benefits as justification for why cost-benefit analysis cannot be conducted.\textsuperscript{51} If so much of the GT


\textsuperscript{51} Direct Testimony of Company Witness Edward H. Baine, at 19; Company Response to Staff Set 1-3, included as Attachment CG-18; Company Response to Staff Set 1-9, included as Attachment CG-19; Company Response to Staff Set 1-11, included as Attachment CG-20; Company Response to Staff Set 2-16, included as Attachment CG-21; Company Response to Staff Set 2-17, included as Attachment CG-22;
Plan rests on non-quantifiable benefits, I question how it can even be assessed for cost-effectiveness and prudency and whether it challenges the scope and purpose of a regulated utility.

SECTION TWO:

ASSESSMENT OF GT PLAN INVESTMENTS

Q. PLEASE PROVIDE A BRIEF OVERVIEW OF YOUR ASSESSMENT OF THE TECHNOLOGIES PROPOSED AS PART OF THE GT PLAN?

A. The Company’s specific proposed technology investments largely fall into three categories. The first category is comprised of proposed investments that, with additional support and revision, could provide net benefits to the customer. These investments are considered to be ‘first-movers’ in any grid modernization effort and if used effectively will support or enhance existing cost-effective measures, such as rate optionality, demand side management, and DERs, which have been proven to reduce grid costs and improve load flexibility. Additionally, if functionalized correctly, these investments can provide additional benefits of grid awareness, grid planning and operations, and improved reliability. The second category is comprised of investments that are premature and not cost-effective given the current state of DER penetration and the proposed functionality set out in the GT plan. The third category is comprised of investments that are wholly unjustified.

Company Response to Staff Set 2-25, included as Attachment CG-23; Company Response to Staff Set 2-29, included as Attachment CG-24; Company Response to Staff Set 2-35, included as Attachment CG-25; Company Response to Staff Set 3-70, included as Attachment CG-26; Company Response to Staff Set 4-96, included as Attachment CG-27; Company Response to Staff Set 5-116, included as Attachment CG-28.