Integrated Resource Plan

2015 FINAL SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT
VOLUME 2 - RESPONSES TO COMMENTS ON THE DRAFT EIS

TENNESSEE VALLEY AUTHORITY

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1.0 Introduction

The Draft Integrated Resource Plan (IRP) and Supplemental Environmental Impact Statement (SEIS) were released to the public March 9, 2015 and the notice of their availability was published in the Federal Register on March 13, 2015. This initiated the public comment period which closed on April 27, 2015.

The Draft IRP and SEIS were posted on the project website. Printed copies and/or DVDs containing electronic files of the documents were mailed to certain federal agencies and to others upon request. Others on the project contact list, including several state and federal agencies, organizations, and numerous individuals, were mailed or e-mailed notifications of the availability of the documents and instructions on how to submit comments.

TVA accepted comments submitted through an electronic comment form on the project website and by mail and email. During the comment period, TVA held seven public meetings (see table below) to describe the project and to accept comments on the Draft IRP and SEIS. TVA staff presented an overview of the planning process and draft results. Attendees then had the opportunity to make comments and ask questions about the project. A panel of TVA staff responded to the questions. Two of the meetings were simultaneously broadcast online as webinars and TVA responded to comments and questions submitted by webinar participants in the same manner as those from in-person attendees. About 400 people attended the public meetings in person and by webinar. TVA also held a public hearing on the IRP in conjunction with a meeting of the Regional Energy Resource Council in Nashville. The oral statements made during this hearing are included in the public comments on the draft documents.

Public Meetings Held in 2015 Following Release of Draft IRP and SEIS.

Date	Location
March 19 2015	Chattanooga, TN*
April 6, 2015	Knoxville, TN*
April 9, 2015	Huntsville, AL
April 14, 2015	Tupelo, MS
April 15, 2015	Memphis, TN
April 21, 2015	Nashville, TN
April 22, 2015	Bowling Green, KY

*Meeting also broadcast by webinar.

TVA received about 200 comment submissions which included letters, form postcards, emails, form emails, oral statements, petition-style submissions, and submissions through the project website. The comment submissions were signed by more than 2,400 individuals. The comment submissions were carefully reviewed and synthesized into about 180 individual comment statements. These comment statements and TVA's responses to them are provided

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in Chapter 2 of this volume. The comments and responses are categorized into six broad topics. Most of these topics are further categorized into more specific issues.

About 2,200 individuals submitted comments as part of organized campaigns. These comments were received as pre-printed postcards, emails, and as a petition-like submissions consisting of the text of an online form statement and a list of the names and addresses of those who signed the form. Each of these sets of identical comments was treated as a single comment. Some commenters added additional text to their form comments. When the content of this text addressed topics not included in the form comment, it was treated as an individual comment.

The four organized commenting campaigns were:

- Moms Clean Air Force – 344 signatures to an online form
- Opponents of the Clean Line Plains & Eastern HVDC transmission line – 21 form emails
- Southern Alliance for Clean Energy – 30 emails from online form
- Tennessee Chapter of the Sierra Club – 1,053 signatures to an online form
- Tennessee Chapter of the Sierra Club – 700 pre-printed postcards signed at Earth Day events
- “Tennessee Valley Citizen” – 21 pre-printed postcards. The only return address/organizational identification was “Tennessee Valley Citizen.”

The most frequently mentioned topics included preferences for increased use of energy efficiency and renewable energy, reduced use of fossil-fuel generation, and concerns over greenhouse gas emissions and associated climate change. The majority of the more detailed, technical comments addressed modeling data inputs and assumptions concerning pricing of energy efficiency and renewable energy, energy efficiency ramp rates, and capacity assumptions for wind energy. Other topics stated by multiple commenters included appreciation for TVA’s overall planning process and extensive public involvement, alignment with TVA’s least-cost planning mandate, recognition of TVA’s treatment of energy efficiency as a selectable resource, the importance of cost and reliability, and TVA’s treatment of distributed generation.

Chapter 2 – Responses to Comments

2.0 Responses to Comments

2.1. Editorial Comments

2.1.1. Draft IRP

1. While Section 5.2 of the Draft IRP gives a generalized description of the existing capacity of TVA's existing energy resources, it does not quantify generation by resource type. Quantifying generation would help in understanding each resources contribution to TVA's current and potential future energy supply. (*Commenter: Venon Knight*)

Response: IRP Section 4.3.3 describes the current energy mix. Chapter 7 shows the potential future energy mix, as well as the capacity mix, for all modeled results.

2. The Draft IRP analyzes potential energy efficiency resources as a "virtual power plant" with characteristics similar to those of other energy resources. Throughout the IRP, however, there is little recognition or quantification of the existing energy efficiency virtual power plant resulting from TVA energy efficiency programs since the 1980s. There is, for example, no quantification of this in the Chapter 4 need for power analysis and no apparent quantification of existing energy efficiency in Figures 7-6 through 7-18. (*Commenter: Venon Knight*)

Response: Historical TVA efforts on energy efficiency programs have been successful in reducing the current demand and energy levels. From the late 1970s through the 1980s, TVA's conservation efforts helped customers save 2,341 million kWh and reduced demand by 1,214 MW. It is difficult to quantify the impacts these and recent conservation efforts are having on current electricity usage, although there is no doubt usage would be higher had these efforts not taken place. However, energy use evolves over time and therefore so must energy efficiency programs. As stated in IRP Section 4.1.1, the load forecasting methodology does take into consideration national efficiency measures and trends. The specific TVA EE programs are described in IRP Chapter 7 and SEIS Section 3.5.

3. Draft IRP Section 5.2.1 and Draft SEIS Section 1.1 and Chapter 3 describe TVA as having a current dependable generating capacity of approximately 37,000 MW. Draft IRP Figure 4-6 and Draft SEIS Figure 2-3 show current dependable capacity to be less than 35,000 MW. Please explain this difference. Please also describe the current capacity attributable to energy efficiency efforts. (*Commenter: Venon Knight*)

Response: Various capacity ratings, explained in IRP Section 4.3.2, are useful for different purposes. The 37,000 MW rating is based on summer net capability and the 35,000 MW rating is based on summer net capacity. Capability is the maximum dependable load-carrying ability of units or the number of megawatts that can be delivered by a generating unit without restrictions (i.e., does not reflect temporary capacity restrictions caused by known fuel or mechanical derates) and less station power. The summer net capacity refers to the output of a unit based on summer conditions and on the power factor level normally expected at the time of peak hour (e.g., hot ambient temperatures and water temperatures, cooling tower operation, wind patterns). The summer net capacity is typically less than the capability of a unit. For example, the TVA conventional hydro system is rated at about 3,800 MW of summer net capability but that would require enough water to be available to fully utilize all 109 generators. Since water availability is typically limited during the summer season, the expected summer

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net dependable capacity of the hydro system is about 2,500 MW. Another significant difference between capability and capacity can be seen with respect to the coal fleet. Fuel blends are used for economic and emission-related reasons but coal blends can lead to a lower megawatt output. IRP Section 5.2.1 describes the current energy efficiency efforts; 2012-2014 efforts reduced peak demand by 451 MW and energy demand by 1,843 GWhs.

4. In the Solar summary of the Draft IRP, TVA states: "The utility tracking option is considered a single installation and includes a dual axis tracker that allows the solar panels to follow the sun" (p. 48). However, it is clear that TVA modeled a tracking solar technology that consists only of single-axis tracking systems and does not include dual-axis trackers. (*Commenter: Stephen A. Smith - Southern Alliance for Clean Energy*)

Response: Final IRP Section 5.2.2 has been revised in response to this comment.

5. The environmental scoring metrics presented in Chapter 8.1.2 (page 98) seem too simplistic and downplayed. Consider adding a reference here to the SEIS. (*Commenter: Robin D. Cox - City of Huntsville, Alabama - Huntsville Operation Green Team*)

Response: IRP Section 8.1.2 has been revised as requested.

6. We recognize the inclusion of the discussion of per capita income and regional employment impacts in the Draft IRP. However, we recommend that TVA discuss associated socioeconomic impacts which might not be addressed and/or explicitly quantified by the Regional Economic Model PI+ Model used during the IRP. These associated impacts should include the positive per capita income impacts associated with reduced customer electricity bills resulting from decreased energy consumption due to the various energy efficiency improvements associated with the strategies. The model appears to underrepresent these associated benefits. (*Commenters: Robert J. Martineau, Jr. - Tennessee Department of Environment and Conservation*)

Response: The model TVA employed to capture macro-economic impacts from the planning strategies does include a module that represents the positive impacts of energy efficiency on customer's bills. This positive feedback is the reason why Strategy D performs well on this metric (see IRP Figure 8-8 and the more detailed discussion in Appendix G).

7. The Draft IRP characterizes Strategy D – Maximize Energy Efficiency and Strategy E – Maximize Renewables as "extreme" (p. 100). Despite this characterization, the Draft IRP results show these strategies are the least-cost options over the next several years, result in the most diverse portfolio, provide the most local economic benefits, and most dramatically reduce pollution. Rather than being "extreme," these two strategies are well within the range of a reasonable planning direction. (*Commenter: Amanda Garcia - Southern Environmental Law Center*)

Response: Comment noted. "Extreme" was used to illustrate the fact that the cost metric scores for Strategies D and E differed more from the group average metric scores than did the scores for the other strategies. The Final IRP has been edited to remove this description.

8. On page 104 of the Draft IRP TVA states "we recognize that a commitment to significant levels of energy efficiency as part of the resource portfolio will likely put upward pressure on

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rates, and that could have negative consequences for low/fixed income customers as well as renters." This statement is untrue. The IRP analysis, even with the several flawed assumptions disadvantaging energy efficiency, finds that increased levels of energy efficiency reduce revenue requirements for TVA over the planning period. Reduced revenue requirements translate directly into reduced or downward pressure on rates for all customers. Reduced rates will have a positive impact on low or fixed income customers. Increased energy efficiency also offers these customers real opportunities to reduce bills through participation in EE programs. (*Commenter: Brendon Baatz - American Council for an Energy Efficient Economy*)

Response: The IRP results demonstrate the tradeoffs between total system cost (revenue requirements) and average system cost (as a proxy for rates). Revenue requirements are the sum of all costs to operate the system (fuel costs, capital costs, O&M costs. etc.). System average cost is calculated by dividing revenue requirements by total energy sales. Energy efficiency programs require upfront costs to implement, as detailed in IRP Appendix A. Even if total revenue requirements decline from the implementation of energy efficiency programs because demand is lower, the system average cost metric may rise because total TVA sales (the denominator of the metric) are lower. The IRP results confirm this relationship. Several commenters expressed concern about the ability of low/fixed income customers to participate in energy efficiency programs in part because of the up-front costs that this can entail. TVA plans to work with the local power companies to address this as energy efficiency programs are implemented.

2.1.2. Draft SEIS

9. In the Draft SEIS Summary section, the discussion of solar under Strategy D states, "Overall solar capacity additions are similar but slightly lower than those for Strategy A except for Scenario 5, which has a lower total capacity addition of 1,025 MW" (p. S-13). But in the Draft SEIS Chapter 6, discussion of solar under Strategy D states, "Overall solar capacity additions are slightly lower than those for Strategy A except for Scenario 5, which has a lower total capacity addition of 897 MW" (p. 162). These two statements should be reconciled. (*Commenter: Stephen A. Smith - Southern Alliance for Clean Energy*)

Response: The Final SEIS has been edited to correct this discrepancy.

10. Page S-16 of the Draft SEIS discusses air pollution improvements by emissions type over time. The timeframes for emissions reductions are inconsistent from one air pollutant to the next. While this may have been intentional to highlight the greatest percentage of reductions for each pollutant, it is confusing to the reader. TVA should consider using the same time comparison across all pollutant sources in the Final SEIS. (*Commenter: Michelle Walker Owenby - Tennessee Department of Environment and Conservation*)

Response: The discussion of trends in emissions of air pollutants in the SEIS Summary is meant to highlight the reductions that have occurred since TVA began installing controls for the various pollutants. Section 4.3 of the SEIS describes these trends in more detail and includes the information necessary to determine overall reductions from a common baseline year. The starting year for some trend descriptions is also based on the availability of the necessary data.

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11. The Draft SEIS Summary leaves the reader asking if we need a more refined strategy for comparing generation mix, life cycle costs, and economic impacts. (*Commenter: Robin D. Cox - City of Huntsville, Alabama - Huntsville Operation Green Team*)

Response: Comment noted. TVA worked hard to present its analytical results in a comparative manner that most readers would find informative and useful. TVA thinks the strategy scorecards in the IRP Report do that. The SEIS summary supplements that effort. For the 2011 IRP, TVA weighted scorecard metrics which could be viewed as a more sophisticated, refined comparison method. Members of the IRP Working Group recommended against using weighting in the 2015 IRP. IRP Chapter 6 explains how the scorecards were developed and IRP Chapter 7 provides detailed comparisons of the results across IRP strategies. TVA would welcome suggestions on how to improve strategy comparisons in future IRPs.

12. Page 11 of the Draft SEIS states that Public Utility Regulatory Policies Act standards are relevant to the IRP planning process. We recommend that TVA include a summary of how the PURPA standards adopted by TVA are relevant to the IRP process in the Final SEIS. (*Commenter: Michelle Walker Owenby - Tennessee Department of Environment and Conservation*)

Response: TVA reviewed the potential effects of adopting PURPA standards most recently in the environmental assessment cited on Draft DEIS page 11. Information about the standards, TVA's implementation of them, and their relationship to IRP related resources can be found on TVA's public webpage at http://www.tva.com/environment/reports/purpa/index.htm. The relationship of the standards to IRP activities varies. For example, the Fuel Diversity Standard directs utilities to minimize dependence on one fuel source and that electricity be generated from a diverse range of fuels and technology. TVA's 2011 IRP and the results of the 2015 IRP confirm the importance of resource diversity. Other PURPA standards relate more directly with ratemaking activities that are outside the scope of the IRP

13. SEIS Section 1.2 on the History of the TVA Power System should describe TVA's past energy efficiency efforts in more detail. (*Commenter: Venon Knight*)

Response: SEIS Section 1.2 describes TVA's initial energy efficiency efforts in the 1970s and 1980s. The energy efficiency program has changed since then, with the local power companies now having a larger role in its implementation. The major focus of TVA's energy efficiency efforts in the 1995 *Energy Vision 2020* IRP was on residential heat pump, new homes, and manufactured housing programs, as well as on commercial and industrial new construction, lighting, industrial process energy efficiency, and industrial high efficiency motors programs. TVA's recent energy efficiency efforts and their associated energy savings are described in SEIS Section 3.5.

14. Page 45 of the Draft SEIS describes the construction of new natural gas-fueled CC plants. Any NEPA documents (EA or EISs) completed to support these TVA actions should be cited. (*Commenter: Heinz J. Mueller - U.S. Environmental Protection Agency - U.S. Environmental Protection Agency*)

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Response: The environmental assessments prepared for the Paradise and Allen combined cycle plants are listed in Section 1.7 of the SEIS. References to these EAs have been added to page 45.

15. We recommend that the description of the eScore Program in the Final SEIS state that this program launched in January 2015 and therefore no metrics on its performance are available. We also recommend that the description of the EPA Smart Communities Program in the Final SEIS be revised to list the communities, local power companies, and others that are participating in the program. (*Commenter: Michelle Walker Owenby - Tennessee Department of Environment and Conservation*)

Response: The Final SEIS has been revised as recommended in this comment.

16. Page 53 of the Draft SEIS, in reference to the TVA Green Power Providers Program, states that "For calendar year 2015, the Green Power Providers program capacity for new applicants is capped at 11.33 Megawatts (MW)." TVA should provide additional clarification in the FSEIS on why this program is 'capped' at 11.33 MW. (*Commenter: Heinz J. Mueller - U.S. Environmental Protection Agency*)

Response: The 10-MW capacity cap for the Green Power Providers program was established in 2013 to balance financial considerations with market demand for small-capacity (0.5 to 50 kW), customer-owned grid-connected renewable energy generating facilities. Based on applications received annually since then, this cap has proven sufficient to meet market demand with no otherwise qualifying applicants being turned away. For 2015, the cap was increased by an additional 1.33 MW to 11.33 MW due to unfilled capacity from 2014.

17. On page 55, the Draft SEIS states that TVA is making significant capital investments on coal-retirement related transmission system upgrades. Additional discussion should be provided on why these upgrades are needed. (*Commenter: Heinz J. Mueller - U.S. Environmental Protection Agency*)

Response: The criteria important to the design and operation of the electrical transmission system include the locations of points where the system connects to generating facilities, the amount of power added to the grid by those facilities, and the capacity of the lines transmitting that power to other parts of the system. The removal of a major generating facility, such as a retiring coal plant, can unbalance the system by increasing the load on parts of the system that were not engineered to reliably transmit it. Therefore upgrades to the transmission system are frequently needed when generating facilities are retired (or added). These upgrades can include the construction of new lines, substations, and switching stations and increases to the capacity of existing lines and substations.

18. The discussion of sulfur dioxide on pages 71-73 of the Draft SEIS should be revised to add the missing legend entry to Figure 4-10, use more recent 2013-2014 data in Figure 4-10 if available, add a text description of the trends illustrated in Figure 4-12, and expand and clarify the discussion of attainment status for the various sulfur dioxide standards. (*Commenter: Heinz J. Mueller - U.S. Environmental Protection Agency*)

Response: The text of the Final SEIS has been revised as recommended. Figure 4-10 illustrates 2012 data and more recent data is not available.

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19. We recommend clarifying the first full paragraph on page 76 of the Draft SEIS to reflect the current status of the 2008 ozone non-attainment areas in Tennessee and the revised ozone standards proposed in November 2014. These clarifications should mention the non-attainment redesignation request submitted for Knoxville and better describe the proposed revised ozone standards. (*Commenter: Heinz J. Mueller - U.S. Environmental Protection Agency*)

Response: The text of this section of the Final SEIS has been edited as requested.

20. The discussion of particulate matter on pages 77-78 of the Draft SEIS should be revised to note the 2006 change in the 24-hour average PM2.5 NAAQS, the current status of non-attainment designations for the 2012 PM2.5 annual NAAQS, correct the title of Figure 4-17 to show 1986-2013 instead of 1979-2013, and correct the title of Figure 4-18 to show 1999-2013 instead of 1979-2013. (*Commenter: Heinz J. Mueller - U.S. Environmental Protection Agency*)

Response: The text of the Final SEIS has been edited as requested.

21. Draft SEIS Figure 4-15 would be improved by adding a dotted line illustrating the applicable air quality standard, similar to those included in Figures 4-16 through 4-20. (*Commenter: Michelle Walker Owenby - Tennessee Department of Environment and Conservation - Tennessee Department of Environment and Conservation*)

Response: Comment noted. Figure 4-15 has been revised to show the standard.

22. The Draft SEIS provides a detailed overview of the most common water quality impacts associated with generating electricity, it provides little discussion of the statutory water quality requirements and how they are applied to the protection and maintenance of surface water quality. By referencing the statutory requirements, the conclusions from the study would be strengthened. We suggest the SEIS be revised to reference the statutory requirements such as the Tennessee Rule 0400-40-03, to present specific narrative and numeric criteria in tabular form as done in DEIS Section 4.3 for air quality standards, and to summarize or reference the Antidegradation Statement where specific conditions for regulated actions are described. (*Commenter: Heinz J. Mueller - U.S. Environmental Protection Agency*)

Response: The SEIS text has been revised to reference statutory requirements such as antidegradation statements. A comprehensive listing of water quality standards, comparable to Table 4.5 for air quality standards, would be long and complex due to the different requirements and standards issued by the seven states in the TVA service area.

23. The Draft SEIS on page 148 states that TVA previously had long-term PPAs for power from the four Brookfield Renewable Energy Group hydroelectric facilities on the Little Tennessee River system “when they were owned by the Tapoco Company and Alcoa Power Generating Inc., subsidiaries of Alcoa, Inc.” TVA's most recent PPA for power from these facilities remained in force for a period of time after the facilities were required by Brookfield. (*Commenter: Steven E. Eckert - Brookfield Renewable Energy Group*)

Response: The text of the Final SEIS has been edited to reflect this.

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24. Draft SEIS Figure 7-3 has two sets of bars for Alternative C. The second Alternative C is likely Alternative E. (*Commenter: Heinz J. Mueller - U.S. Environmental Protection Agency*)

Response: Comment noted. This labeling error has been corrected in the Final SEIS.

25. Storage, transportation and disposition of spent nuclear fuel is an issue of particular concern for all nuclear power plants. Page 122 of the Draft SEIS discusses high-level waste storage, and states that storage capacity at Sequoyah and Browns Ferry spent fuel pools has been exceeded, and that dry cask storage has begun at these facilities. The capacity for continued storage at these locations is unclear; page 211 discusses expansion of storage facilities. The need for on-site storage could potentially continue for decades. We recommend that the FSEIS reference the Continued Storage Rule (formerly Waste Confidence), and clarify potential direct, indirect and cumulative impacts that may occur as a result of the continued on-site storage. (*Commenters: Heinz J. Mueller - U.S. Environmental Protection Agency, Michelle Walker Owenby - Tennessee Department of Environment and Conservation*)

Response: Comment noted. See the response to Comment 175. TVA agrees that NRC's Continued Storage Rule and its generic EIS supporting that rule are important documents. TVA has addressed spent fuel storage in its site-specific NEPA reviews involving the licensing of its nuclear plants and its spent fuel management actions. To date, TVA has found no impediments to indefinite storage of spent fuel on its nuclear plant sites, consistent with the NRC determinations.

2.2. Energy Resource Options

2.2.1. Demand Reduction

26. Demand response accomplishes the goal of reducing peak power demand at the specific time it is needed. TVA should pursue increased demand reduction and invoke competitive market models to increase demand reduction participation. (*Commenter: Michael Watson - Duck River Electric Membership Corporation*)

Response: The 2015 IRP included additional demand response as a selectable resource similar to peaking generation. In many cases additional amounts of demand response were selected. TVA has a large demand response program in effect today and the target power supply mix encourages increased use of this resource in the future depending on availability and price of this customer-owned resource.

27. TVA's current rate structure provides little incentive for most customers to reduce their energy use during peak demand periods. TVA should adopt a rate structure with much larger differences in peak and non-peak prices to decrease peak power demand. (*Commenters: Marianne Bentley, Joan Cassens, Tim Holt, Dennis McCorkle, Lucille York, Richard Young*)

Response: Comment noted. The IRP does not address rate design. In 2011, TVA instituted a small time-of-day pricing program affecting power TVA sells to local power companies and industrial customers. Whether or not this results in time-of-day pricing differences varies by LPC. TVA is considering adopting a revised rate structure that would include larger peak and non-peak pricing differences.

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2.2.2. Distributed Generation

28. In Draft IRP Appendix C, TVA underestimates the future impact of distributed generation. DG reductions to TVA loads are determined by a combination of average DG national growth rates, CO_2 regulation scenarios, and a regional adjustment factors. Given the significant renewable energy incentive cuts that TVA has implemented in recent years, the DG analysis likely underestimates the future impact of DG in the TVA region. TVA incentive programs historically provided program participants with an attractive option for cost-effective employment of advanced energy options. The reductions have diminished the value of these options to a point where demand-side, customer-driven DG make equal or greater financial sense for TVA customers. (*Commenter: Cortney Piper - Tennessee Advanced Energy Business Council*)

Response: TVA believes that the assumptions around the broad impact of DG on the TVA system are a reasonable component of the scenario design approach and are aligned with the key assumptions in each scenario that could reasonably impact the future amount of DG in the TVA region. These estimates are only placeholders, however, since the actual penetration of DG resources depends on actual costs of power in the future and the preferences of TVA customers for resources they may prefer to own/control. The residential/commercial distributed generation assumptions ranged from less than 500 MW in 2015 to about 2,500 MW by 2033.

29. Recent TVA decisions on new generation, such as the John Sevier, Paradise, and Allen CC decisions, have been driven largely by regional system stability needs. TVA appears to insist that these needs be addressed by large utility scale facility installations. We encourage TVA to take more programmatic approaches, including agglomerating distributed generation, with greater emphasis on combined heat and power, and energy efficiency on a regional basis. This would avoid large capital expenditures for large generating and transmission facilities. It would be readily scalable and with quicker implementation schedules. By expanding the definition of distributed generation, TVA would provide ownership of DG assets, and, for combined heat and power, provide services beyond just electricity. Another option would be to use the Seven States model to include the LPCs in the equation. (*Commenter: White Harvest Energy*)

Response: Comment noted. TVA's analyses of the preferred options to provide low-cost, reliable service following retirements of existing coal units at John Sevier, Allen, and Paradise did include assessment of several alternatives including use of energy efficiency and distributed resources. These alternatives were found to be unable to provide the necessary real and reactive power supplies and ancillary services needed to maintain system reliability. See the environmental assessments for each of these actions (listed in SEIS Section 1.7) for more detailed descriptions of these analyses. TVA did not evaluate combined heat and power (CHP) options in those analyses, due in part to the uncertainty around obtaining sufficient projects to provide comparable supply and ancillary services since deployment and operation of CHP would require multiple installations coordinated with several local power companies.

30. The Draft IRP does not fully consider the impacts of the rapid increase in distributed generation that will occur in the next few years, driven by the rapidly decreasing costs of PV and other distributed generation, the rapidly decreasing costs and increasing availability of scalable energy storage, and likely increases in TVA rates. This increase is likely to be much greater than the 20% TVA assumes under the Distributed Marketplace scenario. TVA currently

addresses this increase in distributed generation as a load loss. This approach overlooks potential opportunities for TVA in better integrating distributed generation into its energy portfolio and providing high-value services including back-up power. (*Commenters: Teresa and Clarice Hargrove, Tom Kibby, Daniel Rausch, Don Safer - Tennessee Environmental Council, Joseph R. Schiller, Ph.D., Richard Spry, White Harvest Energy*)

Response: Comment noted. TVA did not include small-scale (rooftop) solar as a resource option in the IRP due to the complexity of modeling a small distributed resource, and because decisions around placement and integration costs are dependent on the local power companies on whose distribution systems the facilities would be installed. TVA did include a small commercial solar resource option but it was not selected by the model. TVA is continuing to monitor changes in distributed solar costs, as well as energy storage technologies, and the analysis around deploying distributed resource is an undertaking outside the IRP study process. IRP Appendix C provides the details of the assumptions around Scenario 5, the Distributed Marketplace.

31. The IRP does not recognize that there is significantly more demand for distributed residential and commercial solar PV generation than allowed by existing TVA programs such as the Green Power Providers program. This type of generation was not selected as a component of any of the capacity plans and there is no indication that TVA intends to continue and encourage the growth of these programs. Distributed solar generation can result in lower environmental impacts, avoided transmission and distribution line losses, and lower financial investment by TVA. (*Commenters: Bob Bates, Sophie Bjork-James, Ralph Bowden - Cookeville Meeting of the Society of Friends, Joseph M. Boyd, Jr., J.D., Joan Cassens, Amy Eskind, Edgar Gehlert, Vincent Harriman, Hans-Willi Honegger, Gil Hough - Tennessee Solar Energy Industries Association and Solar Energy Industries Association, Steve Johnson – Lightwave Solar, Mary M. Mastin - Tennessee Chapter of the Sierra Club, Joe W. McCaleb - League of Women Voters in Tennessee, John F. McFadden, PhD, Daniel Tait - Alabama Center for Sustainable Energy*)

Response: TVA recognizes that distributed solar generation can result in several benefits. The IRP assumes that the Green Power Providers program will continue in approximately its current form for some time. TVA is continuing to evaluate the level of incentives that are appropriate to encourage additional distributed solar PV installations. This work, performed outside the IRP study, is being undertaken in cooperation with the local power companies and the Distributed Generation - Integrated Value stakeholder working group. See the response to Comment 16 for an explanation of the current Green Power Providers program capacity cap.

2.2.3. Energy Efficiency

32. Even though electric rates in the TVA region may be lower than the national average, TVA customers have high bills because of heavy reliance on electricity and inefficient use of electricity. TVA customers tend to rely on electricity for heating, air conditioning, water heating, and cooking more than households elsewhere in the Southeast and nationally. This factor, along with the low quality of much of the housing stock and wide temperature fluctuations result in relatively high annual energy costs comprising a relatively large share of area household budgets. Climate change will make this situation worse. Therefore increased energy efficiency efforts will benefit all TVA-region ratepayers. (*Commenter: Louise Gorenflo - Tennessee Interfaith Power & Light*)

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Response: Comment noted. TVA agrees that electricity is used for more purposes in the TVA region than elsewhere in the country. This is often overlooked or ignored when electricity usage in the region is compared to usage elsewhere and it is asserted that Valley residents must be inefficient energy users because they use more electricity. In other regions, electricity use is offset or replaced by use of natural gas more than it is in the Valley. In the Northeast, energy resources that are used also include heating oil. Other commenters have pointed out that not all of the region's ratepayers would necessarily benefit from energy efficiency, particularly low-income residents. That is an issue and a concern that TVA will try to address when it implements the IRP. The 2015 IRP took an innovative approach to evaluating energy efficiency as a selectable supply-side resource in order to determine the most cost-effective level of energy efficiency. The recommended Target Power Supply mix includes increasing amounts of energy efficiency in the future, and it will be the responsibility of TVA and the local power companies to develop implementation plans to deliver increased amounts of this resource.

33. Individual energy efficiency projects make sense for many reason. It is not clear, however, that they reduce the need to build additional power plants or reduce per capita energy consumption. This calls into question the wisdom of relying on energy efficiency as a resource in the integrated resource plan. (*Commenter: Michael Watson - Duck River Electric Membership Corporation*)

Response: TVA agrees that the efficacy of energy efficiency programs is more uncertain than other resource options because the success of these programs in large part depends on interaction between local power companies and most of the end-users of TVA generated electricity. However, experience in this area shows that properly designed and implemented energy efficiency programs can reduce the needs for additional capacity as well as reduce individual and overall energy needs from what they otherwise might have been.

34. Light pollution is an increasingly serious problem resulting in loss of the ability to see the night sky, adverse impacts to human health and to wildlife, and wasted energy. As part of its energy efficiency efforts, TVA should promote more efficient night lighting, including street lighting, and the use of full cutoff light fixtures that eliminate wasted lighting. TVA should also promote the adoption of light pollution ordinances. (*Commenters: Joseph M. Boyd, Jr., J.D.*)

Response: Comment noted. Light pollution and local ordinances on lighting are outside the scope of the IRP. TVA does have a policy of implementing higher efficiency night lighting with full cutoff fixtures at its facilities and recognizes that reducing night lighting for energy efficiency reasons would have the collateral benefit of reducing light pollution.

35. The City of Bowling Green supports TVA's continued investment in energy efficiency for residential and commercial clients. The residential and commercial programs we have administered have realized real savings. Our residential program has focused on income-restricted clients who are directly benefitting from the investments. We are willing to work with TVA to continue to develop local energy efficiency programs. (*Commenter: Brent Childers - City of Bowling Green, Kentucky*)

Response: Comment noted. TVA is pleased that the City of Bowling Green has had success with energy efficiency efforts and looks forward to continued partnership with the City in this

area. TVA recognizes that partnerships such as this are essential to the success of energy efficiency efforts.

36. The role of the local power companies in implementing energy efficiency programs appears to be a barrier to the expansion of these programs. I urge TVA to greatly expand these programs and not allow the LPCs to be the deciding factor in this expansion. (*Commenter: Denise Bivens*)

Response: The local power companies have the relationship with the end-use customer that is necessary to deploy much of the energy efficiency in the Valley. They are not a barrier to implementation, and have in fact been partners with TVA for many decades in implementing efficiency programs. Many of the LPCs are leaders in this area, delivering innovative programs to their customers. TVA will continue to partner with the LPCs in delivering energy efficiency options.

2.2.4. Energy Storage

37. The discussion of energy storage and hydroelectric resource options in Draft IRP Chapter 5 do not address the potential for existing hydroelectric dams on the Tennessee River and Cumberland River systems to be operated, perhaps after modifications, as pumped storage systems. This option may provide low cost storage potential while operating the river systems within current constraints. (*Commenter: Venon Knight*)

Response: The 2015 IRP evaluates several hydro options, including modifications to existing TVA hydro facilities and a generic pumped storage location. TVA has previously evaluated its existing hydro facilities for their ability to be modified to operate in a pumping mode and this has not proven feasible. TVA will continue to review development in hydroelectric generation technologies and evaluate them for incorporation into the TVA system.

38. The treatment and consideration of energy storage in the IRP is inadequate because TVA has failed to consider newer advanced storage technologies that are already being implemented by other utilities. These new storage resources include batteries, thermal units, and mechanical resources that can provide high-speed response, large cost reductions, and highly scalable sizing located close to load or grid congestion points. Proven benefits include providing maximum capacity during peak times, frequency regulation, integration of intermittent renewable generation, and distribution and transmission cost reduction. TVA should include these advanced storage technologies in its model in conjunction with renewable energy; the resulting reduction in overall system costs and advancement of the number and timing of coal retirements would achieve low-cost power and environmental stewardship goals. (*Commenters: Zachary M. Fabish - Sierra Club et al., Michael Goff, John F. McFadden, PhD*)

Response: TVA recognizes the potential benefits of advanced storage technologies. Section 5.1.1 of the IRP describes the criteria used in considering potential energy resource options. The criteria state that to be considered, resource options must 1) use a proven technology or one that has reasonable prospects of becoming commercially available during the planning horizon, 2) be available to TVA within the region or be available to be imported through market purchases, and 3) have sufficient operating experience that reliable cost and performance data is available. Battery, thermal, and mechanical storage options were not included because

of operational limitations and/or limited cost and performance data. TVA continues to monitor the development of advanced storage technologies and will likely address them in future IRPs.

39. While we applaud TVA for considering the expansion of energy storage, we note that the types of storage options were very limited and storage was not selected in any of the capacity expansion plans. Additional storage would have facilitated the integration of more renewable energy while increasing system flexibility and reserve capacity and reducing environmental impacts. (*Commenters: Mary M. Mastin - Tennessee Chapter of the Sierra Club, John F. McFadden, PhD - Tennessee Environmental Council, Joseph R. Schiller, Ph.D.*)

Response: Comment noted. Two large utility-scale storage options, pumped storage and compressed air energy storage, were included as energy resource options. Neither was selected as a component of the strategies. See also the response to Comment 38.

2.2.5. Hydroelectric

40. The Brookfield Smoky Mountain Hydro assets are included as a potential energy resource in the IRP. TVA's acquisition of hydroelectric capacity from the Brookfield facilities would help TVA meet its key IRP objectives of a diverse portfolio, clean energy with lower environmental impacts, increased use of renewables, reliability, and avoided risk associated with changing market conditions and fuel and carbon uncertainty. The Brookfield facilities are certified as low impact by the Low Impact Hydropower Institute and provide important recreation and environmental activities, as well as local economic benefits. The facilities are operated in close coordination with TVA hydroelectric facilities and have recently undergone extensive modernization. (*Commenter: Steven E. Eckert - Brookfield Renewable Energy Group*)

Response: Comment noted. Additional hydroelectric generation acquired through PPAs is a component of some of the power supply plans. TVA will continue to evaluate the pricing and portfolio fit of hydro PPAs, including the Brookfield facilities, to determine if they are a least-cost option.

2.2.6. Natural Gas

41. The City of Memphis has been cited by the EPA for air quality violations and the need to improve overall air quality. TVA has already taken steps to repower its Allen plant in Memphis to cleaner natural gas turbine technology. This will contribute to cleaner air quality and provide the TVA system with additional flexibility that will help integrate new renewable energy. (*Commenter: Steve Cohen - U.S. House of Representatives*)

Response: Comment noted.

42. The heavy reliance on natural gas-fueled generation in all of the strategies, coupled with the coal plant retirements, places TVA in a vulnerable position should restrictions be placed on fracking reducing gas availability or the price of gas otherwise greatly increase. It is unclear how TVA would respond to this situation. (*Commenter: Daniel Shultz*)

Response: TVA's reliance on natural gas-fueled generation has increased as part of an effort to maintain a diverse portfolio and in conjunction with retirements of coal-fired units. The IRP scenarios evaluate a large range of future natural gas prices and availability and the price of natural gas is also identified as one of the key indicators to be monitored as the IRP is

implemented. TVA believes it has captured a robust set of potential outcomes in order to formulate the recommended Target Power Supply.

43. The use of fracking (hydraulic fracturing) to produce natural gas results in significant environmental impacts that are not adequately described in the Draft SEIS. Because of these impacts, TVA should not use natural gas produced by fracking. Given that TVA is unlikely to agree to this, the IRP should at a minimum describe the measures that TVA uses to assure that the production of its natural gas supply does not result in significant environmental impacts. (*Commenters: Susan Brandenburg, Eileen Brogan, Kristi Harrison, Mary Headrick, Patrick Miller, Gail C. Roberts, Jim Smith*)

Response: Natural gas must meet a uniform set of standards for chemical composition, (defined by individual pipeline tariffs) when received into an interstate pipeline. It is then deemed to be 'pipeline quality' and co-mingled with all other natural gas for everyone's use. While TVA does contract to purchase gas from individual suppliers with known source areas, neither TVA, nor other natural gas customers, can determine the specific source of natural gas delivered as part of the co-mingled gas stream in a pipeline. The environmental impacts associated with natural gas extraction, transportation, and use are described in the SEIS. TVA does not have specific environmental criteria that govern its natural gas purchases.

44. TVA has greatly increased its natural gas generation in recent years and proposes large further increases in the IRP. This is increasing TVA's reliance on this resource, which increases risk for TVA due to the volatility in the price of natural gas. The availability and cost of natural gas may also be affected by much-needed regulations addressing the air and water pollution and high methane emissions from the production of fracked gas. (*Commenters: Dennis Lynch, John F. McFadden, PhD - Tennessee Environmental Council*)

Response: Comment noted. See also the response to Comment 42

2.2.7. Nuclear Energy

45. I look forward to seeing the parameters of the analysis of a more aggressive nuclear option. Perhaps rather than a separate heavy nuclear option, the maximum renewables scenario should be redone to treat nuclear as a renewable source. This is appropriate because most studies suggest the external costs of nuclear power are comparable to those of renewables, and nuclear fuel is far less subject to price and supply risk than fossil fuels. (*Commenter: Michael Goff*)

Response: Comment noted. The results of the nuclear sensitivity analysis are discussed in IRP Section 8.3. This analysis showed that new nuclear generation would offset new gas generation and purchases of renewable energy and that nuclear additions increase total cost but lower fuel risk. Small modular reactors are presently cost-prohibitive, but cost-sharing would render them more financially attractive, and the final IRP recommendation includes TVA’s continued evaluation of SMRs as part of its technology innovation efforts. TVA does not presently count nuclear generation in its definition of renewable energy resources in the IRP; these resources are hydroelectric, wind, solar, and biomass-fueled generation.

46. Should an AP1000 plant at Bellefonte be included in an IRP strategy, additional emergency response planning would be required by TVA, the Tennessee Division of Radiological Health, and other Tennessee state agencies due to Tennessee counties falling

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within the 50-mile emergency planning zone required by NRC. (*Commenter: Michelle Walker Owenby - Tennessee Department of Environment and Conservation*)

Response: Comment noted. Neither the AP1000 plant nor any other new nuclear plant is included in the IRP alternative strategies or the Target Power Supply.

47. The IRP correctly does not include the completion and operation of Bellefonte Nuclear Plant in any of the capacity expansion plans. TVA should stop spending $60 million a year to keep the construction license active and close out the project. (*Commenters: John F. McFadden, PhD - Tennessee Environmental Council, Don Safer - Tennessee Environmental Council*)

Response: Comment noted. While none of the strategies evaluated in the IRP include completion of Bellefonte Units 1 and 2, the ultimate fate of this plant will eventually be decided by the TVA Board of Directors.

48. Since the IRP analyses show that small modular reactors are neither needed nor cost-effective, TVA‘s continued investment of resources to permitting and research activities related to SMRs should cease as it does not appear to be a sound investment of ratepayer dollars and provides no long-term benefits. (*Commenters: John F. McFadden, PhD - Tennessee Environmental Council, Don Safer - Tennessee Environmental Council, Stephen A. Smith - Southern Alliance for Clean Energy*)

Response: SMRs were not selected as components of any of the capacity expansion plans or the Target Poser Supply. While the merits of this technology have yet to be fully demonstrated, they are sufficiently promising, especially if CO_2 emissions are severely constrained, to justify further evaluation. The IRP recommendation includes continuing to work on SMRs as part of TVA's technology innovation efforts and consideration of cost-sharing opportunities if they become available.

49. We encourage TVA to continue to support the development of small modular reactors. SMRs can play a significant role in meeting the challenges in each of the IRP scenarios due to their advantages of modularity, lower capital investment, siting flexibility, and efficiency while supporting nonproliferation and U.S. manufacturing goals. Their load following capability can also play an important role in integrating distributed generation resources. They are also an important potential source of clean energy. (*Commenters: Edgar Gehlert, Jack L. Suggs – Oak Ridge Electric Department, Mark S. Watson - City of Oak Ridge Tennessee*)

Response: Comment noted.

50. The IRP relies too much on the continued and increased use of nuclear energy. Watts Bar Unit 2 is old technology. There is no foreseeable plan for long-term disposal of TVA's spent fuel rods. Nuclear power is expensive, as shown by the closure and requested subsidies of merchant nuclear plants. The risk for major accidents is so high that private insurance is not available. (*Commenters: John Andes, Amy Eskind, Anna Miller Grabowski, Kristi Harrison , Sandra Kurtz, John F. McFadden, PhD - Tennessee Environmental Council, Patrick Miller, Shirley Moulton, Brandi Prewitt, Luisa Ramirez de Lynch, Mark Tolley*)

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Response: Comment noted. TVA believes that nuclear power is a proven technology with an excellent safety record that will continue to be a core component of its diverse portfolio. TVA has a plan for management of spent fuel on the Watts Bar site, which was addressed in the June 2014 Independent Spent Fuel Storage Installation Watts Bar Nuclear Plant Environmental Assessment.

51. The extended power uprates (EPUs) for all three aging Browns Ferry Nuclear Plant units are selected as the only new baseload generation in all capacity expansion plans. This is very risky given TVA's history of schedule and cost problems with its nuclear fleet, as well as industry-wide problems with EPUs. EPU projects for reactors of various designs, including the same design as at Browns Ferry, have a history of cost and schedule problems. Some EPU projects, such as Duke Energy's Chrystal River 3 EPU, are costing customers billions of dollars. Several utilities have also experienced increased O&M costs following the completion of EPU projects. TVA should reevaluate its assumptions and reliance on the EPUs. (*Commenters: John F. McFadden, PhD - Tennessee Environmental Council, Don Safer - Tennessee Environmental Council, Daniel Shultz, Stephen A. Smith - Southern Alliance for Clean Energy, Mark Tolley*)

Response: TVA has evaluated the risks and benefits around the extended power uprates at Browns Ferry and is proceeding with licensing and other permits and applications. These uprate projects have been previously reviewed and approved by TVA and work on them has been proceeding. The IRP shows that these projects would deliver value to the ratepayers if completed.

2.2.8. Power Purchase Agreements

52. Net metering of customer-owned renewable generation represents a subsidy by all rate payers for the few that pursue rooftop solar or other forms of net-metered distributed generation. (*Commenter: Michael Watson - Duck River Electric Membership Corporation*)

Response: Comment noted. Net metering is a rate policy question which is outside the scope of the IRP.

53. The Draft IRP report and the Draft SEIS both state that because TVA cannot take advantage of investment incentives to promote renewable energy, it is financially advantageous for TVA to obtain wind and solar energy through power purchase agreements (PPAs). We encourage this as a means of lowering the levelized cost of wind and solar energy. To fully capitalize the attributes of PPAs, TVA should adjust their term length from its standard 20 years to at least 25 years to better match the book life of the generating facility and industry practice elsewhere in the U.S. (*Commenters: Gil Hough - Tennessee Solar Energy Industries Association and Solar Energy Industries Association, Cortney Piper - Tennessee Advanced Energy Business Council*)

Response: TVA will analyze potential power purchase agreements over a variety of terms. The IRP study included a 25-year term for solar power purchase agreements. As contracts with different terms are structured, TVA will evaluate such purchase opportunities as they are offered.

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2.2.9. Renewable Energy

54. TVA should pursue additional sources of renewable generation including municipal solid waste burned directly or after converting into gas, from methane generated from livestock waste, and from methane from sewage treatment plants, including from digestion of sewage solid wastes. These sources would provide TVA with dispatchable generation without burning fossil fuels. (*Commenter: Brandi Prewitt*)

Response: TVA purchases power from several small facilities powered by landfill gas and burns methane from the adjacent wastewater treatment plant at its Allen coal plant. The new Allen combined cycle plant that will replace the Allen coal plant will continue to burn methane from the wastewater plant. TVA continues to accept proposals for purchasing power generated by methane as part of its Renewable Standard Offer program. Qualifying biomass fuels eligible for this program are a) all wood waste including “black liquor” from pulp and paper processing, mill residues, industrial waste wood, and waste wood from woodworking or wood-processing, so long as the wood is not chemically treated or coated; b) all agricultural crops or waste; c) all animal and other organic waste; d) all energy crops; and e) landfill gas and wastewater methane. These standards currently exclude the combustion of municipal solid waste.

2.2.10. Selection Criteria

55. Section 5.1.1 of the Draft IRP states that energy resource options considered in the IRP must use a proven technology or one that has reasonable prospects of becoming commercially available during the planning period. TVA has inconsistently applied this criterion. Small modular reactors, which are in a very early stage of development, are included as resource options. Several energy storage technologies such as some types of battery storage which are already in commercial development or much closer to being commercialized than SMRs are excluded. TVA also does not adequately address foreseeable improvements in existing energy resources such as wind turbines. (*Commenters: Sherry Loller, Mary M. Mastin - Tennessee Chapter of the Sierra Club, Cortney Piper - Tennessee Advanced Energy Business Council, Joseph R. Schiller, Ph.D.*)

Response: IRP Section 5.1.1 has been revised to better describe the criteria for including energy resource options. Small modular reactors were included as an option consistent with TVA’s ongoing commitment to technology innovation. TVA continues to monitor storage technology options, and two alternatives are included in the study as resource options. TVA's assessment of battery technology did not indicate it had a sufficient level of detail around cost and performance assumptions to include as an energy resource option at this time. The decisions around the underlying assumptions on wind turbine technology are addressed in IRP Section 5.2.2 and Appendix B.

2.2.11. Solar Energy

56. Strategies A, B, C and D limit solar capacity expansion to 300 MW/year and a total of 4,000 MW by the end of the planning period. Strategy E has a higher expansion limit. These limits are reached under high growth scenarios. TVA should explain the reasoning behind these limits and explicitly note that the capacity expansion model may be forced to select natural gas or other resources over less costly and cleaner solar because of these solar expansion limits. (*Commenters: Robin D. Cox - City of Huntsville, Alabama - Huntsville Operation Green Team, Mary M. Mastin - Tennessee Chapter of the Sierra Club, John F.*

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McFadden, PhD - Tennessee Environmental Council, Gail C. Roberts, Stephen A. Smith - Southern Alliance for Clean Energy, Daniel Tait - Alabama Center for Sustainable Energy)

Response: TVA established the annual growth rate limit on solar at 300 MW/year for Strategies A–D. The 300-MW per year expansion limit under Strategies A, B, C, and D was established by examining the Solar Electric Power Association Top Ten Data Report Set which included information on utility scale solar installations between 2010 and 2013. This data was analyzed to determine the solar capacity that some of the leading utilities have been able to install and integrate on a yearly basis. This capacity was then standardized by converting it into a percentage of each utility's total supply. Applying this growth rate to the TVA system suggests that a 300 MW/year annual growth rate is reasonable. This reflects the ability for projects to be sited, permitted, and constructed in a given year as well as the ability of the TVA power system to integrate their generation onto the grid in a reliable manner. The growth rate was accelerated to 500 MW/year in Strategy E - Maximize Renewables in recognition of that strategy's explicit goal of promoting aggressive use of renewable technology. The 4,000 MW cumulative limit on solar expansion in Strategies A–D is based on an NREL study of US solar potential which assessed the technical potential for solar in each state, adjusted for the approximate proportion of each state that is serviced by TVA. Strategy E includes a limit of 8,000 MW, driven by its requirements that energy needs be met first with renewable generation per the strategy design.

57. The Draft SEIS (page 155) states that all capacity expansion plans include a continuation of the current Renewable Standard Offer and related Solar Solution Initiative programs until 2020, adding a total of about 325 MW of predominantly solar capacity and small amounts of wind and biomass-fueled generation. These two programs are currently adding about 120 MW of capacity each year. If they continue at this current capacity, they would add up to 720 MW of solar capacity through 2020. Please clarify the difference between the stated 325 MW and the potential 720 MW capacity increases. (*Commenter: Stephen A. Smith - Southern Alliance for Clean Energy*)

Response: The IRP assumes that the existing RSO and SSI programs do not expand beyond their present commitments. These commitments include facilities that have not yet come online, and this is the source of the 325 MW increase. This modeling approach was selected in order to model all renewable growth as selectable supply-side resources. The IRP does not set program policy, including the future of the RSO and SSI programs. The final IRP recommendation includes growth in solar power over the planning period, and TVA will use the overall direction established in the IRP to inform program direction.

58. The IRP capacity expansion plans include the continuation of the current Renewable Standard Offer (RSO) and related Solar Solution Initiative (SSI) programs until 2020. These programs are currently adding 120 MW of available capacity each year. These are excellent programs which have seen incremental improvements each year and we support their continuation beyond 2020 regardless of the IRP strategy chosen. (*Commenter: Gil Hough - Tennessee Solar Energy Industries Association and Solar Energy Industries Association*)

Response: Comment noted. See the response to Comment 57.

59. TVA should be more proactive in promoting community solar projects, which currently receive little attention in the IRP. These projects, whether constructed by local power

companies or others, provide the opportunity for those who cannot construct their own solar facilities to participate in solar-electric generation and reap the financial and other rewards of solar energy. Most local power companies have sites adjacent to substations, other facilities, or power lines that are suitable for community solar projects. (*Commenters: Ralph Bowden - Cookeville Meeting of the Society of Friends, Margaret Evans, Mary M. Mastin - Tennessee Chapter of the Sierra Club, John F. McFadden, PhD, Lynn Strickland, Patrick Watermeier, Michael Watson - Duck River Electric Membership Corporation*)

Response: Comment noted. The IRP did not evaluate specific solar program offerings such as community solar, and instead focused on utility- and commercial-scale solar facilities. Many community solar projects are similar in size to the commercial projects modeled in the IRP and described in IRP Section 5.2.2. The final IRP recommendation includes growth in solar power over the planning period, and TVA will use the overall direction established in the IRP to inform program direction. A few LPCs have community solar programs; contact your LPC to indicate your interest in participating in them.

60. TVA, perhaps together with the local power companies, should explore alternative business models for promoting residential solar PV installations. These could include community solar facilities, rent/buy models, rooftop space rented by developers, bulk equipment purchasing, and other alternative financing arrangements. (*Commenters: Arlen Coyle, Mary Headrick, Hans-Willi Honegger, Jack Jeffers, Richard Spry*)

Response: Comment noted. While outside the scope of the IRP, TVA and several LPCs are exploring community solar offerings and evaluating business models around residential solar deployment.

2.2.12. Wind Energy

61. As landowners and neighbors of landowners on the route of Clean Line's proposed Plains & Eastern HVDC transmission line or otherwise interested citizens, we oppose TVA's consideration of the HVDC wind energy option. The IRP analyses show that this option is costly, risky, and inflexible. It is unnecessary to achieve carbon reduction goals and will harm those of us along the HVDC transmission line route. (*Commenters: Carol A. Overland - Legalectric Inc., Opponents of the Clean Line Plains & Eastern HVDC Transmission Line Campaign Emails*)

Response: Comment noted. The IRP analyses show that the HVDC wind energy option is a viable component of the strategies late in the planning period. TVA is not, however, making a commitment to interconnect with the Plains & Eastern line or to purchase wind energy transmitted by it or any other HVDC line at this time.

62. Most of the capacity expansion plans include the HVDC wind energy option late in the planning period. Utilization of this reliable, low cost renewable energy option will result in environmental and economic benefits, especially to western Tennessee. We request that you to utilize this resource with an earlier 2020 start date. (*Commenters: David Berry - Clean Line Energy Partners, Steve Cohen - U.S. House of Representatives, Frances Lamberts, Myron Lowery - City of Memphis Tennessee, Mark H. Luttrell, Jr. - Shelby County Tennessee Board of Commissioners, Mary M. Mastin - Tennessee Chapter of the Sierra Club, John F. McFadden, PhD, Carey Parham - Millington Industrial Development Board, Cortney Piper - Tennessee Advanced Energy Business Council*)

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Response: Comment noted. Several scenarios and the sensitivity analyses evaluated selection of HVDC wind much sooner in the planning period, and the IRP recommendation includes direction to consider wind deliveries sooner in the planning period if operational characteristics and pricing result in lower-cost options. The SEIS evaluated the environmental impacts of earlier wind capacity expansion as part of alternative Strategy E.

2.3. Environmental Impacts

2.3.1. Air Quality

63. Additional natural gas generation will occur in all strategies. While the burning of natural gas for electricity production results in fewer air emissions than burning coal, carbon dioxide and nitrogen oxides are still produced. Depending on the locations of the new gas plants, local attainment/nonattainment designation under the National Ambient Air Quality Standards will be an important consideration in siting the plants. Attainment with air standards and the delivery of affordable and reliable electricity are both critical factors that inform industries' decisions to locate operations in Tennessee. (*Commenters: Robert J. Martineau, Jr. - Tennessee Department of Environment and Conservation*)

Response: TVA agrees that attainment with air standards and the delivery of affordable and reliable electricity are both critical factors that inform industries' decisions to locate operations in Tennessee and other parts of the TVA service area. States are responsible for establishing limitations on emissions from pollution sources in order to achieve the ambient standards. Emission limitations have been set for all of TVA's fossil plants and TVA has in place controls and processes for complying with these limitations. TVA also considers the ambient standards in the siting and operation of proposed generating facilities.

2.3.2. Biological Resources

64. Most species of birds are protected under the Migratory Bird Treaty Act and eagles receive additional protection under the Bald and Golden Eagle Protection Act. Seventy-two species of birds identified by the Department of Interior as of conservation concern, as well as the bald and golden eagles, occur in the TVA region. Consistent with TVA's environmental stewardship mission and to comply with Executive Order 13186 – Responsibilities of Federal Agencies to Protect Migratory Birds, TVA should work with the Department of Interior to complete and implement a Memorandum of Understanding between TVA and the Department for the conservation of migratory bird populations. This memorandum should be completed prior to completion of the IRP and the measures within it incorporated into the IRP alternatives. (*Commenter: Joyce Stanley - U.S. Department of Interior*)

Response: TVA lands and the TVA reservoir system provide numerous benefits to migratory bird populations. These areas are managed by TVA and local, state and federal partners to benefit migratory birds and to provide wildlife-oriented recreational opportunities, including bird-watching and waterfowl hunting. TVA complies with applicable regulations by incorporating protective measures and minimizing impacts of its operations to migratory birds. TVA is developing the MOU under E.O. 13186 with the Department of Interior for the conservation of migratory bird populations. TVA will work with regional and national USFWS Migratory Bird and Ecological Services Offices to complete an MOU equivalent in scope to those developed by DOI and other federal agencies. TVA is committed to follow the measures outlined in the MOU to continue to comply with E.O. 13186, the MBTA, and the BGEPA as the IRP is implemented.

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65. The Draft SEIS does not analyze the potential impacts of the various IRP alternatives on the many endangered, threatened, or candidate species and their designated critical habitats that occur in the TVA region. In our comments submitted during the IRP scoping, we recommended that TVA analyze the impacts to fish and wildlife populations, listed species, and their habitats that would result from the alternatives, including those from the construction and operation of new energy resources and the continued operation of existing energy resources. We also recommended that TVA analyze how the IRP alternatives might affect fish and wildlife resources in the context of climate change. We are concerned that without these proper analyses, TVA may inadvertently select an IRP alternative which presents substantial negative impacts to listed species. (*Commenter: Joyce Stanley - U.S. Department of Interior*)

Response: The IRP is a programmatic action that does not itself authorize any site-specific actions, such as the construction and operation of new generating facilities, affecting endangered or threatened species, designated critical habitats or other biological resources. Consequently, the SEIS does not contain detailed analyses of the potential impacts of each of the IRP alternatives on these resources. TVA will conduct the appropriate detailed impact analyses when it proposes actions to implement the IRP. While site- and implementing action-specific impact analyses are not possible at this time, the SEIS does quantify the land area requirements for implementing the alternative strategies. These land area requirements include both the land occupied by new and expanded generating facilities and associated with the nuclear and fossil-fueled generation fuel cycles. They provide an indicator of the potential for impact to many biological resources, although TVA has found that through informed siting and facility design processes many potential impacts can be avoided or minimized.

2.3.3. Coal Plant Waste

66. The Draft SEIS states that 21% of coal plant waste is reused. Are there plans to increase that percentage? (*Commenter: Robin D. Cox - City of Huntsville, Alabama - Huntsville Operation Green Team - Huntsville Operation Green Team*)

Response: In calendar year 2014, the beneficial reuse of CCRs produced at TVA coal plants increased to 29 percent. TVA has recently been certified by the Tennessee Department of Transportation for the use of fly ash from the Bull Run plant as a replacement for Portland cement in concrete for TDOT projects. TVA continues to seek safe, environmentally responsible opportunities to divert CCRs from disposal and into beneficial use applications.

2.3.4. Greenhouse Gas Emissions and Climate Change

67. The Draft SEIS does not adequately describe the impacts of TVA's future greenhouse gas emissions because it does not extrapolate the global, irreversible economic and environmental impacts much beyond the TVA region and the 20-year planning period. (*Commenter: John Todd Waterman - Organizing for Action-TN Climate Campaign and Citizens' Climate Coalition*)

Response: The SEIS presents a reasonable discussion of the impacts of greenhouse gas emissions in Section 4.2 and Chapter 7. This impact assessment aligns with the Council of Environmental Quality's recently revised draft guidance on assessing greenhouse gas emissions in NEPA reviews by quantifying future emissions under the alternative strategies and the Target Power Supply, referencing other studies such as IPCC reports for details on potential global and longer-term impacts, and addressing the potential effects on climate change on the future operation of the TVA power system.

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68. TVA's current generation fleet is very water-intensive, and the use of water for power plant cooling is the largest single water use in the TVA region. Water will be one of the natural resources most heavily impacted by climate change, especially in the Southeast as water temperatures rise. While the Draft SEIS briefly describes the potential effects to water resources from climate change, it does not adequately describe the how the potential changes in water temperatures and/or extended droughts could impact TVA's existing and future thermal generation. High water temperatures have already resulted in curtailment of generation at TVA coal and nuclear plants in recent years. (*Commenters: Angela Garrone - Southern Alliance for Clean Energy et al., Michelle Walker Owenby - Tennessee Department of Environment and Conservation*)

Response: Comment noted. TVA acknowledges the potential impacts of climate change on the future availability and temperature of water for cooling nuclear and fossil-fueled generating facilities. As stated in SEIS Sections 5.2 and 7.5.2, these potential impacts may result in the need to reduce generation ("derate") at individual plants in order to meet thermal discharge limits. TVA has derated nuclear plants in some recent years due to reduced flows and high water temperatures in the Tennessee River during periods of drought and/or unusually high ambient temperatures. To reduce the potential for future derates, TVA has recently installed additional cooling capacity at Browns Ferry Nuclear Plant. Recent derates at TVA coal plants on the Cumberland River were largely due to greatly reduced river flows during the seven-year drawdown of Lake Cumberland while Wolf Creek Dam was being repaired. Despite the overall increase in generating capacity that will occur as the IRP is implemented, both water use and water consumption by TVA generating facilities would decrease under Strategies A–E and the Target Power Supply (see SEIS Section 7.5.3). TVA's Climate Adaptation Plan (TVA 2014h) addresses the relationship between climate change, electricity demand, reservoir operations (including hydropower generation), and cooling water requirements. TVA's planning processes include identification and adaptation to significant risks, including climate change. Potential adaptation measures include physical changes to improve the durability and stability of specific facilities (such as the installation of additional cooling capacity at Browns Ferry) and resiliency measures to continue the operation of facilities and/or allow them to recover more quickly after damage.

69. We believe the Council on Environmental Quality's December 2014 revised draft guidance for Federal agencies' consideration of GHG emissions and climate change impacts in NEPA outlines a reasonable approach, and we commend TVA for using that draft guidance to help outline the framework for its analysis of these issues. (*Commenter: Heinz J. Mueller - U.S. Environmental Protection Agency*)

Response: Comment noted.

2.3.5. Historic Properties

70. The Draft SEIS states that Browns Ferry Nuclear Plant and Shawnee Fossil Plant are eligible for listing in the National Register of Historic Places, but that TVA has not consulted with State Historic Preservation Officers on their eligibility. Please clarify why TVA has not consulted on the eligibility of these two plants. The Final SEIS should also describe any consultations with State and Tribal Historic Preservation Officers on the development of the IRP. (*Commenter: Heinz J. Mueller - U.S. Environmental Protection Agency*)

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Response: TVA consulted with the Kentucky State Historic Preservation Officer on the eligibility of Shawnee Fossil Plant in late 2014. The SHPO concurred with TVA's determination that the plant is eligible for the NRHP. TVA has not had occasion to consult with the Alabama SHPO on the eligibility of Browns Ferry Nuclear Plant since TVA conducted the inventory of its facilities in 2012. TVA will do so if and when it proposes actions that could affect its eligibility. TVA has not consulted with State or Tribal Historic Preservation Officers on the IRP because TVA has determined that the development of the plan does not have the potential to affect historic properties. TVA will consult, as appropriate, during the planning of actions to implement the IRP.

2.3.6. Low-Income and Minority Populations

71. Although environmental justice is discussed in the SEIS existing environment section, neither the Draft IRP nor the Draft SEIS provide a detailed discussion of the effects of the strategies on low-income and/or minority populations in the TVA region. Low-income populations would be most adversely affected by any increases in their power bills resulting from implementation of one of the strategies. A large proportion of low-income and/or minority populations live in poorly insulated homes. They often cannot participate in energy efficiency programs because they lack the resources and/or live in rental housing, which is not a focus of TVA's residential energy efficiency programs. Conversely, focusing increased energy efficiency efforts on these ratepayers would likely generate the highest returns. (*Commenters: Louise Gorenflo - Tennessee Interfaith Power & Light, Robert J. Martineau, Jr. - Tennessee Department of Environment and Conservation*)

Response: TVA acknowledges that the implementation of the IRP could increase TVA's revenue requirements which could eventually result in increases in customer power bills. Although minimizing potential future revenue requirements is part of TVA's least-cost planning approach, the determination of how these requirements would be met by future rate changes is outside the scope of the IRP. TVA recognizes that more low-income and/or minority residents likely live in poorly insulated homes, including rental housing, than other residents. While TVA currently has few energy efficiency programs targeting these populations, it is actively working with the local power companies in Huntsville, Alabama, Knoxville, Memphis, and elsewhere to design and deliver such programs. These efforts include the Extreme Energy Makeover component of the EPA Smart Communities Program described in SEIS Section 3.5. TVA and the LPCs are currently starting to implement this program in Knoxville and Huntsville.

72. The Draft SEIS does not contain a discussion of environmental justice and socioeconomics related to either the existing and/or proposed assets and needs by resource category. EO 12898 on environmental justice direct Federal agencies to make achieving environmental justice part of its mission by identifying and addressing, as appropriate, disproportionately high and adverse human health or environmental effects on minority and low-income populations. EPA notes that the strategies may have implications on minority and/or low-income populations. The Final SEIS should describe whether community concerns related to environmental justice were raised and whether environmental justice populations were meaningfully engaged in the process. It would also be helpful to include maps identifying the locations of existing and proposed assets along with demographics and socioeconomic information associated with the facilities or projects. (*Commenter: Heinz J. Mueller - U.S. Environmental Protection Agency*)

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Response: Although TVA is not among the Federal agencies subject to EO 12898, it routinely considers the potential impacts of its proposed actions on minority and low-income populations. Section 4.16 of the SEIS describes the prevalence and distribution of low-income and minority populations in the TVA service area. SEIS Figures 4-32 and 4-33, in conjunction with Figure 1-1, show the distribution of TVA's generating facilities in relation to the prevalence of low-income and minority populations. A few of TVA's recent actions to reduce emissions of air pollutants at its generating plants are at plants located in areas with relatively higher low-income and/or minority populations; see, for example, the analysis of environmental justice impacts in the recent environmental assessment for the new combined cycle plant and retirement of coal units at Allen Fossil Plant (TVA 2014d). Because the locations of other new generating facilities are not known, assessment of their potential environmental justice impacts is not possible at this time. The IRP public involvement process included public meetings held across the TVA service area, as well as online. These meetings were announced in news releases, advertisements, and notifications to community leaders and organizations. Potential environmental justice impacts were among the issues raised during public scoping and in several comments TVA received during the public review of the draft IRP and SEIS. Particular issues raised in these comments included the effects on low-income populations of future rate increases resulting from the implementation of a strategy, the limited ability of low-income populations to participate in energy efficiency programs, and the potential for more of the cost of operating the TVA system to be borne by those unable to reduce their energy usage through energy efficiency efforts or installation of distributed generation.

2.3.7. Land Use Impacts

73. Land requirements for implementing the alternative strategies vary more than other quantified environmental resources. The largest contributor to this variation is the large land area requirements for solar PV facilities relative to their generating capacity. This is a consequence of TVA's emphasis of only utility-scale, ground-mounted solar PV technology rather than smaller distributed PV. Land impacts from ground-mounted PV systems can be minimized by siting them on lower-quality sites such as brownfields, abandoned mining land, or existing transportation and transmission corridors. Although PV land impacts can be mitigated, any new generation resource will result in land use impacts. In its SEIS, TVA must also consider the benefits of solar generation compared to alternative forms of generation. TVA should also place the land use impacts of large scale solar generation in context with the TVA region. For example, 4,000 MW of utility-scale ground-mounted solar would occupy about 50 square miles, less than 0.1% of the TVA service area. (*Commenters: Angela Garrone - Southern Alliance for Clean Energy et al., Joe W. McCaleb - League of Women Voters in Tennessee*)

Response: Comment noted. The SEIS acknowledges in Section 7.2.3 that building-mounted PV facilities, which account for the majority of small distributed PV installations, do not negatively impact land use. Although ground-mounted PV facilities can be sited on lower-quality sites to reduce land-use impacts, only a small proportion of solar developers in the TVA region have, to date, developed or proposed PV facilities on such sites. Section 7.5.6 of the Final SEIS has been revised to better compare the land use impacts from PV facilities with those of other generating facilities and to place the land use impacts of PV generation in context of the overall TVA service area.

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74. The discussion of facility land requirements in the SEIS is a useful tool in evaluating and comparing new generating facilities. The discussion should, however, better describe how the land is impacted. For example, the long-term impact on land of a coal-fired power plant can have a much more significant long-term effect than would a wind or solar farm. (*Commenter: Heinz J. Mueller - U.S. Environmental Protection Agency*)

Response: Comment noted. Section 7.5.6 of the Final SEIS has been revised to discuss the different long-term impacts.

75. The discussion of land use impacts in the SEIS appears to have been applied to denigrate the expansion of solar PV generation, which relies almost entirely on large-scale projects that occupy a large land area. The use of more rooftops, brownfield sites, and parking lots for PV installations was ignored and would otherwise have reduced the land impacts. (*Commenters: Hans-Willi Honegger, Mary M. Mastin - Tennessee Chapter of the Sierra Club*)

Response: The land area required by the new generating facilities associated with each strategy was estimated in order to both quantify the change in land use that would result from the construction of the new facilities (very few of which would likely be on existing industrial sites) and to serve as a proxy for potential impacts to resources such as wetlands, endangered and threatened species, vegetation, wildlife, prime farmland, and cultural resources. All of the new solar generation associated with each strategy (except for the solar component of the Generation Partners Program and a small portion of the solar component of the Renewable Standard Offer program) is assumed to be from utility-scale facilities. Such facilities have historically been ground-mounted in the TVA region and this is expected to be the case for the foreseeable future. As stated in SEIS Section 7.5.6, the site-specific impacts of solar PV facilities are typically much less that those of other generating facilities.

2.3.8. Socioeconomics

76. The inclusion of socioeconomic impacts as part of the overall environmental impacts discussion in the SEIS downplays the importance of economic impacts. (*Commenter: Robin D. Cox - City of Huntsville, Alabama - Huntsville Operation Green Team*)

Response: The National Environmental Policy Act requires Federal agencies to utilize a systematic, interdisciplinary approach with the integrated use of natural and social sciences in determining the effects of proposed action on the human environment. The Council of Environmental Quality regulations for implementing NEPA (40 CFR 1508.8) define effects as being synonymous with impacts and to include ecological, aesthetic, historic, cultural, economic, social, or health effects. The discussion of socioeconomic impacts in the SEIS is given the same prominence as the discussion of other impacts. Socioeconomic impacts are also components of the IRP metrics and thus play an important role in the strategy evaluation.

77. We acknowledge TVA's efforts to describe the socioeconomic impacts of the strategies. The inputs and outputs utilized to draw these conclusions are, however, not clearly described in the Draft SEIS. We recommend that the Final SEIS described these inputs and outputs based on their descriptions in Appendix G of the Draft IRP. TVA should also describe associated socioeconomic impacts that are not addressed and/or explicitly quantified by the REMI model. One of these is the positive per capita income impact associated with reduced customer electricity bills resulting from decreased energy consumption due to energy

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efficiency improvements. (*Commenter: Michelle Walker Owenby - Tennessee Department of Environment and Conservation*)

Response: SEIS Section 7.5.7 has been revised in response to this comment.

2.3.9. Water Resources

78. Although mentioned in Draft SEIS Section 4.5 on groundwater, Section 4.6 on water quality does not mention coal combustion residuals as being a potential cause of degraded water quality through seeps of direct hydrologic connection to surface waters. (*Commenter: Heinz J. Mueller - U.S. Environmental Protection Agency*)

Response: Comment noted. Final SEIS Section 4.6 on water quality has been revised to include coal combustion residuals as a potential cause of degraded water quality. EPA's new Coal Combustion Residuals rule is formulated to determine and remedy such impacts.

79. Although TVA has not yet specified which designs may be included in an early site permit application to the NRC for small modular reactors, the Final SEIS should include an estimate of water use and consumption for each possible SMR design. The statement in the Draft SEIS that it would operate with closed cycle cooling with relatively low water use rates and relatively high water consumption rates is not sufficient. (*Commenter: Angela Garrone - Southern Alliance for Clean Energy et al.*)

Response: Based on currently available engineering design and the characteristics of the Clinch River Site, water use and water consumption rates are preliminarily estimated to be about 1,400 gallons/MWh and 1,300 gallons/MWh, respectively.

80. During the planning of any new combined cycle plants utilizing raw water, TVA should conduct an assessment of potential impacts to nearby public water systems utilizing ground water or surface water. (*Commenter: Michelle Walker Owenby - Tennessee Department of Environment and Conservation*)

Response: Comment noted. TVA regularly performs this assessment as part of its review of new generating facilities.

81. The discussion of sources of water quality impacts in Draft SEIS Section 4.6 addresses impacts from power generation but does not address impacts from extraction of fuel that powers generation facilities. Resource extraction often can impact water quality more significantly than the power plant operation. These indirect impacts should be considered and identified in the Final SEIS. (*Commenter: Heinz J. Mueller - U.S. Environmental Protection Agency*)

Response: SEIS Section 4.6 has been revised to add a brief description of these impacts which are described in more detail in Section 7.2.

82. The Draft SEIS discusses water quality impacts associated with the various strategies. However, many aspects of these potential impacts are not discussed in detail. We recommend that the Final SEIS describe the water quality impacts associated with the various types of generation resources considered in the IRP. (*Commenter: Michelle Walker Owenby - Tennessee Department of Environment and Conservation*)

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Response: SEIS Sections 4.5, 4.6 and 7.2 describe water quality impacts associated with the various types of generation resources.

83. The state-of-the-science for understanding the significant impacts to water quality from hydrologic alterations such as hydroelectric dams has grown significantly along with the understanding of ways to work to improve those significant water quality impacts. We commend TVA for its work on improving operation of its dams to reduce these impacts, including its early attention to the importance of evaluating flows below dams. We would welcome working with TVA to better understand and where possible share with other dam operators those improvements that TVA has already put into place that have resulted in improved water quality. We request that TVA include in the IRP any efforts where it plans to take additional measures to improve the water quality below its dams. Such measures should be considered as an integral part of future planning for power generation both to more accurately cover environmental impacts as well as to highlight TVA's knowledge and experience in this area. (*Commenter: Heinz J. Mueller - U.S. Environmental Protection Agency*)

Response: Comment noted. TVA continues to monitor water quality in its reservoirs and in tailwaters downstream of its dams and to evaluate the need for additional improvements. The operational characteristics of TVA's hydroelectric dams used in the IRP modeling include those related to maintaining and improving water quality. Many of these characteristics were established by the 2004 *Reservoir Operations Study* and other processes and the IRP does not propose to change them. Should TVA propose to construct and operate additional hydroelectric turbines (a component of many of the IRP capacity expansion plans), TVA would evaluate associated opportunities for improving water quality in the tailwaters of the affected dams. The improvements that TVA has made at its dams to address their impacts are described in the *Reservoir Operations Study* (TVA 2004) and the 1990 *Final Environmental Impact Statement, Tennessee River and Reservoir System Operation and Planning Review.* TVA would welcome working with EPA to communicate to other dam operators the improvements it has made and, equally important, the analytical methods that led to those improvements.

2.4. Greenhouse Gas Emissions

84. A major shortcoming of the Draft IRP is its failure to evaluate options for compliance with EPA's Clean Power Plan and factor such compliance into TVA's resource planning. The CPP will take effect and require action during the period of time covered by the 2015 IRP. The Draft IRP justifies this omission by stating that the final form of the CPP is uncertain; similar uncertainty is a condition of several other projections which the Draft IRP does evaluate in detail. The results presented in the Draft IRP show that compliance with the CPP is readily and cost effectively achievable, with 2020 CO_2 emission rates between 600 and 800 lbs/MWh under the reference case. By 2030, reference case CO_2 emission rates would decline to between 450 and 650 lbs/MWh. The 2020 rates are below the interim 2020-2029 goals and the final 2030 goals for six of the seven TVA states. 2030 rates would below the final 2030 goals for all TVA states. TVA should revise the IRP to address this issue and to consider CPP implications more generally, as the multiple avenues to CPP compliance pose different risks and benefits to TVA from an emissions profile standpoint. (*Commenter: Zachary M. Fabish - Sierra Club et al.*)

Response: See the revised discussion of this topic in IRP Section 7.1.3. Addressing this issue in more detail at this time is not feasible for several reasons, including that the final Clean Power Plan has not yet been issued and is expected to incorporate several changes from the proposed plan and because the IRP covers parts of seven states, each of which will eventually have to develop separate, as yet undefined, implementation plans under the Clean Power Plan. TVA expects to address the CPP, should it be enacted, in detail in the next IRP. What the IRP analyses show, however, is that under all strategies TVA will continue to reduce CO_2 emissions from its system and facilitate complying with the Clean Power Plan.

85. While the IRP is not designed to assess compliance with EPA's Clean Power Plan by the seven states in which TVA operates, we do note that all of the strategies result in large reductions in CO_2 emissions. This puts TVA and the seven states in which it operates in a good position for meeting future environmental regulatory requirements. It also shows that this can be done with relatively low cost increases. (*Commenters: Amanda Garcia - Southern Environmental Law Center, Chris Ann Lunghino - Sierra Club Beyond Coal Campaign, Robert J. Martineau, Jr. - Tennessee Department of Environment and Conservation*)

Response: Comment noted.

2.5. Integrated Resource Planning

2.5.1. Data Inputs and Assumptions

86. Appendix A of the Draft IRP Report is a summary letter report from Navigant Consulting which is included to support TVA's claim that the energy resource cost and performance data used in the IRP modeling are "representative" of proprietary and industry sources (p. 42). We question this "representative" claim as a third of the values differed by more than 10% and almost a quarter differed by more than 20%. For wind energy, almost half the values differed by more than 20%. For nuclear energy, an energy resource where TVA has historically had cost overruns, delays, and suspensions, 12 or 31 values differed by more than 20% with TVA's values typically lower than recommended. The magnitude of these differences has likely had large impacts on the modeling results. (*Commenters: Zachary M. Fabish - Sierra Club et al., Dennis Lynch, Simon Mahan, Stephen A. Smith - Southern Alliance for Clean Energy*)

Response: As stated in IRP Appendix A, Navigant's review included approximately 264 variables for all resource types included in the study. In some cases a 10–20% variation results in a very small difference, such as between an 8% outage rate for a gas plant versus a recommended rate of 10%. For wind energy, the primary sources of variation were around outage rates and capital costs with Navigant recommending higher values than those TVA proposed. For nuclear, the variations centered on outage rate and cost assumptions with Navigant recommending higher costs than TVA was proposing. TVA incorporated this feedback before finalizing the values used in the study. The letter in Appendix states:

> "On balance for all the generating and storage resources examined, the substantial majority of the proposed TVA parameter values for which comparisons were performed were consistent with recommended values—about two-thirds of all compared values. For those parameters with material differences in values of 10% or more, a number of those were to some degree offsetting within a given resource/technology. The TVA values reviewed were provided in spring 2014, and the summary above relates to recommendations and comparisons based on the values provided at that time. Since then, TVA has modified numerous values to be used in its IRP modeling, in part

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> reflecting the outcome of this review. TVA staff was extremely helpful and responsive both in providing supporting information needed in the review/comparison process, and in providing useful feedback and clarification on the draft workbook deliverable and the constituent parameter values. It is clear that TVA is striving to fairly represent all of the potential new generating resources in its IRP modeling, thus laying the basis for meaningful IRP modeling of resource expansion alternatives."

TVA incorporated Navigant's recommendations into the analysis to adjust many of the original inputs. The final capital cost values have been added to Appendix A for additional clarity and in response to this and other comments.

87. In the Draft IRP, TVA claims to be using 'industry-standard' cost estimates. Whether this is the case for wind and solar energy is questionable, as their cost estimates appear to be significantly inflated. It would be more accurate to model the projected cost of alternative energy resources at the time that competing conventional resources could be brought on line. Wind and solar are currently cost-competitive with gas and this difference is increasing. (*Commenters: Joseph R. Schiller, Ph.D.*)

Response: As stated in the IRP text and in response to other comments, all of the input assumptions were subjected to third-party review before inclusion in the study. The cost estimates for wind and solar are not significantly inflated. The revised Appendix A includes an additional benchmark range on wind and solar capital costs from a Fall 2014 Lazard report indicating that TVA's analysis includes costs lower than, within, and slightly above the projected 2015 capital costs for wind and solar. TVA also conducted sensitivity analyses around wind and solar capital costs assumptions, the results of which are discussed in Section 8.3 of the IRP report. Finally, it is important to note that solar and wind are the only resources forecast to decline in cost (in real terms) over time. Solar capital costs are assumed to decline at 3.5%/year through 2020 and remain flat from 2020-2030 (i.e., not rise with inflation) and wind capital costs rise at less than the rate of inflation.

88. The Draft IRP on page 37 in the discussion of transmission costs states "Transmission: A new generating resource has to be connected to the transmission system. Costs are typically expressed as dollar per kilowatt ($/kilowatt)." This statement seems to imply transmission costs are the same for all energy resources. This is not the case for distributed resources. (*Commenters: Joseph R. Schiller, Ph.D.*)

Response: Comment noted. Distributed resources do not connect to the TVA bulk transmission system and therefore do not experience these interconnection costs. TVA did not model distributed resources as selectable, supply-side resources in the model, so analyzing the cost of connecting distributed resources to the lower voltage distribution system is not necessary. Distributed resources are included in scenario the Distributed Marketplace scenario.

89. A recent SNL Energy report estimated likely prices for CO_2 emissions in the southern U.S. to have a base case range of $29-33/ton. This cost is considerably higher than the CO_2 costs that TVA is predicting in the current outlook. The use of higher CO_2 emissions costs would greatly reduce the cost difference between Strategy A and Strategies D and E and impact the choice of the least-cost scenario. (*Commenters: Synapse Energy Economics, Inc.*)

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Response: TVA uses the carbon forecast in the Current Outlook scenario as a reasonable proxy for a carbon-constrained future, whether as a result of regulatory or legislative actions. This forecast was derived by reviewing forecasts from several third-party vendors and then determining a mean of those forecasts. It is important to note that many forecasts of carbon pricing are forecasts for all sectors of the economy, which may differ from forecasts specific to electric utilities. TVA translates these forecasts into a dispatch adder reflecting that about 50% of the energy generated or purchased by TVA comes from carbon-free sources. TVA continues to forecast that a carbon-constrained future will give credit for these non-emitting resources. TVA also evaluated a scenario (Scenario 4, De-Carbonized Future) which specifically examined the impacts of a much higher carbon penalty. With the combination of TVA's non-emitting generation/purchases and the sector-specific impact to TVA, the carbon forecast in the Current Outlook accurately represents the impact of a carbon-constrained future.

90. Despite lacking the actual prices, the coal price assumptions illustrated on page 57 of the Draft IRP show very stable future coal prices with little variation between scenarios. The overall trend appears to be similar to that of the DOE 2015 Annual Energy Outlook reference case. The AEO report, however, appears to show a greater chance of increased future coal prices in the East South Central region (encompassing the TVA area) than does the TVA forecast. TVA's modeling should incorporate this potential for higher coal prices. TVA's coal plants receive coal from a variety of sources with different price trends and forecasts and it is unclear whether TVA's coal price forecasts account for the actual delivered prices to individual coal plants. It is also unclear whether TVA's 2014 delivered coal price illustrated on page 57 reflects TVA's actual average delivered price of about $2.40/MMBtu. (*Commenters: Synapse Energy Economics, Inc.*)

Response: The Annual Energy Outlook attributes long term coal price growth to declining productivity in key supply basins and not to a potential cost of carbon. All but one of the IRP scenarios include various levels of the cost of carbon, modeled as a tax, which increases the cost of generation dispatch in proportion to the carbon content of the fuel used. The additional cost moves coal units farther out the dispatch stack, reducing their probability of dispatching and reducing demand for coal. Lower demand will reduce the need to mine coal blocks with higher production costs/lower productivity, reducing the chance of increased future coal prices. The 2014 price reflects TVA's projected volume weighted average delivered price across all plants at the time the analysis was performed of ~$2.20/MMBtu. TVA uses an integrated modeling approach in developing delivered prices to each coal plant which iterates price and volume between the coal, gas and power models. Additionally, TVA ran a stochastic simulation that produced a range of possible prices above and below the expected price, as well as their probability of occurrence.

91. Draft IRP Figure 6.5 shows coal prices continuing to rise in the decarbonized economy scenario. This requires explanation. Is it because the carbon price is included in the cost of coal? This suggests adding a cost of carbon has no net effect on the highest carbon-emitting resource. This defies logic as the purpose of the carbon price is to increase the cost of carbon-emitting resources. (*Commenters: Joseph R. Schiller, Ph.D.*)

Response: Figure 6.5 is shown on a nominal basis, which incorporates each scenario's projection of economic growth and inflation. On a real basis, the trajectory of delivered coal prices in the De-Carbonized Future scenario is essentially flat and is lower than all other

scenarios except the Stagnant Economy scenario. The carbon tax does tend to lower the demand for coal and its price, but the Growth Economy scenario has the opposite effect. Other factors, such as increasing transportation costs also impact the delivered cost of fuel. The inclusion of a carbon tax increases the cost of coal dispatch, rather than the cost of coal, leading generators to switch to lower cost coals or alternate fuels. The De-Carbonized Future scenario also includes increased energy efficiency and distributed generation and lower economic growth, all of which reduce coal demand relative to the reference case due to reduced generation. Reduced coal demand and movement to lower cost coals reduce the delivered cost of coal into TVA's plants. The net effect of adding a cost of carbon is reduced coal demand, contributing to the goal of a decarbonized economy.

92. While the IRP has a metric for coal waste, it is not clear how the costs of coal waste disposal, including the costs of leaks/spills from coal ash ponds, are included. Similarly, it is not clear how the cost of coal plant air pollution, handling spent nuclear fuel rods, and the costs of river water temperature increases due to steam plant cooling are included. (*Commenter: Dennis Lynch*)

Response: Costs for coal ash handling are included in the costs of operating coal units. The costs associated with the Kingston ash spill are being recovered through rates as disclosed in TVA's financial filings. Specific costs associated with air pollution equipment are included for those units requiring additional investment (primarily the seven less controlled units at Shawnee Fossil Plant). Nuclear fuel and fuel handling are included with nuclear costs. There is no direct cost modeled for river water temperature increases.

93. TVA has burdened energy efficiency with improper cost assumptions and restrictive growth caps, resulting in the inclusion of unnecessarily small amounts of this least-cost energy resource. Energy efficiency can save customers significant amounts of money on their electricity bills in the short-term and can help TVA cost-effectively meet energy demand in the long-term. (*Commenters: Southern Alliance for Clean Energy Campaign Emails*)

Response: TVA's cost and performance assumptions for energy efficiency are described in IRP Appendix D. TVA appreciates that some stakeholders have concerns with these assumptions and has conducted sensitivity testing (described in IRP Section 8.3) to determine the impact of changes to some of these key assumptions. As detailed in Section 8.3, changing these assumptions does not appear to materially alter the trajectory of EE over the study period and the original EE case results still form an effective boundary for the analysis.

94. The Draft IRP does not take into account the evolving industry standards on solar generation. It calculates future impacts using assumptions for solar systems installed under the current IEEE 1547 electric code. The pending implementation of the updated IEEE 1547 standards will introduce modern power electronics that greatly improve solar performance and enhance the value of solar to the TVA system. (*Commenter: Gil Hough - Tennessee Solar Energy Industries Association and Solar Energy Industries Association*)

Response: IEEE standard 1547 addresses interconnection standards for distributed resources, including solar. As discussed earlier, the IRP does not model distributed resources as selectable supply side options because these resources are not owned or deployed by TVA. TVA recognizes that smart inverters can have a positive impact on grid power quality and improve interconnection of distributed solar resources. The advent of smart inverters was

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preceded by problems caused by heavy PV penetration in western state markets such as California and Arizona. Smart inverters help mitigate voltage and reactive power problems, and the value of smart inverters is heavily dependent on their location within the grid. The IRP models solar at a generic location because locational differences across the grid cannot be accounted for in the system-wide modeling construct.

95. The Draft IRP states that the majority of future solar capacity additions will be obtained through PPAs and purchases through the Green Power Providers program. TVA needs to ensure that its solar PPA assumptions properly represent the relationship between capital cost estimates and the resulting energy price offered to TVA. We again request that TVA disclose this information to ensure its PPA assumptions reflect true market prices. We note that the TVA-NextEra 80-MW solar project is priced at $61/MWh. TVA should also adopt a PPA duration of at least 25 years, rather than the current 20 years, to better reflect its assumed 25-year book life for solar technologies. (*Commenter: Stephen A. Smith - Southern Alliance for Clean Energy*)

Response: The capital costs used for solar resources are stated in Appendix A, along with benchmark information from a publically-available source. As with other resources, the costs used were reviewed by a third-party reviewer and the IRP Working Group prior to being used in the analysis. As IRP Section 5.2.2 states, the book life of solar assets is assumed to be 25 years. The assumed PPA term for solar is also 25 years. Finally, in response to this and related questions from stakeholders, a specific sensitivity case was run with solar pricing similar to those offered by the commenters. Results are discussed in IRP Section 8.3.

96. TVA's assumed costs for PV solar systems appear to be similar to those proposed during the Tennessee Valley – Renewable Information eXchange process in November 2013. Due to delays in TVA's IRP schedule, current market data shows that solar costs are significantly lower at ca. $1.55/watt$_{DC}$ for utility scale fixed-axis, $1.83/watt$_{DC}$ for utlity scale 1-axis, $3.48/watt$_{DC}$ for residential and $2.25/watt$_{DC}$ for commercial. The use of updated solar costs would provide a more accurate representation of the cost competitiveness of solar energy. These lower current costs confirm that solar prices continue to drop at a faster rate than the draft IRP predicts. (*Commenters: Amanda Garcia - Southern Environmental Law Center, Gil Hough - Tennessee Solar Energy Industries Association and Solar Energy Industries Association, Mary M. Mastin - Tennessee Chapter of the Sierra Club, Joe W. McCaleb - League of Women Voters in Tennessee, Cortney Piper - Tennessee Advanced Energy Business Council, Stephen A. Smith - Southern Alliance for Clean Energy*)

Response: TVA included a wide range of solar costs in the IRP analysis, including sensitivity cases with very low costs. The range of capital costs considered in the analysis is listed in IRP Appendix A and includes the range of costs referenced in the comment. There always is an unavoidable gap between data inputs and the results of analyses.

97. While TVA appropriately adopted an escalation rate forecast for solar development that recognizes a continuing cost decline, TVA's forecast is 2% higher (more costly) than that recommended through the TV-RIX process. It also does not reflect the considerably greater cost decrease that occurred in 2014. Using more current escalation rates would likely have resulted in the inclusion of more solar capacity expansion. (*Commenter: Stephen A. Smith - Southern Alliance for Clean Energy*)

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Response: TVA does not understand the claim of the forecast being 2% higher (more costly) than the recommended range from the TVRIX process. As explained to the IRP working group (in which the commenter's organization participated), the de-escalation rates on solar followed the TVRIX recommendations through 2030. As described in the responses to other comments, TVA conducted additional sensitivity analyses on solar pricing that are discussed in IRP Section 8.3.

98. TVA's assumptions in determining the net dependable capacities for wind and solar energy ignore the likelihood of variability in wind and solar resources canceling out. In many hours, below-average wind generation, for example, will be compensated by above-average solar generation (or vice versa). Analysis of 15 years of data showed that combined wind and solar resources reduce system risks far more often than their variability increases risks. Further analysis shows that at high system load factors combined wind and solar resources have relatively little variability and remain within 20% of the median value during the vast majority of hours in the 15-year dataset. (*Commenter: Stephen A. Smith - Southern Alliance for Clean Energy*)

Response: TVA models the individual characteristics of each resource type within the context of an overall system portfolio optimization that reflects the entire TVA system. The resource planning algorithm selects the least-cost combination of resource types that maintains the reliability of the system. The referenced analysis above is an over-simplified approximation of the detailed analytics behind the hourly system dispatch conducted in each of the IRP study cases. TVA's industry-standard models take an extremely refined look at all possible resource combinations and the resulting cost and reliability of those combinations.

99. In the Draft IRP, TVA states that because it cannot take direct advantage of federal financial incentives to encourage wind power development, it is financially advantageous for TVA to acquire wind energy through power purchase agreements. The Draft IRP, however, does not appear to consider the extension of the recently expired wind energy production tax credit. This credit has been extended each time it has expired over the past twenty years and it is reasonable to consider its extension in the IRP modeling. By failing to analyze its potential extension, TVA has artificially inflated future wind energy prices. TVA should analyze its extension effective on a near-term date such as January 1, 2016, as well as its availability after completion of the Clean Line HVDC ca. 2021. This would enable TVA to procure tax credit-enabled lower cost wind energy power purchase agreements as they become available. (*Commenters: Zachary M. Fabish - Sierra Club et al., Synapse Energy Economics, Inc.*)

Response: As discussed in IRP Section 5.2.2, the comment correctly notes that TVA cannot take advantage of federal tax credits directly. The IRP base case scenario reflects currently effective federal tax policy and therefore does not assume that the expired wind production tax credit is reinstated. TVA did analyze a scenario assuming lower costs for wind (through extending the wind production tax credit, for example) as part of the sensitivity case work described in IRP Section 8.3. As expected, lower costs for wind power resulted in earlier adoption of additional wind.

100. It is unclear whether the IRP data inputs for wind energy addressed the characteristics of current state-of-the-art wind technologies and anticipated future capacity increases and cost reductions for wind energy. Information previously provided to TVA through the TVRIX process showed anticipated capacity factor increases for HVDC and MISO wind energy of 4-5% by

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2019 and another 4-5% by 2023, with levelized cost of energy (LCOE) decreasing by 10-12% over each period. In-Valley capacity factors were anticipated to increase by 9-10% by 2019 and another 9-10% by 2023, with LCOE decreasing by 11-13% over each period. More recent forecasts in the 2015 DOE Wind Vision Report show even greater reductions. (*Commenters: Vincent Harriman, Chris Ann Lunghino - Sierra Club Beyond Coal Campaign, Simon Mahan, Synapse Energy Economics, Inc.*)

Response: TVA formed the Tennessee Valley Renewable Information Exchange (TVRIX) in 2012 to provide input and recommendations on renewable energy (see IRP Chapter 3), including on wind energy generated both within and outside the TVA service area. TVA staff and an independent external reviewer (Navigant Consulting, Inc.) reviewed the recommendations and made adjustments based on available industry information from NREL, Lawrence Berkeley National Lab, and other sources. Unlike all other future capacity costs, the cost for wind and solar was assumed to decrease in real terms based upon the TVRIX recommendation and findings by the reviewers. TVA recognizes that wind technology has been improving dramatically over the past 10 years and will likely to continue to do so, but perhaps at a decreasing rate for both cost and efficiency improvements as rotor diameters are limited by material strength, rotor heights are limited by engineering concerns and regulations, and innovations in installation slow causing the installation costs to be more aligned with inflation. The 2015 DOE Wind Vision Report was not available at the time of the deadline for IRP inputs in early 2014. There always is a gap between inputting data for analyses and completing them. Without a deadline for inputs, completing analyses would become impossible because newer, more recent data would constantly require restarting analyses. However, TVA will continue to entertain proposals for wind generation and work with industry groups to stay abreast for opportunities to use more wind as part of a diverse, economical, and reliable generating portfolio.

101. Much of TVA's wind data inputs are based on pre-2012 technology and are essentially frozen for the duration of the planning period. Contrary to recommendations of the TV-RIX, TVA's approach excludes technology learning and market adaptation to new wind regimes, such as the development of wind turbines optimized for lower wind speed sites. Based on such developments, TVA should model wind energy cost reductions in the range of 6-19% and performance improvements in the range of 1-18% between now and 2020. (*Commenters: Southern Alliance for Clean Energy Campaign Emails, Stephen A. Smith - Southern Alliance for Clean Energy*)

Response: TVA elected to include only known technology available at the time of the IRP analysis. This includes technology available in 2013 and 2014. This is consistent with our natural gas assumptions, for instance, that do not reflect future improvements to unit efficiencies (heat rates) or unit ratings. TVA did conduct sensitivity analysis around better performance for wind resources and the final IRP recommendation is to monitor key variables regarding the pricing and performance of renewable resources, natural gas and other fuel prices, and impacts from breakthrough technologies to maintain a flexible portfolio consistent with least-cost planning.

102. The cost of HVDC wind energy is competitive with any other form of new generation available to TVA. A recent wind power purchase agreement for a windfarm near the western end of the proposed Plains & Eastern Clean Line is $23.35/MWh for 20 years. Based on responses to recent Requests for Information by Plains & Eastern, the average price for wind

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energy generated in this same area is $24/MWh for 25 years. Transmitting this energy via HVDC to the TVA system would add cost approximately $20/MWh and this cost includes necessary upgrades to the TVA transmission system. The total likely cost for high capacity HVDC wind is $40-45/MWh with no exposure to the risk fuel price volatility or potential carbon dioxide regulation associated with natural gas generation. TVA should ensure it is using appropriate costs for HVDC wind energy. (*Commenter: David Berry - Clean Line Energy Partners*)

Response: Comment noted. As discussed in IRP Appendix A, TVA has included appropriate, benchmarked costs for HVDC wind and all resource types in the analysis. Wind resources have no fuel or carbon costs assigned to them.

103. The Draft IRP underrates the annual capacity factors for In-Valley and MISO/SPP wind energy. TVA derived these capacity factor assumptions from its current wind energy PPAs which use technology deployed before 2012. In contrast, TVA used up-to-date technology assumptions for determining the annual capacity factor for HVDC wind. More recent data from NREL and others shows appropriate annual capacity factors of at least 32% and rising to 40% by 2030 for In-Valley wind, and 44% rising to 50% by 2030 for MISO/SPP wind. (*Commenters: Vincent Harriman, Simon Mahan, Stephen A. Smith - Southern Alliance for Clean Energy*)

Response: TVA derived the wind capacity factors with input from TV-RIX, internal expert review, and an independent external reviewer (Navigant Consulting, Inc.). Data from NREL at the time of the IRP analysis showed a maximum of 30% capacity factors available for Southeastern projects. Some stakeholders provided information on a potential low-wind-speed turbine soon to be available from GE; however upon direct inquiry to GE, they were unable to provide verifiable data on this particular wind turbine model at the time. It is likely that over the course of a two year study certain inputs may change, but the uncertainty analysis captures variation in key inputs. See also the response to Comment 100.

104. TVA should update its calculation of wind Net Dependable Capacity to ensure that the appropriate capacity value is assigned to the HVDC wind energy option. Instead of its unique NDC calculation methodology, TVA should use a more standard method such as the effective load carrying capability calculation used by MISO, ERCOT, and others. TVA should also use wind profiles representative of each wind resource area rather than the composite of TVA's current wind energy purchases, include over-subscription contracts to reflect proposed commercial contracts, and evaluate load throughout the entire year to select peak hours rather than just the summer hours. The resulting NDC for HVDC wind would be approximately 28 percent instead of 14 percent. (*Commenters: David Berry - Clean Line Energy Partners, Simon Mahan, Max Shilstone - Clean Line Energy Partners, Stephen A. Smith - Southern Alliance for Clean Energy*)

Response: TVA has discussed this issue at length with many of the commenters. As they are aware, TVA does use specific wind profiles by resource area to determine net dependable capacity. The resulting differences in net dependable capacity are small, between 8% and 17%, so TVA elected to use 14% for each resource type as described in IRP Appendix B. The commenters' methodology, including focusing on non-peak hours instead of the peak hours, is non-standard and produces a non-standard result. TVA's net dependable capacity credit is consistent with capacity values in other reliability coordination areas throughout the country, including areas where future wind farms may be located. TVA has current experience with

over-subscription contracts and has seen offers for future over-subscribed contracts that could deliver higher net dependable capacities by constructing additional turbines. In each case, these contracts are more expensive than similar contracts that are not over-subscribed. The pricing assumptions used in the analysis do not assume the characteristics or costs of an over-subscription model. TVA will continue to evaluate contracts as they are structured to determine the best value to the ratepayer of any contract structure. Finally, TVA did evaluate sensitivity cases examining the effect of increasing wind net dependable capacity without a corresponding increase in cost. These results are discussed in Section 8.3 of the IRP report.

105. TVA's existing wind energy power purchase agreements expire by the end of the IRP planning period. Several of the capacity expansion plans do not include wind energy, resulting in TVA's energy portfolio containing no wind energy at the end of the planning period under several combinations of strategies and scenarios. This situation is contrary to that of utilities across the county, including other large utilities in the southeast. It is likely at least partly attributable to the incorrect and/or outdated assumptions TVA used in modeling wind energy. (*Commenter: Simon Mahan*)

Response: The commenter is correct that most of TVA's existing wind agreements expire by the end of the study period. The cases where no new wind is added are associated with the Distributed Generation and Stagnant Economy scenarios where TVA experiences very low or no load growth over time and the need for additional energy resources is low. In these cases, additional wind generation (which is predominantly off-peak) is not selected. Lower amounts of natural gas and solar resources are also selected in these cases. The primary driver is the overall lower resource needs.

106. We question the pricing used in modeling wind energy, which TVA has not publicly disclosed. Does it represent actual prices offered to TVA by wind developers or is it based on historical prices? A recent analysis by Lazard shows unsubsidized 2013 wind power purchase agreement prices from around the country of $37-$81/MWh. 2012/2013 prices published by Lawrence Berkeley National Laboratory in 2014 show all-in delivered costs of wind energy for HVDC/SPP and MISO resources in the $40s-$50s/MWh range. In-Valley wind should be benchmarked in the upper-$50s-$60s/MWh range. TVA should base its wind energy pricing on these current delivered costs (including anticipated future cost decreases) and offered prices, and publish these costs in the Final IRP. (*Commenters: Zachary M. Fabish - Sierra Club et al., Amanda Garcia - Southern Environmental Law Center, Sandra K. Goss - Tennessee Citizens for Wilderness Planning, Sandra Kurtz, Simon Mahan, John F. McFadden, PhD, Joseph R. Schiller, Ph.D., Max Shilstone - Clean Line Energy Partners, Stephen A. Smith - Southern Alliance for Clean Energy, Daniel Tait - Alabama Center for Sustainable Energy*)

Response: TVA has added capital cost information for wind to IRP Appendix A.

107. We appreciate the fact that TVA has initiated the Distributed Generation Integrated Value (DG-IV) analysis. We are concerned with the recent slow progress of this analysis. Had it been completed earlier, it would have provided useful information and better consideration of the value of distributed generation in the IRP. (*Commenters: Ralph Bowden - Cookeville Meeting of the Society of Friends, Tim Holt, Steve Johnson – Lightwave Solar, Mary M. Mastin - Tennessee Chapter of the Sierra Club, Joe W. McCaleb - League of Women Voters in Tennessee, Dennis McCorkle, Lucille York*)

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Response: Comment noted.

2.5.2. Distributed Generation

108. Although there are few in the TVA region at present, net-zero energy buildings are likely to become more numerous. These buildings are constructed with very low energy demands, which are typically met by on-site solar PV generation, backed up by the area power grid. As they become more common, their electrical infrastructure costs will increasingly be transferred to the rest of the TVA customer base. TVA should be considering how it can best recover the true cost that these buildings impose on its power grid and customers. (*Commenter: William Murphy*)

Response: TVA is monitoring the emerging trends around net-zero buildings, and is developing methods to forecast the impact of these buildings on energy consumption in the TVA service area.

109. The discussion of distributed generation penetration on page 120 of the Draft IRP report states that regulation of CO_2 emissions is the most likely driver of growth in renewable energy. Please explain the role of the impacts of resiliency and energy surety as drivers for increased renewable generation. How are the economic benefits of resiliency and energy surety considered in the IRP analyses? (*Commenter: Robin D. Cox - City of Huntsville, Alabama - Huntsville Operation Green Team*)

Response: The design of DG assumptions integrated into the IRP scenarios was intended to leverage key drivers that were already being developed as part of the scenario constructs, such as CO_2 regulations. TVA also reviewed national studies to get ideas about how to develop the DG penetration levels that would be reasonably representative of what could occur in the TVA service area, recognizing that there are a number of other considerations that would play into specific DG site selection decisions, such as system resiliency and energy security. The IRP does not attempt to capture those selection details, but rather does a more generalized analysis around DG impacts.

110. The draft IRP defines distributed generation as customer-driven generation produced on the distribution network, including residential and commercial solar photovoltaics and industrial natural gas. In its analyses, distributed generation is treated as a load loss. This treatment ignores the ability of distributed generation to perform as an energy resource that benefits the TVA system, and that has many of the same attributes as energy efficiency. These attributes include avoided energy, avoided generation, avoided transmission and distribution capacity, avoided line losses, and avoided environmental compliance costs. TVA should incorporate new distributed resources into its load forecasts and ensure it is fairly considered and analyzed as a selectable resource. (*Commenter: Amanda Garcia - Southern Environmental Law Center*)

Response: The IRP is not a locational-based study, and therefore site-specific impacts and benefits cannot be properly captured in the analyses. TVA is continuing to explore options for the modeling of distributed energy resources in the context of its long-range planning studies, including improvements to demand and energy forecasting to better reflect distributed generation impacts. In addition, TVA is conducting separate studies to help address some of the locational impacts and benefits.

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2.5.3. Modeling Coal Retirements

111. The modeling of potential coal unit retirements appears constrained to allow units to be retired economically only after 2020. Consequently, the model is not allowed to decide whether to economically retire Shawnee Units 1 and 4 prior to 2020 and before TVA spends hundreds of millions of dollars to retrofit them. Under the terms of the Clean Air Agreements, TVA must retrofit these units, repower them to burn renewable biomass, or retire them by December 31, 2017. In December 2014, TVA announced its decision to retrofit the two units. Despite requests to disclose economic evaluations of the retrofit proposal in late 2014, TVA has never justified the retrofits as economic. The capacity expansion plans indicate that the economics of these retrofits are marginal, and in many plans they are retired in 2026. Given that TVA has yet to spend large amounts of money on the retrofits, TVA should use the IRP process to determine whether the retirements of Shawnee Units 1 and 4 is the least cost option. (*Commenters: Zachary M. Fabish - Sierra Club et al., Synapse Energy Economics, Inc.*)

Response: The IRP modeling construct incorporates TVA Board decisions, including to control Shawnee units 1 and 4, in the Base Case. The details of the Shawnee decision can be found in the 2014 environmental assessment available at http://www.tva.com/environment/reports/shawnee_units1+4/index.htm. All of the Shawnee units were allowed to be retired starting in 2017 if economic. The remaining units can either be controlled or retired but that decision does not affect the ability to continue to operate the two controlled units.

112. While allowing the modeling to make decisions about retiring coal units is commendable, the process used by TVA may overly restrict the ability of the model to make least-cost decisions. TVA has provided little information about the parameters used in modeling existing coal units or which costs can be avoided by their retirement. Unexplained parameters include compliance with the finalized coal combustion residuals rule and the pending effluent limitation guidelines, as well as revisions to the Cross-State Air Pollution Rule and ozone and sulfur dioxide standards. It is unclear whether the model can select individual coal units for retirement or must retire whole plants comprised of individual units. The IRP repeatedly addresses coal “idling” rather than “retirement” decisions, and it is unclear how the increased security and maintenance costs of idling compare with those of retirement. It is also unclear whether the modeling seeks to avoid major capital investments during the final few years of a unit’s life. The IRP does not state whether TVA is bound to long-term contracts for its coal plants and how the associated costs are modeled. Nor does it describe whether the anticipated costs of retirement include associated transmission system improvements or the costs of post-retirement site remediation. (*Commenters: Synapse Energy Economics, Inc.*)

Response: The selection of coal units for retirement avoids the cost that would have been incurred if the plant were operational (e.g., on-going plant and fixed operation and maintenance costs, clean air capital improvements, ash mitigation and compliance, water compliance costs). Coal unit configurations vary by plant but are typically based on groups of units connected to the same smoke-stack. Retirement and idling costs are the same in the model. Each unit selected for idle/retirement incurs costs that include transmission upgrades as well as closure costs. TVA owns all of the coal units that are considered for idling/retirement. Only one coal plant is not owned by TVA, and that contract was assumed to be in effect until it ends in 2032.

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2.5.4. Modeling Energy Efficiency

113. While the draft IRP's approach to modeling energy efficiency is laudable, it falls short of satisfying TVA's statuary obligation to treat energy efficiency on a consistent and integrated basis. While TVA claims to treat energy efficiency as a supply-side resource, TVA has burdened energy efficiency with several costs and constraints that are not adequately justified. In contrast to its treatment of risk for supply-side resources, TVA arbitrarily attached a "planning factor" cost adder to energy efficiency based on unsupported "design and delivery" uncertainty. The design uncertainties incorporated into the planning factor address the use of proxy programs in block design, measured life uncertainty, and fixed shape uncertainty. These uncertainties do not exist, are otherwise captured in the model, or are benefits of energy efficiency rather than risks. The delivery uncertainties are LPC delivery performance, realization rate, and codes and standards. LPC delivery performance is already accounted for in the conservative 25% year 1-5 ramp rate. TVA already markets many energy efficiency programs directly to customers and could use these efforts to mitigate LPC delivery performance. Risk regarding realization rates is already captured, or should be, in the characteristics of the blocks themselves. Codes and standards create no additional risk and would more likely result in additional energy efficiency and a load decrease. Risk-mitigating characteristics of energy efficiency, relative to supply-side resources, include reduced fuel price volatility, forecasting uncertainties, future environmental regulation, and stranded assets. These positive aspects are omitted from the evaluation. (*Commenters: Brendon Baatz - American Council for an Energy Efficient Economy, Amanda Garcia - Southern Environmental Law Center, Louise Gorenflo - Tennessee Interfaith Power & Light, Mandy Mahoney - Southeast Energy Efficiency Alliance, Joseph R. Schiller, Ph.D., Stephen A. Smith - Southern Alliance for Clean Energy*)

Response: Comment noted. TVA has provided extensive documentation in IRP Appendix D, in IRP Working Group conversations and seminars, and in other public venues substantiating the rationale for the inclusion of the planning factor. The commenters provide no justification for their insistence that the planning factor is not necessary other than a statement that the underlying uncertainties simply "do not exist, or are otherwise captured." TVA disagrees that inclusion of these factors does not meet its statutory obligations. The modeling conducted in this IRP is intended to further strengthen TVA's ability to meet all statutory obligations and to analyze all energy resources on a consistent basis as selectable resources. The growth and ramp rate assumptions are discussed in previous comment responses and are separate from the planning factor in basis and rationale. Codes and evolving efficiency standards represent a real risk to the assumptions. The study assumes that energy efficiency programs can be deployed beyond whatever the future codes may be. If codes tighten, then it is reasonable that the next-best energy efficiency alternative will either be more expensive or less available because the baseline code has been adjusted. This is discussed further in IRP Appendix D. The commenter is incorrect that benefits of energy efficiency, including reduced fuel price volatility and environmental risk /cost are excluded from the analysis. They are explicitly included. It is curious that the commenters add a risk-mitigating benefit of "reduced stranded assets," however, since energy efficiency reduces overall energy sales at the same time that it increases capital costs to deploy additional EE resources. Taken together, these tend to increase the risk and impact of stranded costs.

114. A second area in which TVA has burdened energy efficiency with costs and constraints that are not adequately justified is in the draft IRP's failure to account for all of the supply-side

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costs that investment in energy efficiency would avoid. The draft IRP identifies two categories of avoided costs: avoided energy and avoided capacity. It undervalues each of these by failing to account for marginal line losses and the full avoided costs of transmission and distribution. The draft IRP suggests avoided transmission and distribution losses can average 6.5%. However, because the marginal line loss rate is much higher, a loss rate of at least 10% to 20% to fully quantify line loss rates during times of peak demand would be more accurate to quantify the avoided capacity benefits of energy efficiency. The draft IRP has apparently considered transmission costs associated with supply-side resources. It is unclear how reduced transmission costs, as well as reduced distribution costs, are accounted for in the energy efficiency analysis. (*Commenters: Amanda Garcia - Southern Environmental Law Center, Stephen A. Smith - Southern Alliance for Clean Energy, Synapse Energy Economics, Inc.*)

Response: The IRP model accounts for avoided transmission and distribution losses using a system average approach. The IRP does not model location-specific criteria for any resource type, including energy efficiency; this ensures that all resources are treated consistently. In some areas marginal line losses may exceed the average; in other cases they may be below the average. For long term resource planning TVA therefore uses the system average. New generating resources include transmission costs as part of their cost structure. Energy efficiency, because it is behind the meter load reduction, is not assessed these costs.

115. A third area in which TVA has burdened energy efficiency with costs and constraints that are not adequately justified is by restricting its growth to 25% of the previous year for years 1-5, to 20% for years 6-15, and to 15% per year thereafter. These limits are based on the ability of TVA and program partners to expand the delivery infrastructure and the expectation of increasing consumer/participant awareness. These ramp rate limits are unrealistically low compared to those being achieved by numerous utilities across the nation. More recent sensitivity analysis by TVA has shown using a 40% ramp rate in years 1-5 would result in much greater energy efficiency selection in the early-to-middle years of the planning period. A previous 2012 TVA energy potential study showed higher ramp rates were technically achievable and could result in much greater achievable savings. (*Commenters: Zachary M. Fabish - Sierra Club et al., Amanda Garcia - Southern Environmental Law Center, Louise Gorenflo - Tennessee Interfaith Power & Light, Mandy Mahoney - Southeast Energy Efficiency Alliance, Synapse Energy Economics, Inc., Daniel Tait - Alabama Center for Sustainable Energy*)

Response: IRP Appendix D addresses the energy efficiency ramp rates used in the study. TVA appreciates the view of the commenters that faster ramp rates can be achieved but believes that the values used in the study represent a reasonably aggressive growth rate over time. It is important to note that while the percentage growth rate slows over time, the absolute GWh growth rate grows in each year of the 20-year study. As described in the IRP, EE is not a resource TVA controls. TVA can influence deployment of EE but must rely on LPC partners and end-use customers to implement programs. This is part of the rationale for a measured approach to EE deployment. The total volumes of energy efficiency available in the IRP (after applying ramp rates) were mapped to TVA's current EE potential study to validate their reasonableness. Finally, TVA completed a sensitivity case with faster ramp rates; this case results in small increases in EE by 2033 with slightly more selected near to mid-term.

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116. In light of the identified costs and constraints imposed on energy efficiency, the final IRP should treat energy efficiency on a consistent and integrated basis by making the following changes:
- Remove the planning factor
- Fully account for the transmission and distribution benefits by applying a 10% adjustment for energy benefits based on marginal line loss; applying a 20% adjustment for capacity benefits based on marginal line loss; valuing avoided transmission at $20.21 per kW-year; and valuing avoided distribution at $48.37 per kW-year.
- Adjust the initial ramp rate to 40% until TVA achieves savings equivalent to 1.5% of sales, then allow it to decline incrementally to 20%.
- Increase the total number of blocks available during the planning period to reflect the technically achievable energy efficiency identified in TVA's potential study. (*Commenter: Amanda Garcia - Southern Environmental Law Center*)

Response: The rationale for the planning factor described in detail in IRP Appendix D. TVA does not agree that inclusion of the planning factor is inappropriate. The planning factor addresses costs and risks that are specific to energy efficiency and do not apply to other resource types. Excluding it would diminish TVA's ability to perform resource planning on an integrated, consistent basis. See the response to Comment 114 on marginal line loss and transmission and distribution costs and other responses to comments on ramp rates. TVA did compare our energy efficiency blocks to TVA's most current potential study to assess their reasonableness. They align with the Achievable-High in the near term and Economic potentials in the long term.

117. The addition of the planning factor cost adder risk adjustment to energy efficiency resources before the initial strategy assessments and system optimization have been completed is an inappropriate resource planning practice. All energy resources have risks, such as fuel price volatility for natural gas-fired generation. If additional risk-related costs are added to one resource and not another, the two resources are no longer comparable. Any additional resource-specific risk adjustments should instead be considered in sensitivity analyses. (*Commenter: Brendon Baatz - American Council for an Energy Efficient Economy*)

Response: Comment noted. The inclusion of the planning factor before the optimization is run is designed to address known uncertainty with energy efficiency modeling and costs. Other resources have costs assigned to them in a similar manner. The best comparison is the use of a CO_2 cost penalty as a proxy for assumed CO_2 regulation. This is applied as a cost to CO_2-emitting resources in the model, similar to how the EE planning factor is applied. The two are similar in concept, and the use of a CO_2 cost adder is very prevalent in industry.

118. TVA's energy efficiency planning factor, in combination with the high energy efficiency cost forecast, results in the total modeled cost of energy efficiency during the second decade of the planning period that is roughly equivalent to the cost of replacement power and generation. Given the use of unreasonably high cost assumptions and the arbitrary planning factor adjustments, it is not surprising that Strategy D – Maximize Energy Efficiency fails to demonstrate significant cost savings and suggests substantial rate impacts. Had TVA used more reasonable program costs and either eliminated the planning factor or used a less restrictive planning factor, the cost of Strategy D would have been considerably lower and likely the lowest-cost choice among all strategies. (*Commenters: Louise Gorenflo - Tennessee*

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Interfaith Power & Light, Sandra K. Goss - Tennessee Citizens for Wilderness Planning, Stephen A. Smith - Southern Alliance for Clean Energy, Synapse Energy Economics, Inc.)

Response: Comment noted. See the responses to Comments 116 and 117.

119. As an alternative to the growth caps imposed on energy efficiency, we recommend TVA adopt an inverse cap structure in which a reasonable target is set for the end of the planning period and growth caps are set for each year based on a formula allowing for gradual incremental progress towards the ultimate target. Such an approach would balance TVA's ability to rapidly ramp up energy savings in the early years when achieving lower net savings. (*Commenter: Stephen A. Smith - Southern Alliance for Clean Energy*)

Response: This approach of setting an end-year target and then incrementing towards it would appear to invalidate the concept of modeling energy efficiency as a selectable supply-side resource. Modeling EE as a supply side resource was a specific request of many IRP stakeholders, including the commenter. TVA established a reasonable maximum ramp rate on EE based on research and experience. The total volumes of EE available in the study (after applying ramp rates) were mapped to TVA's current EE potential study to validate their reasonableness.

120. Confidential cost data provided to IRP Working Group members shows TVA's assumed costs for Tier 1 energy efficiency measures to be much higher than TVA's 2013 costs as reported by the Energy Information Administration. The Tier 1 residential costs are also much greater than the national average of $ 0.016/kWh reported by Lawrence Berkeley National Laboratory. (*Commenter: Synapse Energy Economics, Inc.*)

Response: There are several key differences between cost data to the EIA cost data included in the Lawrence Berkeley National Laboratory (LBNL) report, and the costs used in the IRP analysis. With regard to the EIA, the reported costs capture only a portion of the programmatic impacts and spend as EIA requests some program types be excluded. EE volumes reported to the EIA are "gross" (meaning at the customer's meter; these savings are independent of the customer's motivation/action absent the program) while the IRP volumes are "net," meaning realized at the transmission-system level.. The gross volumes are higher than the net volumes because the net volumes adjust for potential free-ridership, etc., through a "net-to-gross" factor. Adjusting for this difference is important for resource planning to ensure that modeled volumes represent direct savings attributable to the energy efficiency program. Calculating average rates using a net volume (as done in the IRP) results in a higher average cost than using a "gross" volume (as reported to the EIA).

In contrast to the LBNL report, it is important to note that a small percentage of TVA Residential Portfolio savings have come from residential lighting, which have historically made up a large portion (44%-60%) of the benchmark energy efficiency portfolio. Comparing TVA's projected costs, which exclude this previously low-cost option, to historic benchmark costs which do include this resource, creates an apples-to-oranges comparison. A recent LBNL report (The Total Cost of Saving Electricity through Utility Customer-Funded Energy Efficiency Programs, April 2015) states that excluding residential lighting-only rebate programs would raise the total cost of saved electricity by approximately 70%. TVA's energy efficiency costs have been added to IRP Appendix A.

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121. TVA's projected energy efficiency program costs are unreasonably high and not supported by evidence or industry experience. As described in its 2014 EnergyRight Solutions Highlights report, TVA has recently implemented energy efficiency programs for $0.018/kWh of gross savings, somewhat below the national average. The cost increases assigned to Tier 2 and 3 energy efficiency blocks in the Draft IRP are, in contrast, unreasonably high. The experience of other utilities, as recently reported by ACEEE, shows that energy efficiency program costs have remained relatively stable over time and show little to no positive correlation with program scale. Based on the costs of existing programs across the country, Tier 2 and Tier 3 levelized costs of net savings should be no higher than 3 and 5 cents/kWh of net savings, respectively. (*Commenters: Zachary M. Fabish - Sierra Club et al., Mandy Mahoney - Southeast Energy Efficiency Alliance, Stephen A. Smith - Southern Alliance for Clean Energy, Synapse Energy Economics, Inc., Daniel Tait - Alabama Center for Sustainable Energy*)

Response: As described in the response to Comment 120, the IRP energy efficiency volumes are expressed on a "net," rather than a "gross," basis in order to appropriately represent their impact on the generation system. Calculating average rates using the net volumes would increase reported average costs versus using gross volumes, and the 2014 EnergyRight Solutions report expresses energy efficiency volumes on a gross rather than a net basis. The Tier 1 costs in the IRP generally align to TVA's existing portfolio and cost estimates. As described in IRP Appendix D, Tiers 2 and 3 are representative of an energy efficiency supply stack and not necessarily program blocks. The costs in the supply stack are representative of costs for implementing sector programs with differing costs and adoption potential. These blocks are made up of programs yet to be designed or implemented, and reflect mid-potential (Tier 2) to low- to-mid-potential (Tier 3) adoption.

Comparing TVA's EE costs to those in the ACEE report can be challenging because the fundamental construct of the IRP energy efficiency design is different than many reported peer utility results. Many of the states referenced in the report implement residential lighting programs to a much greater degree than TVA, which may lower their historic costs. Even so, TVA's energy savings align with others in the industry (as compared to the 2013 *E Source DSM Achievements and Expenditures* report), to TVA's regional peers, and to TVA's historic costs. TVA cost assumptions are compared to the other benchmark costs (namely a gas combined cycle unit) in IRP Appendix D, similar to those utilities in the ACEE paper. In order to provide a robust analysis of these EE costs, TVA has run several EE sensitivities to better understand the impacts of key energy efficiency assumptions (discussed in IRP Section 8.3). These cases were considered in the development of the final recommendation.

122. Unlike most other energy resource options, the potential expansion of energy efficiency is constrained by the TVA's current tight O&M budget. The resulting limits on energy efficiency expansion are rather arbitrary and do not appear to be supported by engineering studies to define the real technical and economic limits available to customers. These limits result in making energy efficiency less competitive as an open selection option and constrain its selection. The IRP should honestly describe this situation. (*Commenter: Venon Knight*)

Response: The energy efficiency expansion limits are not constrained by TVA's future O&M budgets. They reflect TVA's current starting point (in terms of program impacts and funding) and allow growth based on the most current potential study and aggressive growth rates that

reflect the realities associated with deploying increasing amounts of efficiency programs, as described in IRP Appendix D.

123. The IRP evaluates the cost to TVA of implementing energy efficiency programs. It does not address the cost to the local power companies of increased energy efficiency. LPCs operate on a non-profit basis and their reduced income resulting from the reduced power sales attributable to increased energy efficiency affects their income. This could result in non-participants subsidizing those who participate in energy efficiency programs. We would like TVA to consider a one-ownership study of energy efficiency which better addresses the cost to the LPCs. (*Commenters: Jack L. Suggs - Oak Ridge Electric Department, Mark S. Watson - City of Oak Ridge Tennessee*)

Response: TVA did not consider the reduced revenue for either the LPCs or TVA in the optimization of EE in the model. The impact to system average cost is reported as a proxy for the rate pressure created at the wholesale level from reduced sales. TVA agrees with the commenters that additional rate pressure would occur at the retail (LPC) level from deployment of energy efficiency. The IRP recommendation (IRP Chapter 9) and the advice statement from the RERC both confirm the need for TVA and LPCs to work together as additional energy efficiency and demand side resources are deployed and "…investigate additional approaches in energy efficiencies and distributed resources, considering those who cannot afford the necessary investments and recognizing fairness and equity for all rate payers" (RERC advice statement to TVA Board).

124. We applaud TVA's innovative approach to modeling energy efficiency as a resource, similar to other energy resources. (*Commenters: Robin D. Cox - City of Huntsville, Alabama - Huntsville Operation Green Team, Amanda Garcia - Southern Environmental Law Center, Louise Gorenflo - Tennessee Interfaith Power & Light, Dana Jeanes - Memphis Light, Gas and Water, Mandy Mahoney - Southeast Energy Efficiency Alliance, Robert J. Martineau, Jr. - Tennessee Department of Environment and Conservation, Mary M. Mastin - Tennessee Chapter of the Sierra Club, Stephen A. Smith - Southern Alliance for Clean Energy, Jack L. Suggs - Oak Ridge Electric Department, Mark S. Watson - City of Oak Ridge Tennessee*)

Response: Comment noted.

2.5.5. Modeling Renewable Energy

125. The methods TVA used in incorporating distributed PV solar generation into the modeling are not clear. To accurately model distributed PV adoption based on cost, it is necessary to adjust the capital cost to reflect the differential between retail and wholesale rates. Typical utility resource plan modeling approaches generally analyze costs as the wholesale level. Such a model can directly incorporate distributed PV through the use of a proxy resource. This proxy resource represents the distributed PV performance characteristics and cost characteristics modified to reflect the difference between production costs at the point of consumption vs. at the point of generation. This modification can usually be represented by modifying the capital cost of distributed PV based on the difference between avoided cost at the point of consumption and the point of generation. (*Commenter: Gil Hough - Tennessee Solar Energy Industries Association and Solar Energy Industries Association*)

Response: IRP Appendix C explains the distributed generation methodology. Distributed generation is broadly defined as generation that is produced on the distribution grid network,

and the contributions from DG represented in this IRP are primarily captured as load reductions. For the purposes of this analysis the residential/commercial sector DG was assumed to be solar PV. Adoption rates were based largely on CO_2 regulation which varied across the scenarios. Using this methodology, the residential/commercial distributed generation assumptions ranged from less than 500 MW in 2015 to almost 4,000 MW by 2040. Although dynamic modeling was not included in this exercise for the DG penetration, it is believed the ranges utilized bound the future. TVA is a wholesaler of electric power to 155 local power companies, each with their own rate structure. TVA is working to determine the value of distributed generation in an initiative, called Distributed Generation Integrated Value which is facilitated by the Solar Electric Power Association. The goal is to develop methods for determining the full and fair value of distributed generation to the grid. Future IRPs can take this work into account.

126. A second method to incorporate distributed PV solar generation into resource plan modeling is to hard wire a determined distributed PV capacity projection. This method relies on separate modeling that fully accounts for market dynamics at the customer level, as can be done with the NREL solarDS model. (*Commenter: Gil Hough - Tennessee Solar Energy Industries Association and Solar Energy Industries Association*)

Response: IRP Appendix C explains the distributed generation methodology. Distributed generation is broadly defined as generation that is produced on the distribution grid network. The IRP focuses on central station resource planning, with the exception of energy efficiency; therefore the contributions from DG represented in this IRP are primarily captured as load reductions. For the purposes of this analysis the residential/commercial sector DG was assumed to be solar PV. Adoption rates were based largely on CO_2 regulation which varied across the scenarios.

127. TVA states that its hydroelectric generators can “generally be categorized as intermediate resources, but their flexibility allows them to operate the full range from baseload to peaking. The limitation of hydro generation is restricted more by water availability and the various needs of the river system such as navigation” (Draft IRP p. 28). The Draft IRP also classifies both conventional and pumped-storage hydroelectric generation as typical peaking resources (p. 28). Despite this inherent operational flexibility, TVA explicitly prevents the flexible operation of the hydroelectric system by pre-loading an hourly hydro generation schedule into the capacity expansion model. By eliminating the potential for more flexible operation of the hydroelectric system, even within the bounds imposed by the various operational constraints, TVA does not evaluate the potential for using the hydroelectric system to integrate intermittent, non-dispatchable renewable resources at a lower cost and with reduced emissions than the dispatch of combustion turbine generation. It is unclear whether the operation of the Raccoon Mountain pumped-storage system was also pre-loaded into the capacity expansion model. This system is doubly effective at integrating intermittent resources due to its ability to be dispatched to fill the valleys left when intermittent generation operates at less than full capacity as well as to switch to pump mode when intermittent resources are operating at high capacities during times of low system load. TVA should model dispatchable hydroelectric generation as a dispatchable resource within the associated system constraints rather than scheduling its output a priori. (*Commenters: Zachary M. Fabish - Sierra Club et al., Synapse Energy Economics, Inc.*)

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Response: The flow of the water through the river system is a very intricate and complex system to manage. TVA manages this flow in an integrated manner to address a number of needs including industrial and municipal water-use requirements, recreation, navigation, water quality, habitat protection, flood control, and power production. TVA is statutorily precluded from operating the river system solely for the purpose of power production. Daily river operations must consider all the uses, the volume of water (i.e., including forecasting rainfall and runoff in the 40,000 square-mile watershed), and the storage space of each conventional dam and the total system. Therefore, daily water releases, including water released for hydro generation, are scheduled by TVA's river operations group and are provided to the dispatch center. The river operations group is also responsible for creating a long-term forecast for power system planning and capacity expansion planning. The capacity expansion model cannot manage the multiple requirements of the river system; therefore a fixed amount of monthly energy is entered into the model for the conventional hydro stations. The model then utilizes the hydro energy to level the load shape served by other generating facilities. Section 5.2.2 of the IRP has been edited to more accurately describe the operation of the reservoir system. The pumped storage facility has slightly different modeling requirements. A monthly energy total is entered in the model. In general, the use of stored energy can be expected at times of relatively high loads and the collection of stored energy can be expected at times of relatively low loads. The water (fuel) of pumped hydro generation is valued at the cost of pumping, allowing for net plant efficiency.

128. We applaud TVA's approach to modeling renewable energy resources. It appropriately addresses their energy production as well as their conservative contribution to winter and summer peak demand. (*Commenter: Jack L. Suggs – Oak Ridge Electric Department*)

Response: Comment noted.

2.5.6. Need for Power Forecast

129. How does the IRP address supplying the electrical load from the hundreds of thousands of plug-in electric heaters purchased each year from retail stores? (*Commenter: Ronny Rowland – Prentiss County Electric Power Association*)

Response: The load forecasting process includes an assessment on an annual basis of electricity consumption and use patterns, and in particular TVA tracks end-use trends like the small heaters mentioned in this question. The analysis also includes ranges around the forecasted peak demands (summer and winter) to account for both weather and end-use variations.

130. Several aspects of the Draft IRP Section 4.1 estimation of power demand are questionable. On page 22 it states that the ability of customers to use a form of energy other than grid-connected electricity to power consumer electronics, lighting and cooling is very limited by current technology. This is a questionable assumption as Direct Current-powered heat pumps and mechanical pumps that can be powered directly from solar and batteries are increasingly available at competitive prices. Section 4.1.2 discusses forecast accuracy based on the accuracy of one year ahead forecasts. The relevance of this to the long-term forecasts necessary for the IRP is questionable. Section 4.1.3 predicts annual system energy and peak demand growth rates of 1.0 and 1.1 %, respectively based on economic growth and energy efficiency projections. It is unclear whether these forecasts consider the accelerating rates of

energy efficiency improvements and customer-owned solar PV installations. (*Commenters: Joseph R. Schiller, Ph.D.*)

Response: IRP Section 4.1 refers to competing forms of energy and not alternative ways to generate electricity, either on or off the grid. Fuel type competition is important to understand because a decline in the price of natural gas could lower the demand for electricity as some consumers switch from appliances powered by electricity to appliances powered by natural gas. For this reason the price of natural gas is one determinant of the electricity forecast. It is true that the technology to generate and store electricity is constantly evolving. While the percentage of electricity generated by consumer-owned (off the grid) solar panels in the TVA service area is small, it is growing. In order to model the potential for unexpected growth in distributed generation, some scenarios embed much higher distributed generation forecasts (e.g., the Distributed Marketplace scenario) than others. While it is certainly true that a 10-year ahead forecast is likely to be less accurate than a 1-year ahead forecast, forecasts that consistently perform poorly 1-year ahead are unlikely to consistently perform well in the long-run. As such, the accuracy of forecasts in the near-term does relate to their accuracy in the long-run. The Current Outlook forecast reflects energy efficiency data purchased from a vendor who bases their projections on the Energy Information Agency's appliance efficiency forecasts. Alternative levels of energy efficiency and customer-owned renewables are modeled in other scenarios in order to encompass a broad range of possibilities.

2.5.7. Planning Objectives

131. As representatives of the local power companies that purchase power from TVA and distribute it to end users, we firmly believe the most important factors to our customers are power cost, reliability, and availability. The final IRP must address and balance these factors. (*Commenters: Austin Carroll - Hopkinsville Electric System, Dana Jeanes - Memphis Light, Gas and Water, David Smart – Western Kentucky Rural Electric Cooperative Corporation, Jack L. Suggs - Oak Ridge Electric Department, Mark S. Watson - City of Oak Ridge Tennessee, Michael Watson - Duck River Electric Membership Corporation, Michael White*)

Response: Comment noted. TVA agrees that balancing these attributes is a key consideration in the IRP.

132. Given the current situation in the TVA service area with relatively low forecasts for growth in power demand, two of the most critical components of resource planning that TVA must consider are innovation and diligent risk management. TVA must be innovative in how it manages its generation fleet without compromising reliability and sustainability. TVA and its customers must also be innovative in how they consume energy while maintaining output and comfort. TVA must mitigate risk in all areas of its business and provide reasonable assurance to its customers that they will have access to low cost and reliable power for years to come. (*Commenter: Dave Hrabosky - Exigent Energy*)

Response: Comment noted.

133. The highest priority of TVA's integrated resource planning is to produce a plan that results in a low-cost and reliable power supply. (*Commenters: Joan Cassens, Irene Waynetta Dowdell, Darrell Gillespie - Dickson Electric Department, Dave Hrabosky - Exigent Energy, Camden Hubbard, John F. McFadden, PhD, Kate Shanks - Kentucky Energy and Environment Cabinet*)

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Response: Comment noted. TVA agrees that cost and reliability are key considerations in the IRP, along with the other issues captured in the scorecard metrics that were selected with input from TVA stakeholders.

134. The reduction of greenhouse gas emissions should be a top priority in the development of the IRP. This can best be accomplished by emphasizing energy efficiency, which, importantly, also reduces end-use expense, and renewable generation while decreasing fossil-fueled generation. (*Commenters: Geneva Andrews, Joseph M. Boyd, Jr., J.D., Marvin Caine, Jimmy Groton, Teresa and Clarice Hargrove, Seth Harrell - University of Tennessee at Chattanooga College Democrats, Heather Holloway, Justin Huff, Cindy Kendrick, Susan Kennedy, Sherry Loller, Andrea Maneschi - United Nations Association of Nashville, Dennis McCorkle, Ruth Peeples, Elizabeth Pierce, Geoffrey Pratt, C. Lee Roberts, Teris Schery, Marjorie L. Swenson, Mark Tolley, John Todd Waterman - Organizing for Action-TN Climate Campaign and Citizens' Climate Coalition, Lucille York, Laura Young, Fred Ziegler*)

Response: Comment noted. TVA has made significant strides in reducing CO_2 emissions and the IRP results show that further reductions would occur under all alternative strategies and the Target Power Supply. Strategies D – Doing More Energy Efficiency and E – Focusing on Renewables would reduce CO_2 emissions more than other strategies, but would cost more and be riskier.

2.5.8. Planning Process

135. Pursuant to Section 113 of the Energy Policy Act of 1992, TVA is obligated to conduct a least-cost planning program to "provide adequate and reliable service to electric customers of [TVA] at the lowest system cost." Lowest system cost, or least-cost, does not necessarily mean cheapest, and must take into account diversity, reliability, dispatchability, and other factors of risk including carbon emissions. Demand and supply resources must be treated on a consistent and integrated basis, taking into account the ability to verify energy savings achieved through energy conservation and efficiency and the projected durability of such savings over time. TVA's long-term planning must also be informed by its statutorily-derived mission "to improve life for the people of the valley through its commitment to service, providing affordable electricity, economic development and environmental stewardship." (*Commenter: Amanda Garcia - Southern Environmental Law Center*)

Response: TVA agrees with the commenter. The IRP study was conducted consistent with the least-cost system planning requirements in the TVA Act. The improvements made in the modeling methodology allowed TVA to analyze energy efficiency and renewable energy as resources that the model could select. This treats these resources consistent with the modeling of more traditional energy resources. In doing this, TVA also took into account necessary features of system operation such as resource diversity, reliability, resource dispatchability, and risk factors.

136. Since announcing the development of this IRP, TVA has made major, costly decisions to construct and operate the Paradise and Allen combined cycle plants. These decisions affect the outcome of the IRP process. We question why TVA has not forced these major capital investments to compete with other energy resources, including cleaner, lower emitting, and potential lower cost energy resources during the IRP process. (*Commenters: Tom Boughan, Ron Castle, Charles Cohen, Dwayne Cutshall, Patrick Dean, Joe Franklin, Louise Gorenflo -*

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Tennessee Interfaith Power & Light, Ursula King, Venon Knight, Kurt Shepherd, Richard Spry, Inger Upchurch, Samuel Upchurch, Kelly Wheeler, Southern Alliance for Clean Energy Campaign Emails)

Response: The decisions about the Allen and Paradise plants were consistent with the 2011 IRP which was in effect at the time the Allen and Paradise decisions were made. Alternative solutions at each site were fully evaluated before the decisions were made to construct combined cycle units at Allen and Paradise (see the environmental assessment prepared for each decision, listed in Section 1.7 of the IRP SEIS). These decisions could not be deferred for consideration in the 2015 IRP. Choosing to site combined cycle units at these plants has not substantially impacted the outcome of the 2015 IRP.

137. What is TVA's budget for developing the IRP? (*Commenter: Ronny Rowland - Prentiss County Electric Power Association*)

Response: The budget for developing the 2015 IRP is about $3.5 million.

138. How does TVA's budget for developing the IRP compare to the expenditures by special interest groups trying to influence the outcome of the IRP? (*Commenter: Ronny Rowland - Prentiss County Electric Power Association*)

Response: TVA does not have enough details about the expenditures by other groups to answer this question.

2.5.9. Potential Energy Resource Options

139. I have designed an energy system that uses wind to produce hydrogen that can then be used for electrical generation and transportation fuel. This system would help meet TVA's clean energy needs described in the IRP, as well as provide revenue to TVA from hydrogen sales. Consider funding the further development and implementation of this energy system. (*Commenter: Robert Crehore - Hydrogen Energy Research Company*)

Response: TVA is committed to the evaluation of all viable energy technologies that can help it achieve its mission to serve the people of the Tennessee Valley.

140. While TVA talks about implementing new technology, there is little of this apparent in the selected energy resource options. An example is thorium reactor technology, which is much safer as plants are not vulnerable to a run-away meltdown, generate little waste (no spent fuel rods to store and protect), and are small and adaptable to a decentralized grid. Unlike much of the energy efficiency and renewable energy technologies, the technology is domestic and would create U.S. jobs. As a government utility, TVA should be pursuing this. (*Commenter: Daniel Shultz*)

Response: All resource options considered for the capacity plans must meet certain criteria as outlined in IRP Section 5.1.1. Consequently, some technologies such as thorium reactors were not evaluated because they are not sufficiently developed. TVA continues to monitor advanced technologies, and when they become viable in a commercial application will include them in future IRP studies as appropriate.

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2.5.10. Resource Plan Implementation

141. In the 2011 IRP, TVA promised to become a regional leader in energy efficiency by targeting system-wide savings as high as 1% of retail sales. TVA subsequently cut it energy efficiency budget and is stalled at less than one third of its 2011 goal. Due to these cuts, TVA lags significantly behind regional leaders, with net energy savings of much less than half that of several regional peer utilities. With the high costs and restrictive growth caps imposed in the Draft IRP, TVA will continue to lag. (*Commenters: Southern Alliance for Clean Energy Campaign Emails, Chris Ann Lunghino - Sierra Club Beyond Coal Campaign, Stephen A. Smith - Southern Alliance for Clean Energy*)

Response: Assumptions used in the 2011 IRP changed, particularly lower load growth and significantly lower natural gas prices. These changes, along with the innovative modeling technique used in the current study for representing EE as a selectable resource, will naturally lead to a different level of EE in the 2015 resource plans. As part of the work in support of the IRP study, and as an assessment of the new technique TVA employed, TVA compared the projected EE levels to comparable current studies conducted by regional peer utilities. With the exception of levels planned by Entergy Arkansas, TVA's EE portfolio will position it to be a regional leader by 2019. More details about that benchmarking work can be found in the EE seminar materials on the TVA IRP webpage.

142. Successful implementation of the IRP will require involvement by multiple stakeholders representing diverse interests, including the LPCs, end-use customers served by LPCs, the states, environmental interests, and energy resource experts such as those who participated in the renewable energy and energy efficiency information exchanges. (*Commenters: Robin D. Cox - City of Huntsville, Alabama - Huntsville Operation Green Team, Amanda Garcia - Southern Environmental Law Center, Dana Jeanes - Memphis Light, Gas and Water, Mandy Mahoney - Southeast Energy Efficiency Alliance, Robert J. Martineau, Jr. - Tennessee Department of Environment and Conservation, Kate Shanks - Kentucky Energy and Environment Cabinet*)

Response: TVA agrees with the comment. See the discussion of these implementation challenges in IRP Chapter 10.

143. The local power companies operate on a non-profit basis. Most of the revenue they receive from customers is paid to TVA and they have very small retained earnings. Revenue reductions from increased energy efficiency, as well as from customer loss due to off-grid distributed generation, could affect their financial viability. As it proceeds with implementing the IRP, TVA must address this issue. Although TVA's structure is unique, utilities elsewhere in the country are addressing this issue and TVA should learn from their experiences. (*Commenters: Mandy Mahoney - Southeast Energy Efficiency Alliance, Jack L. Suggs – Oak Ridge Electric Department*)

Response: Comment noted. TVA is aware of this issue and will continue to work with LPCs as the IRP is implemented.

2.5.11. Stakeholder Involvement

144. Although TVA has increased interaction with stakeholders through its IRP Working Group, TVA has kept a large amount of information critical to understanding and evaluating

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the IRP from being available to the public. One notable example is the lack of quantitative information in the Draft IRP. Numerous charts lack y-axis labels and/or scales. Basic data about the megawattage of different resources, energy by category, and resource prices are also lacking as are explanations of the rationale behind many assumptions. TVA is also providing no meaningful opportunity for public comment on the results of the numerous modeling sensitivity tests conducted after the release of the Draft IRP. TVA should make the missing information available to the public and commit to public review of sensitivity analyses results and related information on future IRPs. (*Commenters: Brendon Baatz - American Council for an Energy Efficient Economy, Zachary M. Fabish - Sierra Club et al., Simon Mahan, Robert J. Martineau, Jr. - Tennessee Department of Environment and Conservation, Joseph R. Schiller, Ph.D.*)

Response: TVA has made available a broad range of information, both publicly and through the IRP Working Group sessions. This process has been significantly more transparent than that of any regional peer utility. The final IRP report includes additional data, and charts have scales on the y-axis. Capacity ratings of candidate technologies are listed in IRP Chapter 5 and system MW values for each strategy/scenario combination are included in IRP Appendix E. TVA will continue to work to refine and enhance its stakeholder engagement process.

145. We applaud TVA for its commitment to extensive stakeholder involvement throughout the development of the IRP. These efforts have included public meetings, the IRP Working Group, the renewables and energy efficiency information exchanges, and the Regional Energy Resource Council. As a result of this, TVA has set a new standard for other utilities. (*Commenters: Lorraine Barker, Dave Bordenkircher, Tom Boughan, Ron Castle, Charles Cohen, Dwayne Cutshall, Patrick Dean, Joe Franklin, Amanda Garcia - Southern Environmental Law Center, Louise Gorenflo - Tennessee Interfaith Power & Light, Sandra K. Goss - Tennessee Citizens for Wilderness Planning, Gil Hough - Tennessee Solar Energy Industries Association and Solar Energy Industries Association, Justin Huff, Dana Jeanes - Memphis Light, Gas and Water, Ursula King, Frances Lamberts, Chris Ann Lunghino - Sierra Club Beyond Coal Campaign, Robert J. Martineau, Jr. - Tennessee Department of Environment and Conservation, John F. McFadden, PhD, Patrick Miller, C. R. Orr, Jackie Tipper Posey, Liane Russell, Kate Shanks - Kentucky Energy and Environment Cabinet, Kurt Shepherd, Stephen A. Smith - Southern Alliance for Clean Energy, Richard Spry, Jeffry Stein, Daniel Tait - Alabama Center for Sustainable Energy, Inger Upchurch, Samuel Upchurch, Kelly Wheeler, Russ Wilcoxson, Southern Alliance for Clean Energy Campaign Emails)*

Response: Comment noted.

2.5.12. Strategies

146. By focusing its short-term investments in energy efficiency and renewable energy, TVA would best advance its stewardship mission. Strategies D and E perform significantly better than the other strategies along all three environmental metrics. They also provide the best path toward achieving the objective set forth in TVA's 2008 Environmental Policy to "stop the growth in volume of emissions and reduce the rate of carbon emissions by 2020 by supporting a full slate of reliable, affordable, lower-carbon-dioxide (CO_2) energy-supply opportunities and energy efficiency." Strategies D and E, with increased emphasis on energy efficiency and renewables early in the planning period, would also give the seven states in TVA's territory the

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most flexibility in complying with the Clean Power Plan. (*Commenter: Amanda Garcia - Southern Environmental Law Center*)

Response: Comment noted. TVA believes a diverse portfolio with a mix of new resources including EE, renewables, and additional gas-fired generation will provide the best opportunity to respond to an uncertain future. TVA has significantly reduced CO_2 emissions from its system already and would continue to do so under all of the IRP strategies and the Target Power Supply.

147. Please be a leader.
• Thank you for the effort you are putting into carefully planning for our future energy needs
• Please close more outdated coal plants to reduce air and water pollution and slow climate change
• Replace coal plants with clean, reliable, solar and wind power, and improved energy efficiency, not nuclear and gas-fired power
• It is important to provide an equitable transition for workers and communities impacted by coal plant closures (*Commenters: Tennessee Sierra Club Earth Day Postcards*)

Response: Comment noted.

148. Thank you for encouraging public comment on your draft Integrated Resource Plan. Your draft plan has made significant strides in promoting the growth of clean energy in the Valley. I write to call for even more growth in clean energy than is currently proposed. Cost-effective energy efficiency can be delivered at significantly higher penetration rates than are currently proposed. More focus on solar, wind and distributed energy, such as storage, is needed to help us adapt to a changing world. In addition to being the most affordable choices over the long run, they build community resilience, grow high-paying local jobs, and contribute to a healthier environment. (*Commenters: "Tennessee Valley Citizen" Postcards*)

Response: Comment noted

149. Thank you for recognizing the importance of a plan that is less dependent on carbon-polluting fossil fuels. We urge TVA to increase the use of renewable energy and energy efficiency during the first 5 years of the plan. The draft plan fails to take full advantage of wind power and energy efficiency early in the planning period due to the use of higher-than-market price forecasts, low wind performance data, outdated technology assumptions, and unreasonably low growth caps. Increased use of renewable energy and energy efficiency would improve air quality, curb climate change, grow the regional economy, create jobs, and reduce utility bills. The draft plan continues to rely too much on expensive, risky gas and nuclear power subject to price volatility and environmental regulations. Maximizing energy efficiency and renewable energy early in the planning period will also allow earlier retirement of more coal plants, eliminating their greenhouse gas emissions and harmful impacts on local communities and human health. (*Commenters: Moms Clean Air Force Online Campaign Form, Patrick Watermeier*), *Southern Alliance for Clean Energy Campaign Emails*

Response: TVA believes the assumptions for wind power are reasonable. Sensitivity cases discussed in IRP Section 8.3 confirm that wind could make an earlier contribution to the portfolio if capability improvements and cost reductions, such as those predicted by many

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commenters, can be achieved. TVA believes a diverse portfolio will position the system for success in the future.

150. The draft IRP confirms the fundamental competitiveness of energy efficiency and renewables as resources. The results show that the five strategies, including Strategy D - Maximize Energy Efficiency and Strategy E - Maximize Renewables, cluster closely in terms of most key metrics, including cost and risk. Differences in present value of revenue requirements and system average cost are minimal. The risk of increased future regulatory and fuel costs are reduced by increased reliance on energy efficiency and renewables. The impacts of the strategies on Valley per capita income are similar, with the most favorable impact under Strategy D. Strategies D and E also satisfy TVA's reliability requirements and perform well in terms of dispatchability. Had TVA used more current cost information for energy efficiency and renewable energy resources and not imposed the unnecessary planning factor constraints on energy efficiency, the key metrics for Strategies D and E would likely have been even more competitive. (*Commenters: Amanda Garcia - Southern Environmental Law Center, Dennis Lynch*)

Response: We agree that the results of all of the IRP strategies are close, but there are some important differences. For example, all of the strategies reduce TVA's environmental footprint, but Strategies D and E are better in this regard. All of the strategies have similar financial results, but Strategies D and E cost up to several billion dollars more. Under the recommended Target Power Supply, as described in IRP Chapter 9, the mix of resources, especially EE and renewables, can be shifted in response to changes in key drivers. The assumptions around modeling EE as a resource are open to refinement as TVA learns more about the challenges around implementation as discussed in IRP Chapter 10.

151. The environmental impacts of generating electricity from fossil fuels are unacceptably high. TVA should therefore select and implement a strategy that minimizes the use of fossil fuels and maximizes the use of cleaner renewable generatin and energy efficiency. (*Commenters: John Andes, Geneva Andrews, Wilkerson Anwen, Marianne Bentley, Denise Bivens, Sophie Bjork-James, Donald Bollenbacher, Jacquelyn Carter, Bruce Compton, Mary Ann Crowe, Le-Ellen Dayhuff, Allen Decuyper, Jesse Farber-Eger, Judy Fisher, William Franks - Cumberland-Harpeth Audubon Society, Edgar Gehlert, Anna Miller Grabowski, Kelly Grant, Toya Hibbs, Lee Hoffnung, Alice Hudson, Cindy Kershner, T Komp, Sandra Kurtz, Thomas Kurtz, Frances Lamberts, Donn Leatherman, Mary M. Mastin - Tennessee Chapter of the Sierra Club, Rosalyn McKeown-Ice, Patrick Miller, Shirley Moulton, Mervin Paulson, Patricia Post, Luisa Ramirez de Lynch, Jared Rex, Jim Smith, Nathaniel Stephenson III, Harold Waddle, Jennifer Westerholm, Kyle Williams*)

Response: Comment noted. All of the strategies show improvement in most facets of TVA's environmental profile.

152. The IRP analysis strongly shows that TVA's proper path forward is to avoid capital-intensive investments in new fossil resources and instead focus on developing low-cost, scalable renewable and especially energy efficiency resources in order to maintain low system costs, preserve TVA's operational and decisional flexibility, and maximize TVA's ability to achieve its environmental stewardship objectives. This recommendation is based on the following conclusions. First, no additional large baseload generation is needed and the model shows system needs can be met with combinations of energy efficiency, renewables, and gas

combustion turbines. Second, the different strategies perform nearly identically on most metrics. The difference in PVRR metrics is less than 2 percent over the 20-year period, within the margin of error and far from "extreme" as it is characterized in the Draft IRP. Third, all strategies show an increase in flexibility and all meet related system reliability standards. Fourth, the impacts of each strategy on overall valley economics are essentially negligible, with only Strategy D showing positive impacts on per capita income.

Given that all strategies perform essentially equally well on cost and economic development, TVA should place primary emphasis on its third core value, environmental stewardship. The strategies that emphasize energy efficiency and renewable energy perform significantly better with regard to the environmental metrics. As noted in other comments, TVA has dramatically overpriced energy efficiency and wind energy. Despite this, TVA will ultimately have real-world data about the price of energy efficiency and cost and risk of renewables and other resources. Therefore the best use for the IRP analyses is to not set a prescriptive 20-year plan but to instead use it as a yardstick for future resource acquisition decisions. If energy efficiency and renewable energy come in at prices below those used in TVA's modeling, as is overwhelmingly likely, then the IRP results show that TVA should prioritize investments in these resources. This will give TVA more flexibility in adapting to the changing utility marketplace than would the large capital investments in fossil resources, including numerous gas turbine plants. (*Commenter: Zachary M. Fabish - Sierra Club et al.*)

Response: TVA does not agree that assumptions for EE and wind power are overpriced; these assumptions and others were subjected to third-party validation and reflect reasonable assumptions for a long-range planning study. TVA also believes that although the plans have PVRR values that are close in a relative sense, the differences are real, amounting to several billion dollars that matter to TVA customers. The IRP Target Power Supply does not set a prescriptive plan, but rather points in a broad direction to give TVA maximum flexibility to respond to uncertainty (see IRP Chapter 9).

153. The IRP represents a good balance between cost, reliability, and environmental obligations. (*Commenters: Austin Carroll - Hopkinsville Electric System, Darrell Gillespie - Dickson Electric Department, Dana Jeanes - Memphis Light, Gas and Water*)

Response: Comment noted.

154. TVA should develop and analyze a "Combined Maximize Energy Efficiency and Maximize Renewables Strategy" that combines the current Strategies D and E. (*Commenters: Sandra K. Goss - Tennessee Citizens for Wilderness Planning, Dennis Lynch, John F. McFadden, PhD, Rosalyn McKeown-Ice, Joseph R. Schiller, Ph.D., John Todd Waterman - Organizing for Action-TN Climate Campaign and Citizens' Climate Coalition*)

Response: General information about the combination of renewables and EE that fit within a least-cost planning framework can be found in the results for Strategies D and E across the five scenarios. Based on the modeling already completed, TVA expects that costs would increase and most environmental impacts would be lower if this combined strategy was modeled. TVA elected not to develop combined strategies that enforce more than one non-optimized component for the resource plan because such a composite strategy would significantly limit the ability of the model to determine the least-cost plan.

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155. TVA should implement a strategy that emphasizes the use of renewable energy to meet future power demands and has increased focus on energy efficiency to curb increasing power demands. (*Commenters: Dr. & Mrs. Thomas J. DiNella, John Guenst, Tim Holt, Jack Jeffers, Jim Johnson, Jon Plumlee, Brandi Prewitt, David Rainey*)

Response: Comment noted. Strategy E emphasized the use of renewable energy and all strategies, as well as the Target Power Supply, have increased EE to curb increasing power demands. See also the response to Comment 134.

156. TVA was founded in part to provide leadership and demonstrate innovative practices for the rest of the country and the world. For several decades TVA was very successful in implementing this part of its mission. Now is the time for TVA to again show leadership by accelerating the move from fossil fuels to clean, non-GHG emitting, less-water intensive, wind and solar generation. The draft plan does not show this important leadership. TVA can and must do more to lead the rest of the country in the transition to clean energy. (*Commenters: Southern Alliance for Clean Energy Campaign Emails, Lee Allen, Deanna Bowden, Richard Brosmore, Kenneth Clark, Irene Waynetta Dowdell, Amy Eskind, David Finlow, Annette Hansen, Marita M. Hardesty, Teresa and Clarice Hargrove, Camden Hubbard, Adam Janko, Tom Jetton, Frances Lamberts, James Marziotti, John F. McFadden, PhD, Jesse Moore, Shirley Moulton, Diana Page, David Patterson, Sona Pyle, Gail C. Roberts, Marlene Shaner, Tonya Spann, Marjorie L. Swenson, Steve Vining, Walter Wunderlich, Fred Ziegler*)

Response: Comment noted. TVA continues to evaluate the opportunity to promote more renewables as part of the least-cost resource plan.

157. We recommend that TVA strengthen language in the Final SEIS that states that none of the alternative strategies are specifically designed to understand and/or achieve compliance with the USEPA proposed Clean Power Plan. (*Commenter: Michelle Walker Owenby - Tennessee Department of Environment and Conservation*)

Response: The IRP and SEIS documents have been revised to clarify the differences between the IRP modeling and the compliance with the proposed Clean Power Plan.

2.5.13. Strategy Evaluation Metrics

158. A tenet of sustainability is that if you plan and manage for water resources, the other issues will sort themselves out. Given this, consider additional metrics related to management of water resources beyond the volume of water used and consumed. (*Commenter: Robin D. Cox - City of Huntsville, Alabama - Huntsville Operation Green Team*)

Response: Comment noted. See also the response to Comment 159.

159. We note the discussion of the impacts of dams on surface waters in Chapter 4 of the SEIS. This could be more fully incorporated into the IRP process by including the impacts on water quality from dams as one of the IRP Environmental Metrics as described in Appendix F of the Draft IRP Report. Omitting this as a metric gives the impression that there is no impact from dams and that the impacts from future hydropower operations are not being taken into consideration. (*Commenter: Heinz J. Mueller - U.S. Environmental Protection Agency*)

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Response: The selection criteria for the environmental metrics evaluated in the IRP Report included 1) coverage of a variety of environmental resources/media; 2) readily quantifiable during the portfolio modeling process; and 3) variation across the expansion plans in order to differentiate the strategies and scenarios. TVA considered and rejected several potential environmental metrics that did not meet these criteria. A water quality metric related to hydroelectric generation was rejected because it would have provided little information useful it quantifying differences among the expansion plans. This is because generation from existing hydroelectric dams is relatively uniform in the various expansion plans. The potential new hydroelectric generation from existing TVA dams selected in some expansion plans comprises such a small proportion of overall hydroelectric generation (ca. 1 percent) that it would not have made a noticeable difference in an associated environmental metric.

160. As a federal agency, TVA should have used the Social Cost of Carbon (SCC) as a metric for evaluating climate impacts caused by CO_2 emissions. The SCC monetizes the economic damages resulting from increases in CO_2 emissions as well as the economic benefits resulting from reductions in CO_2 emissions. While we support TVA's inclusion of a range of potential costs of CO_2 emissions in the planning scenarios, the use of SCC would have approached this more holistically. (*Commenters: Le-Ellen Dayhuff, Angela Garrone - Southern Alliance for Clean Energy et al., Michael Goff, Gil Hough - Tennessee Solar Energy Industries Association and Solar Energy Industries Association*)

Response: There is no consensus around the use of the social cost of carbon in long-range resource planning studies. The De-Carbonized Future scenario includes a much higher cost of carbon similar to many reported values for the social cost of carbon. This scenario therefore assessed the impact of significantly higher carbon penalties on the outcome of the planning study. The capacity expansion plans associated with this scenario typically have less natural gas capacity expansion and more renewable energy expansion that all other scenarios except for the Distributed Generation scenario.

161. Energy efficiency has the potential to contribute more to per capita income than other energy resources due to more local employment. How is this, as well as the higher costs to operate coal and natural gas generating plants factored into the IRP metrics? (*Commenter: Venon Knight*)

Response: The model TVA used to assess the broader economic impacts of the capacity expansion plans includes modules that capture the impact of energy efficiency, renewables and fossil-fueled power plants on employment and per capita income. See IRP Appendix G for a more completed discussion of the modeling approach.

162. The scorecard metrics, as presented, likely lead to inappropriate results. Because the metrics for each strategy are reported as the simple arithmetic average of the scenarios, TVA appears to believe that each scenario is distinct and equally likely. Neither of these is true, as a de-carbonized future could occur during a time of stagnant economy or growth economy, and a de-carbonized future is particularly likely given pending federal regulations. It is also unclear how the metrics are weighted in the Draft IRP. (*Commenters: Synapse Energy Economics, Inc.*)

Response: Comment noted. TVA developed the scenarios to represent distinct plausible futures and believes that the assumptions are reasonable. In addition, to eliminate any bias in

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results, TVA assumed each future is equally likely; this allows individual decision-makers to apply any preferences to the selection of a resource plan. While it is possible to experience different futures that might combine one or more of the key drivers used in the design of the scenarios in the IRP, that does not mean the scenario constructs are invalid. As indicated in the Draft and Final IRP, metrics are not weighted.

163. Given that TVA established the scoring system after modeling results were known, we recommend a two-step process to select a strategy. First, TVA should use PVRR as an initial step to screen out strategies that are particularly expensive. Because PVRR calculations contain a margin of error, only strategies that are within a few percent of the lowest PVRR should be retained and those strategies should be considered equivalent from a PVRR perspective. The most expensive strategy (Strategy E) is less than 2% more costly than the least expensive strategy (Strategy A), the differences are within the PVRR margin of error and all should be retained. The strategies should then be evaluated in a more qualitative way, eliminating those that perform worse in the non-PVRR metrics. This will assure that TVA is choosing a least-cost strategy that helps TVA accomplish its economic development and environmental stewardship missions. (*Commenters: Synapse Energy Economics, Inc.*)

Response: TVA disputes the assertion that the scorecard metrics were determined after modeling results were known. Metrics were discussed with the IRP Working Group before any modeling results were available. Each assessment category described in Chapter 8 of the IRP report presents results for each of the five metric categories. No screening or ranking exercises were performed on the strategies; rather, all five strategies were retained and the combination of the scorecard and the assessment results helped to inform the recommended Target Power Supply presented in IRP Chapter 9.

164. Since TVA's mission includes economic development, it should consider developing more sophisticated measures of economic growth besides those in the draft IRP (pages 99, 162). Several reports from regional and local energy efficiency organizations reference and quantify improved quality of live and economic impacts at the local level. One simplistic example is using a ratio of gross domestic product to energy consumed (GDP/kWh) as a measure of a region's efficiency and economic competitiveness. (*Commenter: Robin D. Cox - City of Huntsville, Alabama - Huntsville Operation Green Team*)

Response: Comment noted. TVA continues to seek ways to improve the assessment of the general economic impacts from its resource plans.

165. The Risk/Benefit Ratio metric is problematic because it can produce identical scores for a strategy with a high level of upside risk and a strategy with a high level of downside risk. The risk profiles for these two strategies are different. Because this metric allows high levels of upside risk to obscure high levels of downside risk, it should be eliminated from the scorecard. The Risk Exposure metric should be retained because it discourages risk-taking strategies. The relatively high Risk Exposure scores for Strategies D and E would likely be lower than those for the other three strategies if TVA used more realistic cost estimates for energy efficiency and wind energy, given the greater price uncertainty of natural gas and more stable cost of energy efficiency and renewable energy. (*Commenters: Synapse Energy Economics, Inc.*)

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Response: TVA does not agree that the Risk/Benefit ratio would produce identical results for the two cases described in this comment. Upside risk is the area between P(95) and the expected value; downside risk (also known as benefit) is the area between the expected value and P(5) – see IRP Figure 6-10. The ratio computed for these two cases would be very different: high upside risk would produce a ratio greater than 1 and high benefit would produce a ratio less than 1. TVA continues to review options to improve the risk analysis done as part of the IRP study

166. The System Average Cost 2014-2023 ($/MWh) metric implies that lower near-term costs will result in a higher total system cost over the full planning period. In addition to burdening future ratepayers by reducing costs to current ratepayers, it disincentives long-term investments with higher upfront costs, such as wind and solar PV generation and energy efficiency, even though these resources result in lower overall costs. This metric does not help in selecting a strategy that aligns with TVA's mission and should be eliminated. (*Commenters: Synapse Energy Economics, Inc.*)

Response: The system average cost metric provides a reasonable indicator of rate pressure by presenting the present value of revenue requirements on a per unit of energy basis over a 10-year period. Because the IRP is not a rate study, this metric is used as a proxy for determining how each strategy might put upward or downward pressure on rates over that 10-year time period. This metric does not imply any trade-off between near-term and longer-term costs, but rather provides another insight into the total plan cost.

167. The System Regulating Capability metric included to assign value to system flexibility should be eliminated. All strategies include more flexible capabilities than TVA has now. We presume that TVA would not implement a strategy that does not meet minimum reliability criteria, and any cost savings of a flexible strategy are already reflected in a lower PVRR. Nor has TVA identified the optimum flexibility score, and the Draft IRP states that TVA will determine this after the IRP is completed. The flexibility metric also only addresses rapid increases in demand and ignores the ability of the system to respond to rapid decreases in demand. Both wind turbines and tracking PV systems can ramp down extremely quickly and, once ramped down, can subsequently be ramped up quickly. It is unclear whether the different ramping capabilities of different renewable technologies were considered in the calculation of the flexibility metric. (*Commenters: Mary M. Mastin - Tennessee Chapter of the Sierra Club, Synapse Energy Economics, Inc.*)

Response: As explained in IRP Section 8.1.3, TVA is still investigating the flexibility metric, but that in the interim TVA believes it provides some insight into the differences in flexibility across the planning strategies. TVA has not determined yet what a "good" score would be for the TVA system, but the relative differences in scores between strategies are meaningful and help understand some of the system performance challenges associated with certain resource mixes. TVA expects to refine this metric in future IRPs.

2.6. NEPA Compliance/Adequacy

2.6.1. Scope of Impact Assessment

168. The draft SEIS does not analyze site-specific environmental impacts of subsequent site- or project-specific actions proposed to implement the IRP. Such analyses must be performed and, where the impacts are significant within the meaning of NEPA, must be analyzed in an

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EIS. (*Commenters: Amanda Garcia - Southern Environmental Law Center, Angela Garrone - Southern Alliance for Clean Energy et al.*)

Response: Comment noted. The IRP SEIS is a programmatic SEIS and the impacts of subsequent site- or project-specific actions proposed to implement the IRP will be the subject of environmental impact analyses during the planning of those actions. The type of future impact analyses, i.e., EIS, environmental assessment, or categorical exclusion, will be determined at that time based on the potential impacts of the action and other factors in accordance with Council of Environmental Quality (CEQ) and TVA regulations for implementing NEPA. This approach aligns with the December 2014 Final Guidance for Effective Use of Programmatic NEPA Reviews issued by CEQ.

169. The Draft SEIS should consider the potential impacts of the full lifecycle of electrical generation on federally protected species and habitat important to them. These lifecycle effects result from resource extraction, resource transportation and storage, resource consumption at generation facilities, and by-products of energy generation and transmission. The evaluation of these effects should include the quantity of habitat affected and the amount and duration of lethal take of federally protected species and species of conservation concern. It should include the impacts of transmission system right-of-way maintenance and upgrades necessary to transmit the power marketed by TVA and the impacts of generating facility water withdrawals and discharges on federal trust species. It would also be beneficial for the Cost section of the SEIS to include the cost of conserving and recovering federal trust species. (*Commenter: Joyce Stanley - U.S. Department of Interior*)

Response: The requested analyses are beyond the scope of the IRP SEIS. In order to conduct the requested analyses, TVA would need to know the exact types of generating facilities that would be constructed in the future, as well as when and where the facilities would be built. The IRP is a framework plan that does not make these decisions. The impact analyses in SEIS Chapter 7 describe several indicators of the potential for impacts to protected species and species of conservation concern. TVA will conduct the appropriate detailed impact analyses when it proposes actions to implement the IRP. See also the responses to Comments 64 and 168.

170. Although TVA uses a metric to measure coal ash generation across the various IRP strategies, the specific environmental impacts of coal ash are not described in the SEIS. Coal ash has already contaminated the groundwater at every TVA coal plant and will continue to do so, rendering it unsafe to drink for the foreseeable future. Ash at TVA coal plants also contaminates surface water through direct, permitted discharges, and unpermitted seeps and subsurface hydrologic discharges, threatening human and ecological health. These threats are directly proportional to the amount of ash that TVA generates and disposes of at its plants and are also affected by the rate at which TVA closes its ash impoundments. Coal ash contaminants of groundwater of particular concern include arsenic, boron, cobalt, manganese, molybdenum, and sulfate, all of which exceed EPA drinking water maximum contaminant levels, EPA health advisory levels, and/or health-based screening levels at one or more TVA coal plants. Coal ash contaminants of surface water of concern include arsenic, barium, chromium, selenium, and vanadium. The Draft SEIS shows that the average annual production of coal ash in 2033 will range between 2 and 3 million tons, depending on strategy, resulting in large differences in the impacts of coal ash on groundwater and surface water resources. This requires a more meaningful analysis in the SEIS that addresses both the

adverse impacts from coal ash disposal and the beneficial impacts resulting from reductions in coal capacity. (*Commenter: Angela Garrone - Southern Alliance for Clean Energy et al.*)

Response: SEIS Sections 4.5 and 7.5.5 have been revised to provide more information about CCR impacts. This comment relies extensively on reports from the Environmental Integrity Project (EIP) alleging widespread damage from CCR contamination. EPA reviewed EIP's reports for its CCR rule, published in the Federal Register on April 17, 2015, and found only limited evidence for determining "proven" damage to health and environment at a few locations. The only TVA location identified as a proven damage case was Kingston and this was due to the structural failure of the Kingston ash impoundment in December 2008. TVA's conversion of its wet CCR impoundments to dry management systems and compliance with EPA's CCR rule should ensure that any risks to health and the environment will be reduced to an appropriate level.

171. Coal generation with carbon sequestration is included as a selectable energy resource, although it was not selected as a component of any of the energy portfolios. TDEC recommends that the Final SEIS include additional discussion of the viability of carbon sequestration in Tennessee. The feasibility of carbon sequestration in Tennessee is relatively unknown. 2010-2011 research indicated that the Knox-Stones River Groups Storage Assessment Unit may be a viable reservoir only under the Cumberland Plateau, as may be the deeper and more extensive Mt. Simon Formation. Tennessee's underground injection control regulations prohibit deep underground injections in the eastern third of the state. The Final SEIS should address whether there is enough information currently available to determine is suitable carbon sequestration sites exist anywhere in Tennessee. (*Commenter: Michelle Walker Owenby - Tennessee Department of Environment and Conservation*)

Response: Comment noted. SEIS Section 4.4 has been revised to note the potential for CO_2 sequestration in the Knox-Stones River Groups. TVA has no plans to pursue carbon sequestration at this time. Should TVA proposed a carbon sequestration project, TVA will conduct a thorough analysis of the suitability of any proposed storage reservoirs.

172. In its discussion of the HVDC wind energy option, the IRP Draft SEIS references the U.S. Department of Energy Draft EIS on the Plains & Eastern HVDC project. Neither EIS adequately evaluates the potential impacts of the 350 miles of upgrades to TVA transmission lines that TVA states would be necessary to interconnect the Plains & Eastern line to the TVA transmission system. (*Commenter: Carol A. Overland - Legalectric Inc.*)

Response: The route of the new TVA 500-kV transmission line that would be necessary to support the Plains & Eastern transmission line interconnection is not yet known and therefore it is not possible to describe its route-specific environmental impacts. Similarly, the exact locations of the segments of existing TVA transmission lines that would be modified to support the interconnection are not known at this time. The potential impacts of the upgrades to the TVA transmission system are qualitatively described in Chapter 3 of the Plains & Eastern Draft EIS. Section 7.4 of the IRP SEIS summarizes many of the typical impacts of constructing and operating new transmission lines and upgrading existing transmission lines in the TVA service area. Should TVA propose to authorize the interconnection of the Plains & Eastern line to the TVA transmission system, TVA will evaluate the potential impacts of its associated transmission construction and upgrade activities in a separate NEPA review(s).

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173. The descriptions of the potential environmental impacts of the 1,260-MW pressurized water nuclear reactor option (i.e., completion of one or both Bellefonte Nuclear Plant units) and the AP1000 nuclear reactor option in Draft SEIS Section 7.2.2 are outdated or incomplete. The discussion of the 1,260-MW pressurized water reactor refers to a 1974 EIS and a 2010 EIS. The discussion of the AP1000 reactor refers to a 2008 environmental report that is outdated given, in part, the cost increases that have occurred with other AP1000 projects. Given that the NRC has not conducted an EIS for a TVA AP1000 reactor, it is not reasonable for TVA to conclude that its construction and operation on the Bellefonte likely would not result in significant impacts. (*Commenter: Angela Garrone - Southern Alliance for Clean Energy et al.*)

Response: SEIS Section 7.2.2 references existing environmental reviews addressing construction and operation of one or two pressurized water reactors or AP1000 design reactors at TVA's Bellefonte site in northern Alabama. These documents provide information about the potential impacts of these site-specific actions and that information is summarized in this programmatic review. We agree that TVA may have to update the information, especially costs, before proceeding with either action. Neither of these actions are included in the alternative strategies or the Target Power Supply evaluated in the IRP SEIS.

174. The discussion of the impacts of operating TVA's existing and committed (i.e., Watts Bar Unit 2) nuclear plants in Draft SEIS Section 7.2.2 is deficient, in part because it refers to previous EISs and reports issued prior to the 2011 Fukushima Dai-ich nuclear accident and the issuance of the Continued Storage Rule. There is no mention of the potential impacts of accidents at TVA's nuclear plants. This should be included in the Final SEIS. (*Commenter: Angela Garrone - Southern Alliance for Clean Energy et al.*)

Response: The commenter is correct that TVA references information and analyses from its earlier NEPA reviews throughout this SEIS when those reviews are relevant to the programmatic impact analyses in this SEIS. In its regulations implementing NEPA, the Council on Environmental Quality encourages agencies to incorporate by reference material to reduce paperwork. 40 C.F.R. §§ 1500.4(j), 1502.21. The EISs issued by TVA and NRC address the risk of design basis and severe accidents at all of TVA's nuclear plants. Many of these analyses have been updated and have been readdressed in subsequent environmental reviews. For example, TVA addressed the risks and potential impacts of such accidents at its Sequoyah Nuclear Plant in its Final Supplemental Environmental Impact Statement, Sequoyah Nuclear Plant Units 1 and 2 License Renewal (June 2011). Only six individuals commented on that SEIS and none expressed concerns about the update of possible accidents. Similarly, TVA updated its analyses of accidents at its uncompleted Bellefonte plant in its Final Supplemental Environmental Impact Statement, Single Nuclear Unit at Bellefonte Plant Site (May 2010). TVA has conducted two reviews of Fukushima related actions. In March 2013, it released a Final Environmental Assessment, Fukushima Response Strategy (March 2013) that covered all three of its nuclear plant sites. This EA was updated and supplemented in May 2014, Supplemental Environmental Assessment and Finding of No Significant Impact, Modifications to Fukushima Response Strategy, Hamilton and Rhea Counties, Tennessee and Limestone County, Alabama. TVA has provided links to all of TVA's EAs and EISs, including most of those referenced in and used to support this SEIS, back to 2003 on its website at http://www.tva.com/environment/reports/index.htm. Any earlier referenced documents can be obtained from TVA upon request.

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175. The Draft SEIS on page 186 states that the impacts of constructing and operating a small modular reactor plant would generally be similar to those of TVA's existing nuclear plants and the other new nuclear options, but proportionately less due to the lower capacity of the SMR plant. The Final SEIS should clarify whether these impacts would be proportionately less in all or only certain impact categories. (*Commenters: Angela Garrone - Southern Alliance for Clean Energy et al., Michelle Walker Owenby - Tennessee Department of Environment and Conservation*)

Response: The feasibility of SMRs has yet to be fully demonstrated and associated impacts of that technology in comparison with current nuclear plants will be better understood after SMR feasibility or merits are demonstrated. As the SEIS states, TVA expects the impacts associated with building an SMR plant generally to be less than those of current nuclear plants. Modular construction techniques with off-site fabrication of many components will be used with SMRs, resulting in reduced on-site construction impacts. The size of the SMR plant site would depend on the number of SMR units installed and, on an acre/MW basis, is unlikely to be larger than the land requirements for current nuclear plants. Refueling cycles for SMRs are expected to be longer than that for current nuclear plants so refueling related impacts should be less over the long term. SMR reactors would be located underground, reducing potential safety and security risks compared to current nuclear plants. The anticipated use of mechanical draft cooling would greatly reduce impacts resulting from the discharge of heated cooling water. More detailed information about SMRs would be provided in the site-specific review that TVA would conduct if it proposes to demonstrate SMR feasibility.

176. The Draft SEIS states that the main environmental impacts of the extended power uprate of the three Browns Ferry nuclear reactors are increased fuel consumption and cooling requirements, but fails to analyze their actual water use and consumption requirements. It is premature to make conclusions about these environmental impacts of the uprate given that TVA has not yet filed a license amendment request with the NRC. TVA must either analyze this in the Final SEIS or acknowledge that this issue has yet to be adequately addressed and will be addressed in a subsequent NEPA analysis. (*Commenter: Angela Garrone - Southern Alliance for Clean Energy et al.*)

Response: TVA has prepared several environmental impact assessments addressing the extended power uprate at Browns Ferry Nuclear Plant, including the 2002 Final SEIS for Browns Ferry Nuclear Plant operating license renewal for Units 1, 2, and 3 and the 2003 environmental assessment of proposed uprates of Units 2 and 3. The main issues identified in these environmental analyses are associated with increased fuel consumption, including the storage of additional spent fuel, and cooling requirements. TVA will submit an environmental report analyzing all potential impacts to NRC as part of the license amendment request. This environmental report will update the earlier analyses.

177. The use of enriched uranium fuel and subsequent production of spent nuclear fuel will increase under all alternative strategies. The Draft SEIS states that TVA intends to store this waste at its nuclear plant sites until a centralized facility for long-term disposal and/or reprocessing are operating. A further stated in the Draft SEIS, any site devoted to this long-term storage would be irretrievably committed to nuclear waste storage. The possible significant impacts of this indefinite, long-term storage of waste on-site have not yet been adequately studied by the NRC in their Continued Storage Rule. TVA must either analyze this in the Final SEIS or acknowledge it has not been adequately addressed and address it in any

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site-specific EA that TVA develops in the future. (*Commenter: Angela Garrone - Southern Alliance for Clean Energy et al.*)

Response: TVA disagrees that NRC failed to adequately study the potential impacts of its Continued Storage Rule. NRC determined that spent fuel storage on-site at nuclear plants until a permanent storage facility is available, if ever, is an activity that is similar for all commercial nuclear plants and storage facilities and therefore a generic analysis was an effective method of evaluating potential impacts from spent fuel storage. NRC issued the Generic Environmental Impact Statement for Continued Storage of Spent Nuclear Fuel (September 2014) to support its determination and its continued storage rule. During this process, it received and considered a large number of comments, including from this commenting organization. TVA takes into account other agencies' reviews of spent fuel storage, including the NRC GEIS, in its reviews. These have been most recently identified in its Final EA, Independent Spent Fuel Storage Installation Watts Bar Nuclear Plant (June 2014). Based on this EA, TVA concluded that the construction and operation of a spent fuel storage facility indefinitely at its Watts Bar Nuclear Plant would not significantly affect the environment.

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3.0 Index of Commenters

Following is a list of the commenters, their affiliations, and the identification number(s) of the comment statements to which they contributed. In some cases, hand-written names were difficult to read and the names listed below are TVA's best interpretations. This index is divided into two sections. The first section lists those who submitted individual comments. Form-style comments are identified by the name of the form (as listed above in Chapter 1). The second section lists the signers of each of the form-style comments.

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3.2. Form Commenters

3.2.1. Moms Clean Air Force Online Campaign Form

A–B

Aldridge, Bruce, Marietta, GA; Altabet, Katie, Greensboro, NC; Amos, Fred, Lagrange, GA; Anders, J, Soddy-Daisy, TN; Anderson, Barry, Kill Devil Hills, NC; Anonymous, Sevierville, TN;

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Armbruster, Jay, Knoxville, TN; Arp, Sarah, Cookeville, TN; Bailey, Craig, Rutherfordton, NC; Banbury, Scott, Memphis, TN; Bankston, Kathryn, Mauk, GA; Barnett, Michelle, Franklin, TN; Bartos, Scott, Arlington, VA; Bassett, Cheryl, Augusta, GA; Bates, Keith, Reidsville, NC; Bauer, Melissa, Woodstock, GA; Becker, Elaine, Roanoke, VA; Benefield, Julianna, Cary, NC; Bentz, Marcia, Durham, NC; Blanton, Thomas, Granite Falls, NC; Bollini, Margaret, Boone, NC; Boone, Merrill, Arlington, VA; Boyens, Marguerite, Decatur, GA; Boynton, Anne, Savannah, GA; Bristow, Mary, Brentwood, TN; Brown, Nancy, King, NC; Buresh, Stephanie, King William, VA; Burr, Deborah, Atlanta, GA; Burt, Marianna, Apex, NC

C–D

Cady, Kim, Nashville, TN; Caldwell, Sarah, Atlanta, GA; Campbell, Paula, Nashville, TN; Campbell, James Michael, Spring City, TN; Cannata, Susan, Spring Hill, TN; Carbrey, Agnes, Lexington, VA; Carlton, Ort., Athens, GA; Carpenter, Laura, Jasper, TN; Carpenter, Jonathan, Jasper, TN; Carr, Steve, Rincon, GA; Carr, Thomas, Amelia Court House, VA; Cash, Kathryn, Lexington, VA; Castaneda-Mendez, Kicab, Chapel Hill, NC; Chait, Andrea, Lithonia, GA; Chipoletti, Marilee, Pegram, TN; Clark, Ted & Susan, Gainesville, GA; Clegg, William, Jamestown, NC; Cleveland, Judy, Lexington, GA; Clewett, Barbara, Lexington, KY; Closupy, Elizabeth, Athens, GA; Coe, Daniel, Louisville, KY; Collins, Janet, Richmond, VA; Collins, TY, Clarkesville, GA; Collum, Taylor, Franklin, TN; Coppotelli, Heide, Cedar Mountain, NC; Costa, Danee, Hoover, AL; Cotter, Joyce, Decatur, GA; Cox, Lisa, Nashville, TN; Crumley, Vera, Asheville, NC; Curtis, Trish, Union Grove, AL; Darnell, Stan, Clarksville, TN; Davids, Kim, Crossville, TN; Davis, Robin, Atlanta, GA; Debnam, Justin, Raleigh, NC; DeGruchy, Joseph, Antioch, TN; DeHeus, Barbara, Elizabethton, TN; del Castillo, Nikki, Yanceyville, NC; Delozier, Stan, Maryville, TN; Denman, Clayton, West Jefferson, NC; Dennen, Kris, Leesburg, VA; Devine, Mandy, Alexandria, VA; Dillard, Johnny, Lenoir, NC; Dillon, Mason, Atoka, TN; Dishman, Patricia, Nashville, TN; Doochin, Dianne, Nashville, TN; Dowty, Roy, Collierville, TN; Driscoll, Christie, Charlotte, NC; Duchow, Jeremy, Townsend, TN; Duke, Robert, Henrico, VA

E–G

Elliott, Teri, Madison, AL; Elliott, Michael, Madisonville, TN; Escobar, Victor, Midlothian, VA; Etheridge, Donna, Raleigh, NC; Etter, David, Horn Lake, MS; Eudy, Elaine, East Point, GA; Farrar, LindA, Nashville, TN; Farris, Marcia, Manchester, TN; Fedorov, Karen, Bealeton, VA; Ferguson, Tom, Atlanta, GA; Filpin, Ryan, Nicholasville, KY; Fisketjon, Diana, Franklin, TN; Fite, Mary, Asheville, NC; Gallimore, Paul, Leicester, NC; Gearner, Olivia, Bowling Green, KY; Gilges, Peggy, Charlottesville, VA; Gilliland, Cathleen, Catlettsburg, KY; Glasscock, Marjorie, Roanoke, VA; Glick, Ed, Edgewood, KY; Gordon, Sandra, Charlotte, NC; Gordon, Paula J., Atlanta, GA; Grahovac, Theresa, Southaven, MS; Green, Laurel, Nashville, TN; Greene, Elizabeth, Lorton, VA; Greene, Elizabeth, Deep Gap, NC; Greenhill, Barry, Reston, VA

H–K

H, S, Nashville, TN; Habrecht, Joanne, Dublin, VA; Hall, Jennifer, Greeneville, TN; Hammerstein, Heidi, Pembroke, GA; Hancock, Lynne, Antioch, TN; Hardiman, G, Tucker, GA; Harter, Lynn, Suwanee, GA; Hawksworth, Melanie, Alexandria, VA; Haygood, Sammy, Clayton, NC; Haythorn, Brian, Thomasville, GA; Heald, Mark, Pleasant Hill, TN; Heaps, Jean, Hattiesburg, MS; Heater, Sherry, Knoxville, TN; Heath, Jamie, Greenville, NC; Helton, Rebecca, Galax, VA; Henderson, Diana, Staunton, VA; Henson, Candace, Martinez, TN; Hernan, Michael, Fairfax, VA; Herron, Jane, Franklin, TN; Hewitt, Erin, Palmersville, TN;

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3.2.3. Southern Alliance for Clean Energy Campaign Emails

Alexiades, V., Knoxville, TN; Barker, Lorraine, Nashville, TN; Barker, Lorraine, Nashville, TN; Bordenkircher, Dave, Nashville, TN; Boughan, Tom, Decherd, TN; Bunch, Van, Signal Mountain, TN; Carden, Kara, Mount Juliet, TN; Castle, Ron, Decherd, TN; Clarke, Mary H., Nashville, TN; Cohen, Charles, Huntsville, AL; Cutshall, Dwayne, Maryville, TN; Dean, Patrick, Sewanee, TN; Franklin, Joe, Johnson City, TN; Gottfried, Robin, Sewanee, TN; Harris, Ronald, Morristown, TN; Heald, Mark, Pleasant Hill, TN; King, Ursula, Nashville, TN; Lewis, Eric, Nashville, TN; Orr, C. R., Sneedville, TN; Posey, Jackie Tipper, Town Creek, AL; Russell, Liane, Oak Ridge, TN; Shepherd, Kurt, Nashville, TN; Spry, Richard, Nolensville, TN; Starbuck, Scott and Lisa, Knoxville, TN; Stein, Jeffry, Nashville, TN; Trantham, Jack, Erin, TN; Upchurch, Inger, Memphis, TN; Upchurch, Samuel, Memphis, TN; Wheeler, Kelly, Vonore, TN; Wilcoxson, Russ, Nashville, TN

3.2.4. Tennessee Chapter of the Sierra Club Campaign Online Form

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3.2.5. Tennessee Chapter of the Sierra Club Earth Day Postcards

The 700 signers of these postcards were not individually recorded.

3.2.6. "Tennessee Valley Citizen" Postcards

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