Tennessee Valley Authority
Regional Energy Resource Council
February 19-20, 2019
Meeting Minutes

The Tennessee Valley Authority (TVA) Regional Energy Resource Council (RERC or Council) convened for the sixth meeting of its third term at 1:00 p.m. Central on February 19-20, 2019, at the Embassy Suites Hotel, 1200 Conference Center Blvd., Murfreesboro, Tennessee 37129.

Council members attending:

Wayne Davis, Chair	Rodney Goodman	Jennifer Mundt
Doug Lawyer	Peter J. Mattheis	Jeremy Nails
Stephen Smith	Dan Ionel	
Doug Peters	Michael Butler	

Designated Federal Officer (DFO): Joe Hoagland
Alternate Designated Federal Officer: Amy Henry
Facilitator: Jo Anne Lavender

Appendix A identifies the TVA staff, members of the public, and others who attended the meeting.

Appendix B is the agenda for the meeting.

Copies of the presentations given at the meeting can be found at http://tva.gov/rerc.

1. Welcome

Dr. Wayne Davis (Chair of the Council) opened the meeting by welcoming everyone.

2. Safety Moment and Meeting Protocols

Jo Anne Lavender, Facilitator, covered the meeting protocols in her presentation (see Slide 10). She also informed the Council members that TVA was not seeking any advice from the Council at this meeting, but that there would be a

public open house at the end of the day (February 19) to get comments from the public on the Draft 2019 IRP and EIS.

3. DFO Update

Amy Henry provided the DFO update (See Slides 11 to 17).

- TVA announced the hiring of a new CEO (Jeffery Lyash) at the Board meeting on February 14, 2019. While currently serving as the President and CEO of Ontario Power, Mr. Lyash also holds office as the EPRI Chair and was previously with Duke Power and Progress Energy.
- At its February 14, 2019 meeting, the TVA Board appointed James "Skip" Thompson as its Chairman for the next two years.
- The TVA Board voted to retire two fossil plants: Paradise Unit 3 by December 31, 2020, and Bull Run by December 1, 2023.
- The TVA Board also voted to adopt a revised net metering standard to replace the standard previously adopted by the Board in 2007; and to close the Green Power Providers (GPP) program to new customers effective January 1, 2020, to phase out the GPP program completely as existing contracts with retail customers expire. The Board also delegated to the CEO the authority to design and implement a new program to replace the GPP program.
- Stephen Smith asked about the timing of the replacement for the GPP program and whether the DSS program is now dead. Amy answered that no changes were made to the DSS program and that TVA expects to make a decision on the GPP replacement by the end of this calendar year.
- Amy informed the Council that the Draft IRP/EIS was made available for public comments on February 15, 2019.
- Amy summarized the Council's prior involvement in the development of the Draft 2019 IRP/EIS (Slides 13 to 16).
- Amy informed the Council that the purpose of today's meeting was to hear views from the Council members on TVA's IRP process to date and how TVA can better engage the RERC in the IRP process. (Slide 17).

4. 2019 IRP Update (Brian Child)

Brian Child provided an update of the IRP process (Slides 18-24).

- The 2019 IRP has focused on three areas: System Flexibility, Distributed Energy Resources, and Portfolio Diversity.
- Brian outlined the scenarios and strategies addressed in the 2019 IRP (Slide 23).
- Brian provided the schedule for development of the IRP, indicating that Board approval and final publication of EIS and IRP is still expected to occur in Summer 2019. (Slide 24).
- Wayne Davis asked how TVA takes into consideration large single-step changes such as Paradise and Bull Run retirements. Brian responded that at the time TVA started running the cases, the retirements of Paradise and Bull Run were already being considered. Thus, while Paradise and Bull Run retirements were not included in the Base Case of the Draft IRP/EIS, TVA ran a sensitivity analysis for these retirements. In the Final IRP/EIS, the Base Case will be updated to reflect the Paradise and Bull Run retirements. Amy added that the retirements of Bull Run and Paradise is consistent with the 2015 IRP.
- Doug Lawyer asked about the life expectancy of the IRP. Brian indicated that looking at the cadence of IRPs developed by TVA (2011, 2015, and 2019), the life of an IRP is about 4 to 5 years.

5. 2019 IRP Process Refresh

Hunter Hydas did a quick refresh for the Council on the IRP and the IRP process (Slides 26 to 30). The IRP feeds into TVA's long-range financial planning. He covered the goals of an optimal plan (Slide 28) and the resource planning process (Slide 29). Hunter also walked through the layout of the Draft IRP and Draft EIS (including the appendices in these documents), and then navigated through sections of the TVA's 2019 IRP website.

6. Stakeholder Engagement in IRP Process

Amy Henry covered stakeholder engagement (Slides 31 to 38) in the IRP process, informing the Council on how the resource planning process conducted under NEPA leads to more informed decision-making and better outcomes.

- Amy discussed the workings of the IRP Working Group, which has met ten times through January 2019. She also summarized RERC's advice and input into the IRP process. (Slides 32 and 33).
- Amy discussed the various avenues of public outreach while developing this IRP. (Slides 35 and 36). The public outreach events included public webinars, public scoping meetings, public meetings and online meetings.
- Amy indicated that TVA's IRP website had nearly 8,000 views as of ____ (date) with an average duration of 2.5 minutes per visit.

7. Portfolio Results (Jane Elliott)

Jane Elliott presented the preliminary IRP results from the Draft IRP analysis (Slides 41-57).

- Jane started out discussing the preliminary observations (Slide 44), winter and summer capacity gaps under different scenarios (Slide 45) and incremental capacity by 2038 (Slide 46) under different scenarios and strategies.
- No new coal would be added. Among scenarios, most coal retirements occur under the Decarbonization scenario – up to 3000 megawatts.
- Incremental addition of natural gas capacity is higher in the Valley Load Growth and No Nuclear Extension scenarios as compared to the other scenarios to ensure reserves are met.
- Less gas peaking capacity added under conditions of declining load. Incremental addition of solar is significant across all portfolios and is highest in Scenarios 3, 4 and 6 and in Strategy E. There is a sweet spot in the mid-2020s to add solar based on forecasted cost trajectory.
- Strategy D (Promote Efficient Load Shape) promotes storage to the greatest extent, where it starts replacing gas.
- No storage selected when it is promoted at 100 percent marginal cost. To ensure selection and explore the impact of storage in this IRP, storage was matched with solar (10 percent storage to solar nameplate capacity in moderate promotion and 25 percent storage to solar nameplate capacity in high promotion).
- Wayne Davis asked for clarification as to which solar (utility scale or behind-the-meter solar) is more attractive. Jane indicated that utility scale

solar is more attractive based on economies of scale and is selected without promotion.

- Mike Butler asked whether TVA is pro-active or reactive on solar. Jane responded that TVA was being pro-active to the extent it could plan ahead for economic solar additions while also helping customers meet their nearer-term renewable goals.
- Doug Peters mentioned that he would be interested in knowing how TVA and LPCs could plan to be pro-active for future solar.
- Wayne Davis indicated that the path of storage was uncertain and that more storage might be promoted if the technology advances farther. Joe Hoagland agreed that the maturity level of gas was higher than storage.
- Jane stated that more EEDR added in the first 10 years of the plan; less opportunity exists in the later years as DOE codes and standards become more stringent and further penetrate.
- Mike Butler asked whether TVA was able to foresee the impact of energy efficiency. Jane indicated that TVA was predicting load growth prior to the recession. It took a while for the DOE codes and standards to have an impact, and TVA has improved methods of forecasting future impacts of codes and standards.
- Wayne Davis asked about the distribution and transmission losses. TVA's response: transmission – 2 percent; distribution – 4 percent.
- Jane indicated that storage in the Base Case is from the Raccoon Mountain Pumped Storage facility.
- Pete Mattheis asked if there was any industrial DR in the DR shown on the charts. Jane responded that current industrial DR programs were assumed to continue and additional industrial DR was not modeled, but plan to model as a sensitivity.
- In considering portfolio net load factors in 2038 (Slide 56), Scenario 5 has the most load swings.
- Jane discussed the planned sensitivity analyses (Slide 57). In addition to the sensitivities discussed in this slide, TVA would be open to any comments made on sensitivities in the Draft IRP/EIS public comment period.
- Joe indicated that while transmission is outside the scope of the IRP, TVA considers three things in making grid efficiency improvements: (1) use of super conductors; (2) managing the grid; and (3) rethinking the way the grid works.

8. RERC Discussion of Results

The salient points of the RERC's discussion of the preliminary results are captured below:

- Jennifer Mundt asked whether the closure of the coal plants takes into account costs of handling coal ash, decommissioning, etc. Jane answered in the affirmative.
- Jennifer also asked why so much solar but no wind was selected by the model. Jane responded that average cost of wind energy is 40 percent higher than solar. Wind is not an efficient resource in the Valley and importing wind from outside the Valley adds to the cost. Moreover, solar matches TVA's load shape better than wind. As to resources currently imported, more wind than solar is imported into the Valley.
- Wayne Davis asked what percent of the load electric vehicles would constitute if all gas vehicles were replaced with EVs. Jane responded that 500,000 EVs would be equivalent to about 1 percent of load, and about 4 million EVs (approximately 17 percent of load) are assumed in the Valley Load Growth scenario.
- Jennifer Mundt asked about the impact of building codes. Jane responded that this is something TVA looks at when building the load forecast. We have a wider gap to close here in the Valley than in other places with stronger codes and ordinances.
- Stephen Smith asked how TVA was dealing with the 700 MW of solar for Facebook and Google. Jane responded that this load is not in the Base Case and that Scenario 3 evaluates new load coming in. Amy Henry added that load changes capture the high and low loads to bound the cases and that the IRP is more a compass (directional) rather than a GPS. Jane added that TVA plans to perform a sensitivity on the impact of accelerated solar, such as for Facebook and Google.
- Stephen Smith also asked whether TVA modeled the possible loss of Memphis as a customer. Jane indicated that the low load case covers significant load loss that could be driven by a number of factors. In fact, the Rapid DER adoption scenario covers a load loss greater than Memphis.

9. Public Listening Session

Four speakers provided comments at the public listening session.

Tony Montagano

- Tony Montagano raised a question as to whether plans and projections were aggressive enough for sustainable resources. He indicated that gas is a limited resource and that we need more sustainable energy in the resource plan.

Ric Perez

- The options outlined in the Draft IRP do not look at non-CO2 nuclear options, beyond SMR. He encouraged the Council to look at advanced fuel design nuclear options that should be commercialized by 2022 and could be game changers.
- Minimum load on the system is a significant issue. While we look at peaks and capacity, decisions are made around efficiency of units and minimum loads are a big deal. While Cumberland has 2500 MW (big units), the capacity factors at Cumberland are under 50 percent. Does it make sense to keep those units? The IRP identifies the need for agility and flexibility. If the nuclear units are upgraded, large units like those at Cumberland will no longer be needed.
- There is a big push for DER and community-scale solar. In the Rapid DER scenario, since distribution resources occur across the Valley, the requirements for TVA would go down. The annual revenue requirements are static and common across all scenarios, and this assumption should be challenged under Option 5 (Rapid DER Adoption scenario). TVA's costs could not be the same with adoption of DER as this drives local ownership.

Eli Molydra

- He is involved in organizing to promote renewables and thanked the Council for opening the meeting to the public. He echoed what the earlier two speakers mentioned.

- He indicated that the projected shift away from reliance on fossil fuels is not as ambitious as had been expected.
- He was hoping to get answers to the question as to what are the obstacles to TVA making a greater shift to energy independent resources, and wondered why this is not happening faster.

Kirk Sorensen (from Huntsville, Alabama)

- He has an engineering background from Georgia Tech. He worked on solar power systems for satellites while at NASA.
- He was initially very interested in solar, but then learned about thorium technology, which was pioneered at ORNL for nuclear reactors. This technology would help decarbonize the future.
- There are no nuclear additions in any of the scenarios in the IRP, only the reduction of Browns Ferry. Thorium has a lot of promise as it is a form of nuclear energy that is responsive to load (*i.e.* follows load) and not used just for meeting the base load.
- Thorium would minimize the environmental footprint. Solar and wind take up a lot of land, and the amount of power generated by solar/wind per unit of land is low compared to the dense footprint of nuclear. Consider this technology as it could be used at brownfields that are already tied to the grid.

10. Metrics and Scorecard Results

Hunter Hydas discussed metrics and scorecard results (Slides 68 to 88).

- There are 5 categories of metrics. Among the metrics identified in Slide 70, three are new for purposes of this IRP: Total Resource Cost, Land Use, and Flexible Resource Coverage Ratio. The Flexible Resource Cost Ratio gets at capacity available in the “duck curve” phase to meet the need for quick ramps.
- Slide 71 describes the alignment of the metrics with TVA’s 3-part mission.
- Hunter went over the preliminary scorecard observations set out in Slide 72.
- Pete Mattheis questioned the usefulness of economics as a metric since all strategies have the same impact on the Valley economy. Amy Henry

responded that the metric is useful to the extent it looks at different activities to determine if there is an impact.

- Strategy B (Promote DER) has the highest participant cost as shown in Slide 73.
- The System Average Cost chart (Slide 74) shows that the costs are higher during the second half of the plan implementation period.
- In Slide 75, PVRR is an indicator of debt pressure while the system average cost represents rate pressure. On this slide, 6C represents where SMRs are forced in.
- Jennifer Mundt asked where TVA was at the present time on Slide 75. Hunter responded that we are at point 1A: about 6.9 to 7 cents per kWh.
- The risk metrics for the current outlook are shown in Slide 76. The highest risk exposure is for Strategy 1D because it has the most storage.
- Mike Butler asked whether risk is a cost. Hunter answered that risk does represent cost. There is a cost trajectory for storage, but if technology for storage advances faster, the anticipated costs could also change.
- In Slide 77 (Portfolio Cost and Risk Exposure), the greatest risk is at the top right corner. The Rapid DER Adoption scenario (bottom left corner) is the lowest with respect to both cost and risk.
- Pete Mattheis asked how sensitivities would be reported out. Hunter answered that the sensitivities are in Chapter 8. We will summarize the results of the sensitivities in the Final IRP.
- Jennifer asked why Valley Load Growth means more risk to the Valley (Slide 77). Hunter explained that growth entails expansion and building more that in turn results in higher risk exposure.
- Hunter covered the environmental metrics (Slides 78-80).
- The flexibility metrics (Slide 81) show that strategies with higher coverage ratios have lower flexibility turn down factors.
- Strategies have an impact within scenarios, but scenarios by far have the greatest impact on results. (Slides 33 to 36).
- Sensitivity results and public comments would be considered by TVA in making the final 2019 IRP recommendation.
- Hunter explained Slide 88, which shows the 2015 IRP recommendation. Wayne supported the format of the recommendation as it makes it easier to visualize how the recommendation is expected to be implemented in the future.

11. Environmental Impact Statement

Matthew Higdon provided a description of the Draft EIS prepared in conjunction with the Draft 2019 IRP (Slides 89 to 97).

- Volume 2 of the Integrated Resource Plan is the Environmental Impact Statement (EIS). This is a programmatic EIS that allows broad coverage through a generic analysis of the impacts of the action. As the IRP is implemented, site-specific environmental reviews may be necessary for individual actions falling under the IRP.
- Chapter 5 (outline of chapter in Slide 90) is the heart of the EIS analysis.
- There are several environmental impacts quantified in the Draft EIS as shown in Slide 91. The bolded items are the new impacts that will be quantified included in the 2019 EIS. The underlined items are the primary environmental metrics used in scorecard.
- Slide 92 shows the CO2 emissions from the five alternative strategies, with the whiskers representing variations among scenarios.
- The trajectory of the CO2 emissions over the planning horizon (Slide 93) shows that there is not much variation in the first 5 years. There is a bump in 2026 due to fewer coal plant outages, a decrease in 2033 at the end of the Red Hills contract period, and then an uptick in 2035 due the potential retirement of Browns Ferry Nuclear units.
- The CO2 intensity decreases (as compared to the Base Case) for all alternatives (Slide 94). Water consumption (Slide 95) represents evaporation losses which are less than 2 percent. The variation in water consumption among alternatives is less than 3 percent.
- The coal waste (Slide 96) closely tracks coal generation. This reflects the retirement of several TVA coal units and the end of the Red Hills contract by 2035.
- Land requirements (Slide 97) are the greatest under Strategy D (Promote Efficient Load Shape) and lowest under Strategy B (Promote DER). The whiskers (variations) are dramatically different between the alternatives.
- The Draft EIS also discusses socio-economic impacts, including those from future coal retirements.
- Mike Butler stated that the groundwater wells in Memphis are currently not being used. He asked whether the EIS analysis takes into account such

significant future uses such as the withdrawals at Memphis. Joe Hoagland indicated that water use in the chart foresees such high capacity users.

- Jennifer Mundt asked how TVA would select from the 30 portfolios analyzed in the IRP/EIS. Matthew indicated that the discussion on the recommended strategy would take place as TVA moves from the Draft to Final EIS.
- Doug Lawyer asked whether the timelines for Bull Run and Paradise had been defined. Matthew stated that Bull Run would be retired by 2023 and Paradise by 2020. It has not been decided yet as to what TVA would do with these plants after retirement.

12. IRP Next Steps

Hunter Hydas explained the next steps in finalizing the IRP (Slides 105 to 110), leading to the staff's recommendation to the TVA Board in Summer 2019. Slide 109 provides a listing of Valley-wide meetings planned for February and March 2019.

13. RERC Discussion

The Council was divided into pairs to discuss the results and to provide feedback on those results. The individual feedback is summarized below:

- Pete Mattheis stated that he was surprised at the similarities among strategies and at the information that was being managed in this IRP process. He suggested that we review how well TVA did with its forecasting in the past IRPs and what it could do better.
- Doug Peters stated that the load shape numbers (after accounting for DER) used by TVA would not be as accurate as they would otherwise be if a Distributed IRP (DIRP) had been prepared. The results of the DIRP should feed into TVA's IRP.
- Dan Ionel stated that there is research in California about the nexus between DR and efficient load shapes. Learnings from California will not translate directly due to climate and demographic differences.
- Mike Butler stated that 8,000 views on TVA's IRP website is tiny in the overall scheme of things. We need to boil things down to what is understandable to the customer. People need to know their existing

electric consumption as otherwise it is impossible to do the tradeoff analysis.
- Rodney Goodman articulated the challenge to get people to read and absorb the IRP. Brochures and interactive online communications would be helpful.
- Wayne Davis stated that this is an excellent and thorough report, but it is overwhelming for the average user. Three things for TVA to consider: (1) what is it that TVA wants to communicate to local providers and people at large; (2) what is it that TVA is trying to communicate and what is it that TVA is actually communicating; and (3) need to explain what "good, better, best" means.

14. RERC Discussion on Questions

The views of individual Council members on three specific questions are outlined below:

What is your assessment of TVA's IRP process to date?

- Pete Mattheis stated that no other utility engages stakeholders the way TVA does.
- Jennifer Mundt echoed Pete's comments, comparing TVA's transparent work to the "black-box" process used by NC utilities.
- Wayne Davis stated that all portfolios assessed in the IRP move towards lesser environmental impacts. TVA should focus on the aspect that the outcomes in all portfolios improve the environment. Jennifer Mundt agreed, asking TVA to emphasize the downward trend in emissions.
- Mike Butler stated that the analysis in the IRP is awesome. The level of thinking in the two volumes is much deeper than what the executive summary shows.
- Doug Lawyer stated that TVA should highlight the economic development aspect, highlighting the businesses brought to the Valley in advancing TVA's vision through the IRP.
- Jennifer Mundt encouraged TVA to communicate with tribes and environmental justice stakeholders.
- Dan Ionel praised the IRP process. TVA had fully engaged not only the RERC but also the IRP Work Group.

- Doug Peters indicated that what the LPCs can bring to the table in future planning efforts is the DIRP.
- Jeremy Nails appreciated TVA involving all the different stakeholders.

How can TVA better brief or engage RERC in the IRP process?

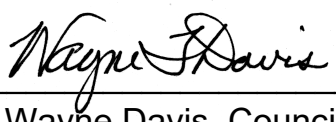
- Mike Butler stated that TVA has done well. Council members need to study the documents to bring more to the table.
- Wayne Davis indicated that TVA has done a good job. He suggested that TVA provide more explanation for the various charts and tables in the IRP.
- Rodney Goodman stated that it would be helpful if TVA provides a summary of the changes as it moves forward.

What suggestions do you have as TVA moves from the Draft IRP to the Final IRP?

- Wayne Davis asked TVA to consider nuclear technologies brought up in public comments. Advances in nuclear technologies are particularly relevant since nuclear has the advantage of providing zero-carbon generation.
- Mike Butler asked TVA to recognize the limitations of models used to make predictions as these predictions are best guesses and can be wrong.
- Wayne Davis supported the format used to provide recommendations in the 2015 format.

Joe Hoagland and Wayne Davis thanked members for their input and for a great discussion on the IRP. The meeting adjourned at 11:30 p.m. Central on February 20, 2019.

Minutes approved:



Dr. Wayne Davis, Council Chair

Date: 04/11/2019

Appendix A
Non-Council Meeting Attendees

TVA Staff			
Jane Elliott	Hunter Hydas	Jessica Coleman	Brian Child
Amy Henry	Jo Ann Lavender	Mathew Higdon	Khurshid Mehta
Barbie Perdue	Michael Scalf	Liz Upchurch	Wilson Taylor
Joe Hoagland	Josh Clendenen		

Members of the Public In Attendance
Christina Reichert
Luisa Freeman
Jason Myer
Kurt Harris
Kirk Sorensen
David Liffrig
Ric Perez
Ellena Souie
Konyn Gwile
Eli Motydra
Anjay Friedman
Steven Muphree

Other
Jennifer Torregiano, Office of the Inspector General
TVA Police

Appendix B
Meeting Agenda

Regional Energy Resource Council

February 19-20, 2019

Meeting Location: Embassy Suites Hotel

1200 Conference Center Blvd., Murfreesboro, TN 37129

Day 1 February 19, 2019	
12:00	**Lunch – RERC (Mirabella D)**
1:00	**Welcome** (Wayne Davis) Welcome (Joe Hoagland/ DFO) Introductions - Council Members **Safety Moment** Building Emergency Plan / Lavender
1:15	**DFO Update and Meeting Purpose** DFO Joe Hoagland / Alt DFO Amy Henry **Recap December 2018 Meeting**
1:30	**RERC Overview and Meeting Protocols** Jo Anne Lavender
1:35	**2019 IRP Update** Brian Child
1:45	**IRP Process Refresh** Hunter Hydas and Amy Henry
2:00	**Break**
2:15	**Draft IRP Documents and Preliminary IRP Results** Jane Elliott
3:45	**Discussion Time – RERC**
4:15	**Break to prepare for Public Open House**

4:30	**Public Open House - 2019 Draft Integrated Resource Plan and EIS**
5:00 – 6:00	**Public Listening Session**
6:00	**Adjourn**
6:30	**RERC Dinner**
Day 2 **February 20, 2019**	
6:30 – 8:15	**Breakfast** (Hotel Dining Room; reserved group seating)
8:30	**Welcome, Recap and Day 2 Overview** Lavender, Davis, Hoagland
8:40	**Scorecard Results** Hunter Hydas
9:10	**IRP EIS** Matthew Higdon
9:20	**Break**
9:35	**IRP Discussion & Questions** Lavender and RERC
10:15	**Break**
10:30	**Continue Discussion** Lavender and RERC
11:00	**IRP Report and Next Steps** Hunter Hydas
11:15	**Next Steps and Wrap Up** Lavender, Davis, Hoagland
11:30	**Lunch on site or to-go**