TVA People's Hearing
Testimony
Taylor McNair

Please state your name.
Taylor McNair.

By whom are you employed?
GridLab.

Have you testified in other IRP proceedings before?
No, this is my first.

Do you have any materials or exhibits in addition to your testimony?
Yes.

Have those been provided in advance?
Yes.

Mr. Chairman, with your permission, may the witness present their testimony?

Thank you, Mr. Chairman.

[Slide Coverpage] Please state your name, occupation, and work experience.
Again for the record, my name is Taylor McNair and I'm the program manager at GridLab. GridLab is a national nonprofit organization that provides technical assistance to policymakers, regulators, and clean energy advocates on the energy transition.

Why is Integrated Resource Planning a critical process in the utility regulatory space?
As we heard today already, Integrated Resource Planning is important as it presents an opportunity for utilities and stakeholders to understand the energy needs of the community, develop a set of metrics and inputs to help achieve those goals, and prepare for near and long-term risks, challenges, and opportunities to meet electricity needs.
The planning process should be transparent; it should accurately represent the actual costs to ratepayers, system impacts, and resource value. And the plans should evaluate opportunities to meet critical goals relevant to not just utilities themselves, but to the stakeholders, regulators, and ratepayers it serves, including reliability, affordability, equity, environmental goals, and more.

[Slide 1] Please summarize the methodology of results of your analysis: TVA's Clean Energy Roadmap.
In pursuit of these goals, GridLab, working with the Center for Biological Diversity, engaged Synapse Energy Economics, a leading energy consulting firm, to evaluate the TVA planning process and help understand if TVA's current proposals are aligned with the needs of the Valley customers and the public at large. The analysis is a guide to inform the 2024 TVA IRP,

demonstrating how TVA can accelerate fossil fuel retirements, enhance renewable resource procurements, and reduce costs for ratepayers, all while delivering substantial economic and environmental benefits for the Valley.

Our driving question was simple: Is TVA prepared to meet national clean energy goals while continuing to deliver benefits to its customers?

[Slide 2] Methodology
Synapse, in consultation with community stakeholders and environmental groups, conducted an analysis of TVA's resource generation mix using electric-sector capacity expansion and production cost modeling. Synapse utilized the EnCompass modeling tool, the same tool that TVA is using to perform its 2024 IRP analysis.

Synapse developed two core scenarios to help evaluate TVA's plan:

The **TVA Baseline scenario** models a status-quo approach, utilizing TVA's 2019 IRP as a benchmark while relying on updated assumptions to reflect today's cost of generating resources, including the impact of the Inflation Reduction Act.
The **100% Clean Energy** scenario requires TVA to achieve 100% clean energy generation by 2035, while also increasing demand-side electrification of buildings, industry, and transportation.
A third scenario, the **Ambitious DER** scenario, explores an even greater expansion of demand-side resources, such as rooftop solar, battery storage, and flexible load.

The 100% Clean Energy scenario and Ambitious DER scenario both require TVA to reduce electric-sector emissions by 80% by 2030, and 100% by 2035, relative to 2005 levels. The TVA Baseline scenario has no emissions constraint applied to the model.

Beyond the emissions constraint applied within the model, the scenarios feature near-identical input assumptions in order to offer a reliable point of comparison between TVA's current planning process and a future clean energy transition. The scenarios feature a few key differences related to energy efficiency measures, electrification, Distributed Energy Resources, and the Planning Reserve Margin assumptions.

- Energy efficiency: the TVA Baseline scenario assumes relatively low levels of energy efficiency, commensurate with its 2019 IRP, whereas the clean energy scenarios feature efficiency levels rising to 1.5% savings per year, on par with efficiency levels achieved by neighboring states.
- Electrification: the TVA Baseline scenario assumes relatively low levels of electrification in the building, transportation, and industrial sectors. The clean energy scenarios model a future in which appliance and vehicle sales rise to 100% all electric by 2030, and 80% of industrial end-uses are electric by 2050.
- Distributed Energy Resources: the TVA Baseline scenario assumes low levels of DER's akin to the 2019 IRP assumptions. The clean energy scenarios utilize TVA's "medium"

and “high” projections for rooftop solar and battery storage. All scenarios rely on demand response as a candidate resource.
- Planning Reserve Margin: The TVA Baseline scenario assumes a Reserve Margin equivalent to TVAs 2019 IRP – 17% in the summer, and 24% in the winter. The clean energy scenarios apply a year-round 17% reserve margin.

Utilizing these assumptions and scenario design, Synapse ran capacity expansion and production cost models to evaluate how the resource mix would change over time in order to meet rising electricity demand. In addition, Synapse performed analysis on other impacts of the energy transition including: jobs and economic impacts; rates, bills, and energy burden impacts; public health impacts; water and land use impacts.

Results Summary
In summary, we found that a 100% clean energy transition for TVA would deliver over $255 billion in economy-wide net savings for Valley customers. The transition would support 15,000 jobs each year, and deliver over $27 billion in public health benefits relative to the Baseline. At the same time, TVA would reduce electric sector carbon emissions to zero while reducing the energy burden of TVA ratepayers.

[Slide 3] Our modeling framework follows the basic IRP structure
To begin, Synapse developed a bottoms-up load forecast in order to evaluate how demand for electricity would change over the study period. In 2020, electricity demand for the TVA region was 164 terawatt-hours. In the TVA Baseline scenario, final electric demand is only slightly higher in 2050 than today. In contrast, the clean energy scenarios see electricity demand rise moderately in the early years, followed by rapid acceleration resulting in a doubling of electricity demand by 2050. In the 100% Clean Energy scenario, electricity demand is 406 terawatt-hours as a result of aggressive, economy-wide electrification.

[Slide 4] How would TVA meet demand in this scenario?
As electricity demand rises throughout the study period, solar, wind, and battery storage resources ramp up to meet rising energy needs. In the 100% Clean Energy scenario, this means that 78% of 2050 generation comes from renewable resources, with the remaining comprising existing nuclear and hydropower. New clean energy resources come along earlier in the 100% Clean Energy scenario compared to the TVA Baseline scenario, as fossil fuel plants retire earlier to meet the emissions constraint.

Even without the imposed emissions constraint, the TVA Baseline is still impacted by natural economic forces that accelerate the retirement of some fossil fuel plants and increase deployments of clean energy. By 2050, the TVA Baseline scenario adds 34 GW of solar, 3 GW of distributed solar, 13 GW of wind, and 9 GW of battery storage.

In contrast, the 100% Clean Energy scenario sees an accelerated deployment of clean energy resources. In response to the binding emissions constraint, this scenario begins rapidly adding wind, solar, and storage to the system in the 2020s. In this scenario, we also assume that only 5

GW of each renewable resource can be built per year, in order to reflect existing supply chain and manufacturing capacity. In many years, this cap is binding, suggesting the system needs the maximum amount of new clean energy capacity possible.

On average, the clean energy scenario requires annual builds of 3.6 GW of solar, 1.5 GW of wind, and 1.7 GW of battery storage. In sum, the total renewable additions are staggering, and far beyond what TVA has currently proposed to meet its clean energy needs: 41 GW of new wind, 46 GW of new battery storage, and 103 GW of new solar energy by 2050.

The Valley region is relatively constrained by the quality and quantity of new wind resources. In order to account for this, we allowed the model to build new transmission lines to neighboring regions to bring in cost-effective wind resources. Despite the added cost for new transmission – $45 billion by 2050 – the model selects 94% of new wind resources out of region.

As the needs of the system rise and firm generating resources retire, the model depends increasingly on battery storage to meet load. In the later years of the study period, the model requires multi-day energy storage to meet the mismatch between renewable generation and electricity demand. As such, nearly one-quarter of all battery storage built, primarily in the late 2040s, is 50-hour storage.

Is a portfolio with this much variable renewable energy reliable?

To evaluate the reliability of the portfolio, Synapse tested how the generation mix would meet load across every hour of the year in 2050. The modeled portfolios meet the binding reserve margin requirement at all times. While some periods experience a small number of loss-of-load-events, Synapse compensates by adding additional long-duration energy storage resources to meet any periods of unserved energy.

[Slide 5] What would this portfolio cost?

Synapse modeled the economic impact of this energy transition, including not just the costs incurred in the electric sector, but also the impact of increasing electrification in the transportation, building, and industrial sectors.

The costs for both scenarios remain similar through the early 2030s – approximately $5 billion per year. However, as clean energy deployments ramp up in the 100% Clean Energy scenario, costs rise to accommodate a dramatic build out of generating resources and grid improvements. By 2050, costs in the 100% Clean Energy scenario rise to approximately $9 billion per year. In the TVA Baseline scenario, alternatively, costs remain largely flat as a result of limited demand growth.

However, on a per-MWh basis, the costs of the clean energy scenario are similar or cheaper than Baseline. As electricity demand grows in the clean energy scenario, increased grid investments are spread out across a larger number of MWh, resulting in similar costs per MWh, around $25-30/MWh in 2050, cheaper on average than today's system.

Importantly, while the electric system investments are substantial, these costs are more than offset by savings in other sectors. As a result of a transition to electric vehicles and electric home appliances, spending on expensive fossil fuels, such as natural gas to heat homes, falls to zero. As a result, non-electric fuel savings add up to nearly $240 billion in cumulative savings through 2050 – 7 times greater than the costs of building out the electric sector.

When these combined factors are taken into account, the importance of economy-wide action is evident. While TVA is not in a position to force its customers to purchase electric vehicles or electric heat pumps, TVA is in a position to support that transition. A comprehensive focus on electrification, grid integration, customer and demand-side flexibility, and an expansion of customer-owned resources can all help enable this transition.

[Slide 6] What does it mean for ratepayers?
After calculating the total system impacts of the energy transition, Synapse then allocates those costs and benefits to individual ratepayers based on the customer class – residential, commercial, and industrial users.

Many customers will actually consume more electricity as they transition away from fossil fuels and rely increasingly on electric appliances and vehicles. Additional energy efficiency measures might cushion this increase.
On a simple $-per-kWh basis, Synapse finds that electricity rates in the 100% Clean Energy scenario remain largely stagnant or slightly decrease over time. However, the estimated monthly bill for a residential consumer in 2050 is about 13% larger.

Importantly, electric bills are just one component of the equation. As consumers spend more on their electric bill modestly over time, we estimate that they reduce spending on fossil fuels for things like heating their home and driving vehicles. Because of this, we estimate that the energy burden – the percentage of annual household income that goes towards energy costs – falls in the Valley, from 7% today to 3% in 2050. The transition to 100% clean energy and an electrified economy has the effect of keeping more money in the pockets of ratepayers, allowing them to spend more freely on other things.

[Slide 7] Job and Economic Impacts
Synapse utilized the industry-standard IMPLAN model to estimate the employment impacts of a transition to 100% clean energy in the Valley. As a result of a dramatic build out of electric sector infrastructure, and the commensurate economic activity from increased construction, manufacturing, and related activity, the Valley stands to add over 15,000 full-time equivalent jobs each year through 2050. Of course, these figures represent a snapshot based on current policy and economic activity. Increased clean energy generation may drive more manufacturing to the region, like an influx of EV manufacturing for example, that could keep additional jobs in the Valley.

Public Health Impacts

TVA's generation fleet is the 6th largest in the country – highlighting the critical importance that this public power provider has not just on the Valley region, but on the nation as a whole. A large portion, nearly 60% of its capacity, consists of fossil fuels, the burning of which results in harmful air pollutants such as NOx, SOx, and particulate matter, as well as climate warming carbon dioxide. These pollutants – which are linked to increased health issues such as asthma or heart conditions, as well as premature death – have dramatic implications for the health of the region. Utilizing the COBRA model developed by the U.S. Environmental Protection Agency, Synapse is able to quantify the economic impact of these pollutants. Overall, as a result of the transition to clean generating resources, electric vehicles, and cleaner appliances, the 100% clean energy scenario amounts to nearly $27 billion in public health benefits relative to the TVA Baseline scenario.

The social cost of carbon – a metric developed by the federal government to evaluate the amount of harm "avoided" by reduced greenhouse gas emissions – provides another variable to evaluate the benefits of a clean energy transition. As a result of the phase out of fossil fuels and the related greenhouse gas emissions, the 100% clean energy scenario avoids over $265 billion in damages through 2050.

Where will we site all of this renewable energy?
As described earlier, the 100% clean energy scenario requires a dramatic expansion of new clean energy resources. TVA's service territory currently encompasses an area of roughly 60 million square miles. Because a majority of wind resources are assumed to be built outside the region, utility-scale solar has the largest land-use requirements for a 100% clean energy future – approximately 540,000 acres in 2050 – or just 1% of the entire service territory of TVA. As a point of comparison, if 540,000 acres of new utility-scale solar were allocated equally across all 200 counties that TVA serves, each county would need to host approximately 2,700 acres of solar – about 480 MW – equivalent to 1-2 average utility-scale solar sites.
The land-use burden could be further eased by transitioning some utility scale development to rooftop solar. The 100% clean energy scenario builds 4 GW of distributed solar by 2050 – an amount of rooftop solar that would occupy just 4% of the estimated rooftop space available in the TVA region. In the Ambitious DER scenario, this rises to 6 GW – covering 6% of available rooftop space in the region.

What about distributed energy?
We also evaluated a sensitivity of the 100% Clean Energy scenario, in which TVA is required to procure additional rooftop solar and battery storage resources sited behind the meter. The scenario also includes flexible load resources, in which certain end-uses are capable of "load shifting." In this analysis, we assume that some end-uses, for example electric space heating or EV charging, can defer load for a few hours.

In this scenario, the model replaces 16 GW of 8-hour battery storage that it otherwise builds in the 100% Clean Energy scenario, as well as other utility-scale renewable resources. The addition of increased flexible demand-side resources results in wholesale electric system costs that are $1.5 billion cheaper in 2050 than the 100% Clean Energy scenario.

Summary
Overall, we found that a 100% clean energy transition for TVA would deliver over $255 billion in economy-wide net savings for Valley customers. The transition would support 15,000 jobs each year, and deliver over $27 billion in public health benefits relative to the Baseline. At the same time, TVA would reduce electric sector carbon emissions to zero while reducing the energy burden of TVA ratepayers.

What does this mean for TVA?
While this analysis was developed in 2023, prior to the 2024 IRP, it offers just one potential pathway for TVA to serve as a model for the rest of the nation on power sector decarbonization. The current information provided by TVA does not suggest that they plan to evaluate 100% clean energy pathways, or accelerate fossil retirements beyond those already announced. Recent announcements suggest that TVA continues to rely on new fossil investments to replace its aging coal fleet. While some of TVAs proposed scenarios and strategies address these topics, it’s unclear if TVA’s portfolio analysis will go as far as evaluating a 100% clean energy system, or higher levels of emissions reductions.

I recommend TVA’s 2024 IRP include explicit carbon reduction scenarios, including pathways to achieve 100% clean electricity by 2035. TVA should also evaluate opportunities to increase customer adoption of demand-side resources such as rooftop solar, battery storage, energy efficiency and flexible load measures. TVA’s 2024 IRP should include robust consideration of the anticipated effects of increased electrification on the transportation, buildings, and industrial sectors.

Our analysis suggests that an ambitious clean energy pathway for TVA can save consumers money, provide economic and human health benefits to the region, and allow TVA to serve as a national model for power sector decarbonization.

Thank you, Mr. Chairman, that concludes my testimony.