Charles P. Nicholson
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Tennessee Advanced Energy Business Council

Dear Mr. Nicholson,

The Tennessee Advanced Energy Business Council champions advanced energy as a job creation and economic development strategy. No other entity in the state concentrates specifically on this robust sector.

We educate public officials and business leaders about Tennessee's advanced energy assets, establish strategic partnerships to connect assets with opportunities, and inform policy that expands and strengthens the industry.

TAEBC seeks to understand the advanced energy sector's priorities (users of energy, manufacturers, installers, researchers, entrepreneurs and service providers), share information about the value of this sector with public and private sector leaders, and develop programs that connect and leverage our state's assets with opportunities to promote Tennessee's advanced energy economy.

Rather than favoring specific technologies, advanced energy is technology neutral. Any technology that makes energy cleaner, safer, more secure and more efficient is considered advanced energy. Examples include electric and plug-in hybrid cars, lightweight composites for the automotive industry, natural gas fueled trucks, pollution control equipment, bio energy, high-performance buildings, more efficient industrial processes, power reliability, combined heat and power and the latest wind, solar, and nuclear technologies.

Our optimism is well-founded. The *Advanced Energy Now 2015 Market Report*[i] published by Advanced Energy Economy, indicated strong growth globally and nationwide in the advanced energy market. At nearly $1.3 trillion in estimated global revenue for 2014, the market for advanced energy products and services is as large as apparel and fashion and almost four times the size of the semiconductor industry worldwide.

The study, conducted by Navigant Research, found that advanced energy in the United States was an estimated $199.5 billion market in 2014, up 14% from 2013 ($169 billion), and five times the rate of growth of the U.S. economy overall. Areas of growth included solar energy (up 39%) and natural gas generating equipment (48%), in long-anticipated response to lower-priced natural gas supplies. Wind power, which suffered a severe setback in 2013 due to the on-again, off-again federal production tax credit (PTC), rebounded in 2014 with four-fold growth, to

$8.2 billion, and a pipeline of projects that could result in revenue rivaling the $25 billion realized in 2012, its biggest year to date.

TAEBC appreciates the opportunity to review and offer comments in response to TVA's Draft 2015 Integrated Resource Plan (IRP). Our comments seek to provide context for TVA's decisions that could make a lasting contribution to Tennessee's economic base over the next decade. We are thankful to be part of the conversation about how to meet the demand for electricity over the next 20 years.

**RESPONSE TO DRAFT 2015 INTEGRATED RESOURCE PLAN**

We offer the following comments to the Draft 2015 IRP:

- Both commercial and public entities in Tennessee are seizing advanced energy to increase their financial performance or competitive edge in the marketplace. TVA has the opportunity to partner with private industry to embrace the benefits of advanced energy for the TVA grid, the local power companies, and the nine million ratepayers in the Valley. Some examples listed below show advanced energy projects currently taking place in the region. Owners of these projects are leaders within their communities; making early adoptions in technologies that benefit the economy and their bottom line. As these projects become more cost-effective and grid parity is achieved, consumers will meet energy demand based on technology preference and the added value distributed energy adds to their operation. We believe there is an opportunity for TVA to work with end users to deploy distributed generation to maximize the technology's full benefits in the Valley.

**TECHNOLOGY: Waste to Energy Gasification**

- **Wampler's Farm Sausage, Loudon, TN**: One of the region's oldest privately-owned businesses uses locally-grown switchgrass as a feedstock to produce power from the hydrogen on-demand system. The PPI CHyP System is supplemented by 530 kW of solar photovoltaic panels installed in 2009 and 2011. The installation includes a series of CHyP Engines integrated into a fully automated process. Each individual CHyP Engine can produce enough hydrogen gas to generate 500 kW. The CHyP units are paired with a series of 375 kW generators that provide power directly to the sausage manufacturing facility.
- **City of Covington, TN:** This West Tennessee city of 9,000 deployed a downdraft gasification system from PHG Energy of Nashville to cleanly convert both biomass wood waste and sewer sludge to fuel gas, and then to electricity utilizing a 125 kW General Electric organic rankine cycle generator. Each day 12 tons of waste material that would otherwise be put in landfills is processed, with highly marketable carbon biochar as the only

byproduct. The plant covers its own parasitic load for power and exports electricity to the co-located waste water treatment plant.

**TECHNOLOGY: Solar Power**

- **Schneider Electric, Smyrna, TN:** Demonstrating its commitment to research and development in the advanced energy sector, in 2011, Schneider Electric opened the US' first megawatt-scale dual voltage solar farm at its medium voltage manufacturing facility in Smyrna. The 1 megawatt solar plant was wired to the industry standard 600 Volts DC, but also to 1,000 Volts DC in order to test new equipment and solar inverters. By increasing the DC voltage of photovoltaic strings from 600 Volts to 1,000 Volts, greater efficiencies can be realized through lower energy losses, smaller wire, and less equipment.
- **Volkswagen, Chattanooga, TN:** In January 2013, Volkswagen dedicated the largest solar installation at an automotive manufacturing facility in the United States and the single biggest solar installation in Tennessee. The 9.5 Megawatt solar system provides 12 percent of the power required for Volkswagen's massive Chattanooga assembly plant when in operation, and 100 percent of the power when not in operation.

**TECHNOLOGY: Advanced Lighting**

- **Thompson-Boling Arena, University of Tennessee, Knoxville**: One of the nation's largest basketball arenas has installed an advanced energy technology, developed at Oak Ridge National Laboratory, featuring lights that are smaller, brighter and up to 85 percent more efficient than conventional arena metal halide lights. Developed by Oak Ridge based LED North America and installed by Bandit Lites of Knoxville, the lights can be turned on or dimmed in seconds. Cooled by graphite foam, another ORNL technology, the ninety 400-watt LED lights produce 200 foot-candles per square foot, compared to the 130-foot candles output in the arena's previous lights.

**TECHNOLOGY: Combined Heat and Power**

- **Eastman Chemical, Kingsport, TN:** Approximately 21 sites in Tennessee utilize combined heat and power.[ii] The chemical and paper industries utilize most of that capacity for a total of 592 megawatts. The benefits of CHP are clear, improved power reliability, lower emissions and an ability to meet corporate energy efficiency goals.

**TECHNOLOGY: Smart Buildings**

- **Nissan Paint Plant, Smyrna, TN:** Nissan's new paint plant is projected to be 30% more energy efficient than the body-on-frame plant it replaced. The new plant was designed and constructed with energy efficiency as part of the

specification and replaces a vehicle paint plant that had been in operation since 1981.

This list is not all-inclusive but rather a selection of how companies are seizing these technologies to gain a competitive advantage.

- Companies **want** access to these advanced energy technologies, like the technologies described above. And TVA is in a unique position to pilot, incentivize, deploy and evaluate these technologies. TVA should not limit access to the $1.3 trillion dollar industry and should keep its options open when considering how to provide reliable, affordable and clean energy to Tennessee and the Valley.
    - *Power Forward 2.0: How American Companies are Setting Clean Energy Targets and Capturing Greater Business Value*[iii] shows that Fortune 100 and Fortune 500 companies are increasing the demand for cleaner, more efficient sources of energy. The report found that 53 Fortune 100 companies reporting on climate and energy targets are collectively saving $1.1 billion annually through their emission reduction and renewable energy initiatives-which certainly qualify as advanced energy.
    - *Power Forward 2.0* further indicates that 215 companies in the Fortune 500 have set targets in one of three categories and will be looking for ways to meet them: 1) greenhouse gas reduction commitments, 2) energy efficiency and 3) renewable energy. Many of these companies have Tennessee ties, including FedEx and General Motors.

  Here are a couple of examples of how the draft IRP might have the unintended consequences of limiting economic opportunities that advanced energy provides. This is a short list and is not all-inclusive.

    - Looking at the Peak Load Forecast in the 2011 IRP, it would appear that the actual results mimic the Lowest Case studied at the time. Peak Demand and Energy Scenarios contained in the current outlook appear biased toward the Highest Scenario modeled versus the Lowest Scenario modeled. If electricity demand continues to decrease in the Tennessee Valley, the use of distributed generation should be reflected more heavily in the Draft IRP. Rather than insisting that all solutions be based on large "utility scale" facility installations, we would encourage TVA to take more programmatic approaches, utilizing distributed generation and energy efficiency on a regional basis to achieve positive impacts – generate more power where it's needed. Individual users each have varying and unique needs power which can be addressed with distributed generation, for example, battery storage or combined heat and power.

- In the IRP draft, TVA seems to underestimate the future impact of distributed generation (DG) in the analysis (Appendix C, page 118). To determine the effect of demand-side, customer-driven, DG reductions to TVA utility loads, the IRP utilizes a combination of average DG national growth rates and CO2 regulation scenarios and a regional adjustment factor. This approach makes sense, but given the significant renewable program incentive cuts that have been implemented by TVA over the past several years, the percentage stated in the draft IRP is likely to underestimate the future impact of DG in the TVA region.

  Historically, TVA incentive programs provided TVA constituents an attractive option for cost-effective employment of advanced energy technologies. The historic reductions have diminished the value of electricity production from these technologies, to a point where demand-side, customer-driven DG options now make equal, if not significantly greater, financial sense for TVA customers.

  This shift in production value will undoubtedly increase the employment of customer-driven DG systems and will likely make the assumption used in the IRP too low.

- One of TVA's initial observations from the draft studies is that renewable sources (particularly solar) make a contribution to power production. Some comments we offer regarding references to solar in the IRP include:
  - We suggest executing 25-year contract PPAs rather than 20 years as outlined in the IRP. The IRP deliberates a 25-year plant book life for utility solar plants, but current policy states TVA will not sign contracts over 20 years partially because it is unsure the assets will last 25 years. The assumptions and policies conflict with each other. Increasing the 20-year contract to 25 years will yield a win-win for TVA, its customers and the industry and will reduce the overall delivered cost of power significantly.
  - We need to understand and request the total installed costs ($ per MW/DC) assumed, including any escalation/inflation rates. Costs are rapidly declining and published academic reports are generally outdated upon publication. Perhaps a survey of private industry developers would be more appropriate/timely.
  - Solar assets are not "selected" in the Draft IRP until mid-2020, in part due to likely inflated solar installation costs. The resulting program designs and contracting mechanisms should be sustainable, but should be optimized in order to take advantage of the 2015, 2016 and 2017 Federal Investment Tax

Credits (ITC) so that TVA's ratepayers benefit from the cost-effective benefits of ITC utilization.

- By limiting solar installations (or other forms of distributed generation) available to TVA customers to the point of waiting lists, TVA could be creating an environment where "grid defectors" become more common. As the price of solar, batteries, and other related technology continue to drop, businesses and residents who are committed to sustainability and don't find it coming from TVA could find a viable financial alternative to grid power by generating 100% of their energy on site. For example (on a larger scale), the City of Boulder, Colorado, has voted to separate from the grid so they can meet their carbon reduction and renewable energy goals.

- TVA should preserve its options for electricity production, including high capacity factor wind accessed via high voltage direct current (HVDC) transmission project, the Plains & Eastern Clean Line. This project will deliver a large amount of low-cost, renewable energy to TVA's transmission system, the construction of this project will create hundreds of jobs, and millions of dollars in tax revenues will be generated. These benefits should be realized as soon as possible, and HVDC wind should be picked earlier in the study window. An HVDC transmission line is another example of advanced energy driving the economic base.

**WHY ADVANCED ENERGY WILL SIGNIFICANTLY HELP MEET FUTURE DEMAND FOR ELECTRICITY AND DRIVE THE ECONOMY**

Advanced energy in the United States was an estimated $199.5 billion market in 2014, up 14% from 2013 ($169 billion), and five times the rate of growth of the U.S. economy overall. There is no reason why Tennessee shouldn't have its fair share of this global, trillion-dollar market economic opportunity.

It stands to reason, that manufacturers of these advanced technologies will also want to locate in a state that creates a favorable market for its products. Additionally, we know that 215 Fortune 500 companies have set targets in either greenhouse gas reductions, energy efficiency and renewable energy. It would make good business sense to offer these companies options to meet those goals with TVA resources and programs.

Below we have provided you with some research that we've conducted that justifies the growth and need for deploying advanced energy technologies in our state.

In 2013, one of the first projects the TAEBC board of directors wanted to pursue was the *Tennessee Advanced Energy Asset Inventory*[iv], a listing of advanced energy assets, unique to Tennessee. It was the first document of its kind dedicated to promoting

the use of advanced energy technologies and assisting Tennessee businesses in deploying or integrating advanced energy products, services or technologies.

We produced the inventory for the Tennessee Energy Education Initiative's online resource center, a public-private partnership that included the Tennessee Department of Environment and Conservation, Pathway Lending and the U.S. Department of Energy.

This first edition examines assets related to energy efficiency, renewable energy and energy management – the focus of TEEI. It is our intention to expand and update this inventory over time.

New technologies like battery storage and carbon fiber are but two of the advanced energy technologies that lie just over the horizon with the potential to play a lasting role in the state's economic development. The inventory is a snapshot of assets that can change rapidly in response to innovations and market forces.

The inventory took a comprehensive, but not exhaustive, identification and review of Tennessee's assets in each of these categories:

- Research: University of Tennessee, Oak Ridge National Laboratory, Vanderbilt University, Tennessee Technological University, Tennessee Valley Authority, etc.
- Organizations: Association of Energy Engineers, Tennessee Department of Environment & Conservation, Tennessee Advanced Energy Business Council, etc.
- Entrepreneurial: Launch Tennessee, Knoxville Entrepreneur Center, Venture Incite, etc.
- Workforce: Middle Tennessee State University, Columbia State Community College, University of Tennessee Center for Industrial Services, etc.
- Incentives: Tax incentives, grants, bonds, state programs, etc.

After reviewing all of the information, we found the potential for expansion of advanced energy technologies will be shaped by economic assets that are unique to Tennessee.

The ability to understand what our unique assets bring to the discussion, as well as their willingness to combine these assets in support of advanced energy technologies will, to a large extent, shape the opportunities for the expansion of the industry in Tennessee.

**One of those assets is the Tennessee Valley Authority (TVA).** TVA has played a major role in the growth of Tennessee's manufacturing base, reduced the volume of sulfur and carbon emissions in the state's air, and its mission includes the use of the agency's resources to improve environmental quality and foster economic development.

TVA by its very nature is an asset to the advanced energy economy because of its three-pronged mission to serve the people of the Tennessee Valley: generating safe, clean, reliable and affordable public power to its region, stewardship of the regions' natural resources, and its dedication to economic development.

The scope of TVA's energy portfolio makes it possible to pilot, incentivize and evaluate a broad range of innovative advanced energy technologies including superconducting transmission cable, smart grids, next-generation batteries and solar panels, appliances for low-energy homes and small modular reactors (SMRs).

Initiatives of TVA have been responsive to efforts by Tennessee's automotive manufacturers to promote clean and advanced technologies, both in their products and in the operation of their manufacturing facilities. In one of the most creative initiatives, TVA, Nissan and Oak Ridge National Laboratory joined to explore a variety of issues that accompany the charging and energy storage of electric cars.

The ability to replicate and build upon this kind of cooperation is a key factor in expanding Tennessee's advanced energy economy.

Tennessee's unique assets (like TVA), along with their willingness to support advanced energy technologies, will shape the opportunities for the expansion of the industry in Tennessee.

Additionally, in 2014 TAEBC created *A Roadmap for Tennessee's Advanced Energy Economy*[v] to learn about the growth of advanced energy technologies in Tennessee. The roadmap states the following:

- With a rank of fourth highest, per-capita residential energy consumption and 25th in commercial and industrial sectors in the nation, Tennesseans can deploy advanced energy technologies to help substantially reduce the amount of electric power they use without a compromise in their standard of living or business practices.
- Advanced energy technologies represent a growing sector of Tennessee's economy. A number of indicators suggest a gradual and sustained growth in jobs associated with the manufacturing, installation and operation of advanced energy technologies.
- An increasing number of innovative technologies will be commercially available over the next five years. Tennessee has an enormous inventory of advanced energy technologies at or near commercial viability. The presence of research capabilities at Oak Ridge National Laboratory and the University of Tennessee, an innovation platform provided by TVA's role as the nation's largest utility, and the desire for greater energy efficiency among the state's automobile industry, together form a unique opportunity to test advanced energy technologies and push them into the marketplace.

**SUGGESTION**

The Tennessee Advanced Energy Business Council suggests TVA explore, as part of its IRP, developing robust and specific partnerships with other assets and the private sector to continue its critical role of piloting, incentivizing and evaluating emerging advanced energy technologies.

Partnerships are a valuable mechanism to explore advanced energy as an economic development and job creation strategy. The Tennessee Advanced Energy Business Council was created to serve as a bridge between assets and the private sector to foster the growth of Tennessee's advanced energy technologies, companies and jobs. We offer our expertise and assistance to TVA to develop partnerships in the categories outlined below, including but not limited to:

1. Reducing power costs through greater energy efficiency
2. Expanding the use of distributed generation
3. Battery storage, to increase options for renewables
4. Modernizing the electric grid
5. Extending the life and improving the efficiency of nuclear power plants
6. Making fossil fuels cleaner and more efficient

In conclusion, TAEBC members and stakeholders are seizing and want access to advanced energy technologies to increase their competitive edge in the marketplace. We encourage TVA to give thoughtful consideration to how the decisions it makes with its IRP may enhance or hinder economic development opportunities. We welcome the opportunity to assist and support TVA fulfill its mission to deliver low-cost, cleaner and reliable power to the Tennessee Valley.

Sincerely,

Cortney Piper, Vice President
Tennessee Advanced Energy Business Council

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[i] Advanced Energy Economy, Advanced Energy Now 2015 Market Report, February 2015: https://www.aee.net/articles/report-advanced-energy-is-a-nearly-1-3-trillion-global-industry

[ii] U.S. Department of Energy, CHP Installation Database, March 2014: https://doe.icfwebservices.com/chpdb/state/TN

[iii] Ceres, Power Forward 2.0: How American Companies are Setting Clean Energy Targets and Capturing Greater Business Value, June 2014: http://www.ceres.org/resources/reports/power-

forward-2.0-how-american-companies-are-setting-clean-energy-targets-and-capturing-greater-business-value

[iv] Tennessee Advanced Energy Business Council, Tennessee's Advanced Energy Asset Inventory, September 2013: http://www.tnadvancedenergy.com/site/wp-content/uploads/2012/09/TAEBC-Energy-Asset-Inventory.pdf

[v] Tennessee Advanced Energy Business Council, A Roadmap for Tennessee's Advanced Energy Economy, June 2014: http://www.tnadvancedenergy.com/site/wp-content/uploads/2014/07/TAEBC_roadmap.pdf