Department of Energy
Washington, DC 20585

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MEMORANDUM FOR THE DEPARTMENT OF ENERGY
ELECTRICITY ADVISORY COMMITTEE

FROM: Gene Rodrigues
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SUBJECT: DOE Responses to the Electricity Advisory Committee's Recommendations made in the *Section 8008 Voluntary Model Pathways For Modernizing the Electric Grid* Report

I would like to extend my gratitude to all members of the Department of Energy's (DOE) Electricity Advisory Committee (EAC) for your development of the *Section 8008 Voluntary Model Pathways for Modernizing the Electric Grid Report* and your timely and thoughtful recommendations that were submitted to me on February 16, 2023.

The Steering Committee[1] identified six 'normative' scenarios to guide the discussions on key concepts, including coordination; robust transmission and distribution systems; flexibility and resilience; and the adoption of new technologies. These discussions have led to six key recommendations, which are addressed in our response below and the attachments, following the order of priority identified by the EAC.

This document aims to achieve three goals: (i) inform the public about ongoing grid modernization efforts, (ii) continue the grid modernization discourse with the EAC, and (iii) catalyze DOE's efforts to engage stakeholders and invest in risk-informed strategies that accelerate the capability and maturity of innovative technology and ensure a smooth transition to a modernized grid.

Regarding the specific recommendations that you made, DOE has the following responses:

[1] Section 8008(a)(3) of the Consolidated Appropriations Act of 2021 requires that DOE, in consultation with a Steering Committee, initiate the development of voluntary model pathways for modernizing the electric grid. The EAC was designated as the appropriate body to serve as the Steering Committee, with additional representation from the Federal Energy Regulatory Commission (FERC) and DOE National Laboratories.

1. **Coordination**
    - **Develop and vet operational coordination framework guidelines that consider the roles and responsibilities of all participants and system requirements under all situations, recognizing that participants may have different roles and responsibilities depending on jurisdictional differences.**
    - **Develop a process that provides an avenue for industry leaders, regulators, and policymakers to ascertain where critical conversations are occurring on topics to prevent duplication of efforts across the industry.**
    - **Consider and educate industry leaders on the effect that the transition to a zero-carbon economy across all interdependent sectors of the economy will have, resulting in increased electric grid demand and utilization.**

DOE agrees that facilitating the coordination of planning and operations across the transmission, distribution, and behind-the-meter domains is integral to ensuring reliable and affordable access to electricity. In recognition of this priority, DOE has invested in research, development, demonstration, and deployment (RDD&D) to advance coordination guidelines and has played a major role in convening key stakeholders and fostering information exchange to catalyze grid modernization efforts. Specifically, DOE has made strategic investments in the following key areas:

- Data standardization, data interoperability, and advanced algorithms to enable risk-informed coordination mechanisms under various system requirements. For example, the Office of Electricity's (OE) Electric Power Outage Data Initiative Nationwide (ODIN) establishes a comprehensive digital reporting standard for power outage data to enable utilities to exchange data with designated stakeholders. Moreover, OE is currently planning a data workshop, in collaboration with the national labs, to highlight the state-of-the-art in Transmission and Distribution (T&D) information sharing and to delineate effective pathways for addressing cross-sector, open data sharing risks.
- Developing holistic, industry-vetted guidelines (e.g., distribution "grid codes") that address regulatory, business, and technical coordination considerations to enable distributed energy utilization at scale. For example, OE is collaborating with the state public utility commissions and utilities to establish risk-informed practices for integrated distribution system planning (IDSP) to enable effective integration of distributed resources and other key considerations for grid modernization. Current efforts also include assessing the mismatch between proposed utilities' investments and what regulators are willing to approve and extending the framework to consider the roles and responsibilities of all participants and system requirements under all situations. Another example is OE's Electricity Delivery System Program's two key efforts (i) Operational Coordination initiative that develops guidelines for operational coordination across the transmission, distribution, and behind-the-meter domains to enable the utilization of grid services from distributed energy resources (DER), and (ii) Distribution System Transformation that develops fundamental grid architecture guidelines and reference designs to enable the utilization of DER and evolving grid structure (please refer to the Attachments 1 and 2).

- Rendering technical assistance to states and industry supporting the development and implementation of DER operational coordination that respects jurisdictional differences. For example, the Joint Office of Energy and Transportation provides technical assistance on coordination, planning and implementation of a national network of electric vehicle chargers and zero-emission fueling infrastructure as well as zero-emission transit and school buses. The Buildings Technologies Office partners with states, utilities, building owners and researchers to inform policy, planning, programs, to regulation to support deployment of grid-interactive efficient building.

I would like to highlight that addressing coordination challenges would not be possible without DOE's strategic partnerships with key stakeholders including the National Association of State Energy Officials (NASEO), National Association of Regulatory Utility Commissioners (NARUC), Energy Systems Integration Group's (ESIG), and Electric Power Research Institute (EPRI). For example, under the "DER Integration & Compensation Initiative," DOE is partnering with NARUC and NASEO to enable state members to assess the impact of the connection, operation, and compensation of DERs within the distribution grid, bulk power system, and wholesale energy markets. Another notable partnership is the NASEO-NARUC Microgrids State Working Group that brings together PUCs and State Energy Offices to discuss existing microgrid projects, funding and financing opportunities, technical assistance, and policy or regulatory frameworks. Moreover, under the "Comprehensive Electricity System Planning Gap Analysis and Research Effort", NARUC and NASEO provide a forum for the development of state-led pathways toward a more resilient, efficient, and affordable grid by enabling a better understanding of key trends in system planning as well as integrated analyses across key points in electricity planning processes.

EPRI has also demonstrated exceptional leadership in this arena by investing in capabilities necessary for coordinated planning and operation. For example, EPRI's DER-VET program, developed in collaboration with the California Energy Commission, provides an open-source platform for optimizing the value of DER and supports site-specific assessments for energy storage and additional DER technologies.

Moreover, there are several important reports that provide valuable insights into the coordination required for a modernized grid. For example, ESIG's report: "DER Integration into Wholesale Markets and Operations" examines the changes in regulation, market rules, planning, and operating practices needed to better integrate distributed energy resources into wholesale markets and operations. It covers the implementation of FERC 2222, and broader gaps related to DER integration in wholesale markets and distribution systems. Another example is "FERC Order 2222 Implementation: Preparing the Distribution System for DER Participation in Wholesale Markets" report, led by Advanced Energy Economy and GridLab, which provides recommendations and guidance for tapping the full potential of DERs in wholesale markets. The report also includes recommendations to help educate state commissioners, inform the FERC and RTOs/ISOs, and support state policies that increase DER value.

These reports and initiatives collectively contribute to knowledge and insight to drive effective coordination mechanisms and accelerate the integration of DERs to achieve grid decarbonization goals.

2. Transmission Planning

Develop a holistic, higher level planning capability at a regional, interregional, bulk power system and/or national level that evaluates and incorporates plausible future scenarios and potential reliability and economics options to inform state and regional planners and policymakers.

This recommendation aligns with DOE's comprehensive approach to transmission planning. DOE employs a multi-faceted strategy that encompasses national-scale transmission planning analyses in partnership with national labs. It also involves providing technical and financial assistance to transmission projects, and investing in the next-generation data, methods, and technology to support robust transmission planning. Below, are a few examples that will illustrate these efforts.

As part of the Building a Better Grid Initiative, DOE is conducting the National Transmission Planning Study, which identifies transmission solutions that can deliver broad-scale benefits to electric customers. The study aims to inform regional and interregional transmission planning processes and identify strategies for accelerating decarbonization while maintaining reliability. Moreover, in partnership with the Pacific Northwest National Laboratory (PNNL) and National Renewable Energy Laboratory (NREL), DOE collaborates with stakeholders and communities to identify pathways for large-scale transmission system buildouts that align with regional and national interests. Additionally, DOE's Transmission Facilitation Program provides financial support to qualified transmission projects across the country.

An important collaborative effort related to planning and paying for transmission is the Joint FERC-NARUC Federal-State Task Force on Electric Transmission. The Task Force convenes recurrent meetings and shares relevant issuances and submissions on FERC's website via e-Library. In addition, ESIG has issued its Multi-Value Transmission Planning for a Clean Energy Future report which aims to revitalize multi-value transmission planning and provide a playbook for transmission planners.

Furthermore, OE continues to invest in R&D efforts in transmission planning. For example, the Transmission Reliability Program strategically invests in developing technology and methods to support transmission planning for a modernized grid. These investments are informed through a deep engagement with industry and academic leaders in the field, as exemplified by the Transmission Innovation Symposium. Another example is DOE's Interconnection Innovation e-Xchange, led by DOE's solar and wind energy technologies offices, that enables faster and fairer interconnection of renewables and storage assets through stakeholder engagement, data analysis, and providing interconnection process roadmaps and technical assistance.

By leveraging these initiatives and resources, and through continuous stakeholder engagement, DOE continues to foster robust transmission planning for a smooth transition to a clean energy future.

3. Distribution System Planning

Develop a shared understanding of strategies for building out distribution systems to meet demand. Provide technical assistance, where required, to facilitate reliable, fair, and equitable integrated distribution planning processes.

OE's Electricity Delivery System Program works collaboratively with industry, regulators, and consumer advocates to develop methods, tools, and guidelines for transitioning to a decarbonized and resilient distribution grid. For example, the Next Generation of Distribution System Platform (DSPx) informs grid modernization decisions related to reliability, operational efficiency as well as DER adoption and their utilization as non-wires alternatives. This collaborative work with the States aims to establish a consistent understanding of key requirements, enabling the adoption of technologies that align with each State's modernization objectives while respecting jurisdictional differences. Other notable efforts are the OE's Distribution System Transformation and Operational Coordination efforts that were briefly discussed under the first recommendation (please refer to the refer to Attachments 1 and 2).

EPRI's open-source distributed energy resource model, OpenDER, is another outstanding resource that supports increased renewable energy capacity on the distribution grid. The model allows for the assessment of the static and dynamic behaviors of DER for planning purposes. EPRI also released a free public model specifications document to complement the OpenDER model software for easy implementation across the electric sector, allowing the utilities and commercial software companies to accurately characterize DER systems for planning, operation, and research purposes.

4. Resilience

Establish formal methods for defining and incorporating resilience into integrated planning processes that can balance priorities across several objectives.

Cyber-physical attacks on the energy infrastructure have significantly increased in the past decade. Moreover, the grid is being tested more frequently by extreme weather and climate events. Recognizing the importance of infrastructure resilience in managing these risks and informing investment decisions, DOE has given significant attention to the issue.

DOE is at the forefront of grid resilience efforts, making risk-informed strategic investments to proactively manage emerging risks related to climate change and adversarial threats as well as regulatory, policy, technology, and demographic uncertainty. For example, OE's North American Energy Resiliency Model (NAERM) provides a platform for assessing the vulnerabilities and interdependencies within the interconnected energy system, enabling DOE to partner with industry, national labs, and

other federal agencies to develop strategic initiatives to mitigate and manage the risks of cyber-physical threats and natural hazards. Specifically, the NAERM team has conducted critical case studies, assessing the impacts of scenarios such as (i) climatic extremes (e.g., wildfires, heatwave, cold snaps, and hurricanes as well as compound climate events), (ii) fuel disruption (e.g., coal and natural gas), and (iii) high penetration of DERs and IBRs. Another key effort is the Transformer Resilience and Advanced Components program which supports the hardening, response, and restoration of electric infrastructure by addressing the challenges facing transformers, critical components, and other grid hardware. Another example is OE's collaborative work with experts and stakeholders to develop risk-informed practices for incorporating resilience and equity considerations within the integrated distribution planning. These efforts focus on developing and disseminating leading practices on electrification, climate forecasting, scenario-based, multi-value and multi-objective decision analyses to allow for balancing investment strategies across several policy objectives that consider equity, flexibility, and resilience. (Please refer to the Attachment 1).

Furthermore, DOE's RDD&D efforts aim to support a just transition to a decarbonized grid. For example, the National Community Solar Partnership, comprising of a coalition of community solar stakeholders, aims to expand access to affordable community solar and ensure other benefits such as increased resilience and workforce development. The Local Energy Action Pilot program supports creation of community-wide action plans to reduce local air pollution, increase energy resilience, lower utility costs and energy burdens, and provide long-term jobs and economic opportunities.

EPRI is also leading several noteworthy initiatives to address grid resilience. For example, EPRI's Ecosystem Risk and Resilience program aims to address ecosystem health as it relates to the evolving generation mix and delivery footprint associated with decarbonization. It also seeks to identify and evaluate the potential new ecosystem benefits of the energy transition. Another significant EPRI initiative is Climate READi (REsilience and ADaptation initiative) which convenes global thought leaders and industry stakeholders to develop a common framework to address resilience challenges. Furthermore, in partnership with DOE, EPRI is examining how the flow of solar information can reduce the non-hardware costs of solar energy. Additionally, under a new collaborative agreement between EPRI and North American Electric Reliability Corporation (NERC), the two organizations coordinate to support the effective deployment of industry resources to address emerging issues.

5. Flexibility

Review and develop gap analyses across the industry and educate key decision makers on metrics and necessary actions needed to ensure reliability, resource adequacy, stability, and recovery for a future utilizing more intermittent and other resources (e.g., demand-side resources, microgrids). Develop a common language and business case for needed operational assets.

Flexibility is widely recognized as a key characteristic of the grid of the future. In line with this objective, OE is strategically investing in data, algorithms, and technology to

facilitate the integration of flexibility into the grid. For example, OE's R&D investments in data and algorithms, through the Advanced Modeling Grid Research Program, enables extracting actionable information to enable wide area visibility, dynamic pricing, and demand response. Moreover, OE's Energy Storage Program focuses on research, regulation, policy, and valuation considerations. DOE is also working with strategic partners to address regulatory and technical barriers associated with the interconnection of energy storage and solar-plus-storage systems to the distribution grid. For instance, EPRI's Building a Technically Reliable Interconnection Evolution for Storage initiative, supported by DOE Solar Energy Technologies Office, provides scalable, consensus-based solutions to address the barriers mentioned above. Moreover, EPRI's Energy Storage and Distributed Generation program develops metrics and simulation methods to optimize citing and design for energy storage, microgrids, and distributed generation projects.

Another notable effort is the Grid-interactive Efficient Buildings (GEBs) initiative that optimizes energy management by utilizing sensors, and smart controls to meet the needs of occupants while considering the grid and external conditions. Moreover, the NASEO-NARUC Grid-interactive Efficient Building Working Group, established with the support of DOE's Building Technologies Office, allows State Energy Officials and state utility regulators to explore GEB and demand flexibility technologies and applications.

While significant progress has been made, the EAC rightly emphasizes the importance of conducting a comprehensive gap analysis and establishing actionable standards and metrics. OE is committed to engaging with stakeholders to identify holistic approaches for addressing these challenges and looks forward to continuing engagement with the EAC on this crucial topic.

6. Advanced Technological Capabilities

Increase efforts to educate regulators and address interoperability gaps/standards. This also includes providing technical assistance, where required, as well as educating utilities (and their regulators) on how advanced technologies have been used reliably in the United States and abroad. Educate policymakers about ongoing technological gaps and the areas where significant additional research and development (R&D) are required to provide the technological tools needed to reach climate goals (e.g., long-term storage, vehicle-to-grid, small modular nuclear reactors, carbon sequestration, storage, re-use)

DOE concurs with the EAC on the importance of fostering innovation, providing education and technical assistance, and addressing interoperability gaps and standards are the key elements for accelerating the adoption of advanced technologies for a modernized grid.

Several offices across DOE (including Advanced Research Projects Agency-Energy (ARPA-E), Office of Technology Transitions (OTT), and OE) are making significant investments in RDD&D efforts across a range of Technology Readiness Levels (TRLs) in addition to evaluating relevant business models and market barriers to commercialization.

). Moreover, the State Technical Assistance to Public Utility Commissions program is a part of the DOE Grid Modernization Initiative that provides technical assistance to help state regulators address challenges associated with rapid technological advancements, the emerging roles of both customers and third parties in the generation and management of electricity, the convergence of operations, markets, and planning across the bulk-power and distribution system domains, and other considerations including equity, affordability, security, and resilience. The Energy Earthshots Initiative aimed at addressing targeted challenges in transforming the nation's energy infrastructure should also be highlighted. The DOE recognizes that achieving the Earthshot goals will require advanced technological capabilities and is coordinating activities across multiple offices within DOE to accelerate the necessary technology development and work with all relevant stakeholders to make sure the private sector and energy infrastructure is ready to deploy them as they are commercialized.

EPRI's Incubatenergy® is an outstanding program, allowing startups to engage EPRI and electric power utilities in paid demonstration projects. The program links startups which are leading the advancement of electrification, decarbonization, and grid modernization with utilities that have the capacity and desire to demonstrate and scale those innovations. Other energy incubators include Clean Energy Innovators Program that support for two-year fellowships for recent graduates to support practical research on innovative solutions to challenges faced by PUCs, utilities, and grid operators. Another example is DOE's Lab Embedded Entrepreneurship Program, which supports new startups developing clean energy and advanced manufacturing technologies by embedding them in national labs for 2 years to (i) enable accelerating the development of their technologies, and (ii) to provide entrepreneurial mentorship and business training. The EAC rightly points out that the adoption of innovative technologies hinges on the availability of interoperability standards for the regulators and utilities. Resources in this space includes NIST's "Framework and Roadmap of Smart Grid Interoperability Standards" as well as various guidelines and standards provided by the IEEE. To address interoperability gaps, DOE, EPRI, and NREL have established an industry-wide consortium to advance research on grid-forming inverters. The consortium seeks to develop specifications and standards for enabling interoperability between inverters from different manufacturers. It also aims to create educational curricula and support workforce development initiatives while disseminating research results. Moreover, ESIG's Grid-Forming Technology in Energy Systems Integration explores the innovations required to define and deploy new system services and discusses the evolution of stability, analytical, and economic tools necessary to ensure stable power systems with high levels of renewables. NARUC's Smart Grid Interoperability Learning Module series is another great example that provides educational material for state utility commissions on the economics of interoperability, operational considerations for interoperability, and roles and responsibilities of state regulators.

In conclusion, thank you again for your thoughtful and impactful recommendations. I am fully committed to ensuring an effective and productive working relationship between the EAC and DOE, and I look forward to future collaborative efforts. If you wish to discuss this matter further, my staff is available to meet with the Committee, as needed.