Department of Energy
Washington, DC 20585

November 21, 2017

The Honorable Michael Simpson
Chairman, Subcommittee on
  Energy and Water Development
Committee on Appropriations
U.S. House of Representatives
Washington, DC 20515

Dear Mr. Chairman:

U.S. Senate Report 113-47, which accompanied the Energy and Water Development and Related Agencies Appropriations Act, 2014 (S. 1245), includes the following language:

> The Committee directs the Department to report on the need for workforce education as a necessary element for the successful and rapid transition of advanced modeling and simulation solutions developed under this program.

This letter is intended to respond to this language.

Need for Workforce Education to Support Transition of Innovative Early-Stage Research in Advanced Grid Modeling and Simulation

Mathematical modeling and control of the electric grid has been an active area of research for decades. Yet, recent availability of faster computation, new and efficient algorithms, and scalable data analytics and modeling approaches show promise for high-payoff, transformational impact. The Advanced Modeling Grid Research Program leverages scientific research in mathematics and computation for application to power system models and software tools, which are used by the utility industry to plan, monitor, and control the electric grid. Advancements will increase the operational efficiency of the electric system, improve reliability and security, enhance resilience, and facilitate coordination across the electricity transmission and distribution systems.

The early-stage nature of applied research in advanced grid modeling and simulation requires a technically skilled and capable workforce to meet demand. Thus, the U.S. Department of Energy (DOE) requested the National Academies to provide guidance on the long-term critical research areas in the mathematical sciences that would advance the analytic foundations needed for the next-generation electric grid, and identify the mix of workforce backgrounds needed to be successful in transitioning the research advancements into operational practice.

The Committee on Analytical Research Foundations for the Next-Generation Electric Grid at the National Academies recommended that this research be best approached by a community that is truly multidisciplinary. In particular, while the coordination of power grid research efforts at the National Laboratories and with industry is important, the Committee noted a need for engagement of experts from fields other than power engineering to join the research effort, such as knowledge of mathematics, statistics, operations research, economics, and computation.[1] Having this multi-disciplinary workforce engaged in advanced modeling research contributes to robust and meaningful solutions to real-world challenges, and thus enhances the rapidity of successful transition to industry. Furthermore, engagement across the workforce pipeline from students to engineering leaders strengthens the platform for research innovation.

DOE's Role in Building an Interdisciplinary Research Community

To catalyze this multidisciplinary workforce and strengthen university-based, power system research efforts, the Advanced Modeling Grid Research Program is leveraging the established research communities of DOE's Office of Science, the National Science Foundation (NSF), and existing National Laboratory-university research partnerships to develop and engage the next generation of world-class researchers. Example supported activities include the following:

- The Future Grid Initiative, led by the Power Systems Engineering Research Center (PSERC), examined the technological and educational challenges of the Smart Sustainable Grid.[2] The Initiative focused on how to integrate future technologies and renewable generation onto the grid while enhancing grid stability, reliability, and efficiency. It recognized that there is a projected shortage of qualified engineers and technicians in the power system area, a need of these individuals to be educated with a new set of skills and tools, and a critical role for ongoing research efforts to contribute to the development of this workforce by educating students through participation in research projects.[3] As part of the project, and in keeping with the education side of PSERC's mission, faculty developed software tools, courses, a virtual library, and training materials to ensure the basis of a workforce well-versed in implementing the future grid. This activity strengthens engagement of leading experts in power systems and energy economics.

- Office of Science's Advanced Scientific Computer Research (ASCR) program supports a project, titled "Multifaceted Mathematics for Complex Energy Systems (M2ACS),"[4] to take a holistic view and develop deep mathematical understanding

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and effective algorithms to remove current bottlenecks in analysis, simulation, and optimization of complex energy systems. Many of the areas of novel mathematics research identified by ASCR form the scientific foundation of the Office of Electricity Delivery and Energy Reliability's (OE) efforts to address issues relevant to the operations and planning of the power system. It is advancing needed workforce capabilities through student participation in research projects. This activity strengthens engagement of leading experts in mathematics and computational science, particularly at DOE's National Laboratories.
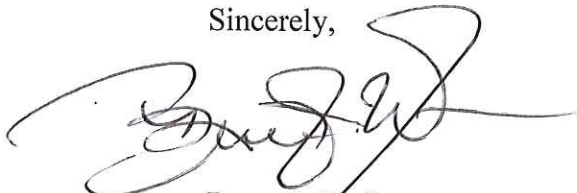
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- The Center for Ultra-Wide-Area Resilient Electric Energy Transmission Networks (CURENT) leads research towards a nation-wide transmission grid that is fully controlled for better performance.[5] CURENT is an NSF Engineering Research Center that is jointly supported by NSF and DOE. As an integral part of the effort, CURENT is focused on developing a new generation of electric power and energy systems engineering leaders with global perspectives and diverse backgrounds. This activity strengthens engagement of leading experts in power systems, as well as K-12 education and undergraduate outreach as a mechanism for sustaining the workforce pipeline.

- The Grid Science Winter School, led by Los Alamos National Laboratory, is aimed at developing a research community around "Grid Science." The focus emerged based upon identification of theoretical research needs perceived within OE and ARPA-E research activities. Research areas included Analysis, Optimization, Control, and Learning over Physical Networks. The effort is structured in a way to bring together and foster interactions between academic and National Laboratory experts in related research areas and the best students and postdocs in these areas. This interaction is essential to catalyzing innovative approaches to the field of advanced grid modeling and simulation. This activity

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If you should have any questions concerning this letter or require further information, please have your staff contact Joseph Levin, Office of the Chief Financial Officer, at (202) 586-3098.

Sincerely,

Bruce J. Walker
Assistant Secretary
Office of Electricity Delivery and Energy Reliability

November 21, 2017

The Honorable Thad Cochran
Chairman
Committee on Appropriations
United States Senate
Washington, DC 20510

Dear Mr. Chairman:

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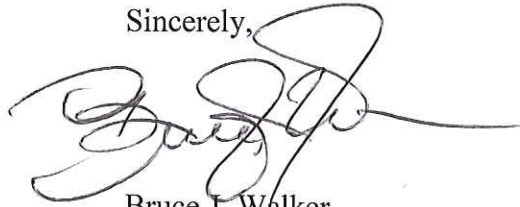
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Sincerely,

Bruce J. Walker
Assistant Secretary
Office of Electricity Delivery and Energy Reliability

Department of Energy
Washington, DC 20585

November 21, 2017

The Honorable Patrick Leahy
Vice Chairman
Committee on Appropriations
United States Senate
Washington, DC 20510

Dear Mr. Vice Chairman:

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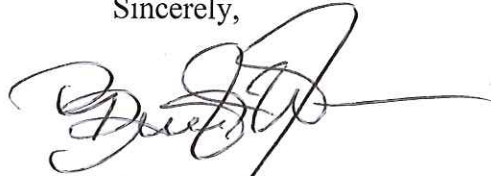
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Sincerely,

Bruce J. Walker
Assistant Secretary
Office of Electricity Delivery and Energy Reliability

November 21, 2017

The Honorable Nita Lowey
Ranking Member
Committee on Appropriations
U.S. House of Representatives
Washington, DC 20515

Dear Congresswoman Lowey:

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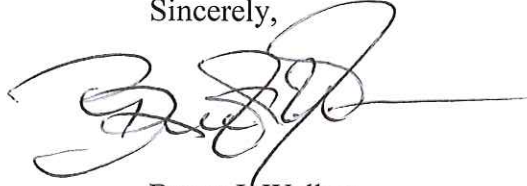
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Office of Electricity Delivery and Energy Reliability

Department of Energy
Washington, DC 20585

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The Honorable Rodney P. Frelinghuysen
Chairman
Committee on Appropriations
U.S. House of Representatives
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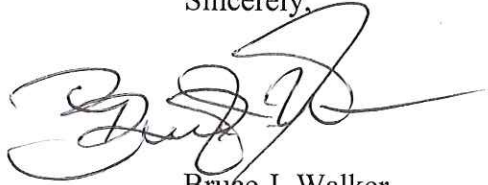
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- The Center for Ultra-Wide-Area Resilient Electric Energy Transmission Networks (CURENT) leads research towards a nation-wide transmission grid that is fully controlled for better performance.[5] CURENT is an NSF Engineering Research Center that is jointly supported by NSF and DOE. As an integral part of the effort, CURENT is focused on developing a new generation of electric power and energy systems engineering leaders with global perspectives and diverse backgrounds. This activity strengthens engagement of leading experts in power systems, as well as K-12 education and undergraduate outreach as a mechanism for sustaining the workforce pipeline.

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Sincerely,

Bruce J. Walker
Assistant Secretary
Office of Electricity Delivery and Energy Reliability

November 21, 2017

The Honorable Dianne Feinstein
Ranking Member, Subcommittee on Energy and
  Water Development
Committee on Appropriations
United States Senate
Washington, DC 20510

Dear Senator Feinstein:

U.S. Senate Report 113-47, which accompanied the Energy and Water Development and
Related Agencies Appropriations Act, 2014 (S. 1245), includes the following language:

> The Committee directs the Department to report on the need for workforce
> education as a necessary element for the successful and rapid transition of
> advanced modeling and simulation solutions developed under this
> program.

This letter is intended to respond to this language.

Need for Workforce Education to Support Transition of Innovative Early-Stage Research in Advanced Grid Modeling and Simulation

Mathematical modeling and control of the electric grid has been an active area of
research for decades. Yet, recent availability of faster computation, new and efficient
algorithms, and scalable data analytics and modeling approaches show promise for high-
payoff, transformational impact. The Advanced Modeling Grid Research Program
leverages scientific research in mathematics and computation for application to power
system models and software tools, which are used by the utility industry to plan, monitor,
and control the electric grid. Advancements will increase the operational efficiency of
the electric system, improve reliability and security, enhance resilience, and facilitate
coordination across the electricity transmission and distribution systems.

The early-stage nature of applied research in advanced grid modeling and simulation
requires a technically skilled and capable workforce to meet demand. Thus, the U.S.
Department of Energy (DOE) requested the National Academies to provide guidance on
the long-term critical research areas in the mathematical sciences that would advance the
analytic foundations needed for the next-generation electric grid, and identify the mix of
workforce backgrounds needed to be successful in transitioning the research
advancements into operational practice.

The Committee on Analytical Research Foundations for the Next-Generation Electric Grid at the National Academies recommended that this research be best approached by a community that is truly multidisciplinary. In particular, while the coordination of power grid research efforts at the National Laboratories and with industry is important, the Committee noted a need for engagement of experts from fields other than power engineering to join the research effort, such as knowledge of mathematics, statistics, operations research, economics, and computation.[1] Having this multi-disciplinary workforce engaged in advanced modeling research contributes to robust and meaningful solutions to real-world challenges, and thus enhances the rapidity of successful transition to industry. Furthermore, engagement across the workforce pipeline from students to engineering leaders strengthens the platform for research innovation.

DOE's Role in Building an Interdisciplinary Research Community

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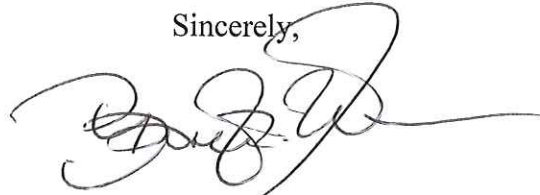
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Sincerely,

Bruce J. Walker
Assistant Secretary
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The Honorable Lamar Alexander
Chairman, Subcommittee on Energy
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United States Senate
Washington, DC 20510

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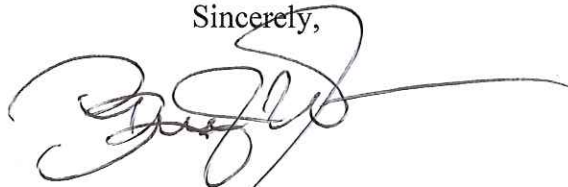
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Sincerely,

Bruce J. Walker
Assistant Secretary
Office of Electricity Delivery and Energy Reliability

Department of Energy
Washington, DC 20585

November 21, 2017

The Honorable Marcy Kaptur
Ranking Member, Subcommittee on Energy
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Committee on Appropriations
U.S. House of Representatives
Washington, DC 20515

Dear Congresswoman Kaptur:

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