STATE OF RHODE ISLAND AND PROVIDENCE PLANTATIONS
PUBLIC UTILITIES COMMISSION

Petition of The Narragansett Electric Company d/b/a National Grid for Approval of its Proposed Power Sector Transformation Vision and Implementation Plan.	R.I.P.U.C. No. 4780

Direct Testimony of Benjamin A. Stafford

On Behalf Of
Conservation Law Foundation, the Sierra Club, and People's Power & Light

April 18, 2018

TABLE OF CONTENTS

I. INTRODUCTION AND QUALIFICATIONS

Q. Please state your name, business name and address.

A. My name is Benjamin Stafford. I am a Senior Consultant with 5 Lakes Energy LLC, a Michigan-based limited liability corporation, located at Suite 710, 115 W Allegan Street, Lansing, Michigan 48933. I reside in Minneapolis, Minnesota.

Q. On whose behalf are you appearing in this case?

A. I appear on behalf of the Conservation Law Foundation, the Sierra Club, and People's Power & Light.

Q. What is the purpose of your testimony?

A. I am providing recommendations concerning National Grid proposals in this case with respect to the Electric Heat Initiative, and to the adoption of heat pump technologies and program elements in Rhode Island.

Q. Please summarize your experience in the field of electric utility regulation.

A. I have worked for nearly 14 years in economic regulation of utilities, electricity regulation, or related fields. I worked for eight years on the staff of the Public Utilities Commission of Ohio (PUCO). I then worked in academia and published works on wholesale energy markets. I also worked for the national trade association Advanced Energy Economy (AEE), representing member company interests in state policy. I joined 5 Lakes Energy in December 2017 as a Senior Consultant. My work experience is summarized in my curriculum vitae, attached as exhibit A.

Q. Have you testified before this Commission as an expert in any other proceeding?

A. I have not testified before this Commission.

In previous roles I have filed or contributed to stakeholder comments in grid modernization proceedings in Minnesota, Michigan, Ohio, Pennsylvania, and Hawai'i. I have also worked with the National Association of Regulatory Utility Commissioners. Following is a brief list of relevant engagements:

- Public Utilities Commission of Ohio 11-0277-GE-UNC *In the Matter of the Review of the Consumer Privacy Protection and Customer Data Access Issues Associated with Distribution Utility Advanced Metering and Smart Grid Programs* / 11-5474-AU-UNC *In the Matter of the Commission Review of Cyber Security Issues Related to Entities Regulated by the Commission.*[1] Engaged as staff member of the Public Utilities Commission of Ohio and Policy Aide to Commissioner Paul Centolella.
- Pennsylvania Public Utilities Commission - M-2015-2518883 *Alternative Ratemaking Methodologies*- Comments of Advanced Energy Economy Institute on Alternative Ratemaking Methodologies in Response to Pennsylvania Public Utility Commission Tentative Order Dated March 2, 2017[2]; Contributor on related whitepaper- *Performance-Based Regulation for Pennsylvania: An Opportunity for*

[1] Case record available https://dis.puc.state.oh.us/CaseRecord.aspx?CaseNo=11-0277 and https://dis.puc.state.oh.us/CaseRecord.aspx?CaseNo=11-5474

[2] Comments available: www.puc.state.pa.us/pcdocs/1522802.pdf ; www.puc.pa.gov/pcdocs/1522781.pdf ; whitepaper http://info.aee.net/performance-based-regulation-for-pennsylvania-report Case Record, Docket M-2015-2518883: www.puc.state.pa.us/about_puc/consolidated_case_view.aspx?Docket=M-2015-2518883

Pennsylvania to Drive Innovation in the Utility Sector from the Advanced Energy Economy Institute

- Minnesota Public Utilities Commission Docket No. E999/CI-15-556[3] Comments of the Advanced Energy Economy Institute on Distribution System Planning
- State of Hawai'i Public Utilities Commission Docket No. 2017-0226[4]- *Proceeding Related to The Hawaiian Electric Companies' Grid Modernization* Strategy- Comments of the Advanced Energy Economy Institute
- National Association of Regulatory Utility Commissioners, Winter Meetings 2017, Staff Subcommittee on Rate Design- Invited presentation: How DER [distributed energy resources] compensation and value identification affect the utilization of DER[5] (on behalf of Advanced Energy Economy)

In the past, I have also contributed to regulatory proceedings as a staff member of the Public Utilities Commission of Ohio, including evaluating major investor-owned utility smart grid and grid modernization investments.

Q. Do you have specific qualifications related to the Electric Heat Initiative as proposed?

[3] Comments available: https://www.edockets.state.mn.us/EFiling/edockets/searchDocuments.do?method=showPoup&documentId={F074615D-0000-CD15-BC2B-F55C7620FE23}&documentTitle=20177-134102-01

[4] Comments available: https://info.aee.net/hubfs/PDF/2017-09-13-AEE-Inst-comments-HECO.pdf

[5] Presentation available: https://pubs.naruc.org/pub.cfm?id=DB98F869-BEE1-259B-7BA3-A7DC42A168D1

A. I have experience with regulatory treatment of energy technologies. From 2009-2012 I was employed at the Public Utilities Commission of Ohio, as Policy Aide to Commissioner Paul Centolella. During that time, Ohio's regulated public utilities received significant funding for smart grid investments and demonstrations under the American Reinvestment and Recovery Act (ARRA). I helped to evaluate utility filings in respect to energy efficiency requirements under Ohio rules and regulations from evaluating technical and market potential studies, and utility proposed technology deployments under energy efficiency programs administered by or for regulated utilities.

I previously worked as Manager, 21st Century Electricity System and PUC Program; and Manager, State Policy for Advanced Energy Economy (AEE) from 2016-2017. AEE is a national association of business leaders who are making the global energy system more secure, clean, and affordable. Advanced energy encompasses a broad range of products and services that constitute the best available technologies for meeting energy needs. Among these are energy efficiency, demand response, energy storage, natural gas electric generation, solar, wind, hydro, nuclear, electric vehicles, biofuels and smart grid. In that role I worked to understand and address relevant market and regulatory barriers to advanced energy technologies, including efficient heating, ventilation, and air conditioning equipment.

Q. What is the purpose of your testimony?

A. The purpose of this testimony is to discuss the appropriateness of National Grid's Electric Heat Initiative (EHI), focusing on the equipment incentives for air source heat pumps (ASHP). With respect to the EHI, I will:

(1) Discuss the importance of heat pump technologies in Power Sector Transformation;

(2) Discuss the appropriateness of National Grid's approach to equipment incentives in the Electric Heat Initiative programs proposed in PUC Docket 4780;

(3) Offer recommendations to improve benefits of National Grid's deployment of programs in the Electric Heat Initiative.

Q. How is your testimony structured?

This testimony is structured as follows:

II. THE IMPORTANCE OF BENEFICIAL ELECTRIFICATION OF HEATING SYSTEMS AND HEAT PUMP TECHNOLOGIES

III. EVALUATION OF NATIONAL GRID'S PROPOSAL

IV. RECOMMENDATIONS AND CONCLUSIONS

Q. Are you sponsoring any exhibits?

A. Yes. I have attached the following exhibits for review.

- Exhibit CLF-SC-PP&L-1: Resume of Benjamin A. Stafford

II. THE IMPORTANCE OF BENEFICIAL ELECTRIFICATION OF HEATING SYSTEMS AND HEAT PUMP TECHNOLOGIES

Q. National Grid proposes to implement the Electric Heat Initiative to increase the deployment of heat pump technologies as a foundational element of Power Sector Transformation. Please explain how electrification of heating fits within the concept of Power Sector Transformation.

A. Power Sector Transformation requires increased flexibility of power demand, and envisions customer and environmental benefits from electrification, including electrification of heating. As noted in the September 2017 staff report Initial Principles for Utility Proposals to Support Beneficial Electrification from the Rhode Island Public Utilities Commission, "Beneficial electrification offers promising ways to manage demand and to avoid unnecessary stress on the system that could increase costs and air emissions."[6] Improving heating system efficiencies through electrification is a good example of beneficial electrification. As discussed below, heat pump technologies can provide a variety of benefit streams to customers, and for the environment.

Q. Do heat pump technologies benefit customers?

A. Yes. Electric heat pumps heating systems represent part of an increasing set of end use technologies that improve environmental performance of homes and businesses. Heat pump technologies use electricity to move heat, whereas many systems convert either a

[6] www.ripuc.org/utilityinfo/electric/Draft%20Initial%20Electrification%20Principles.pdf

fuel source or electricity to heat. Energy savings often translate into significant cost savings for customers.

Q. Does the cost effectiveness of heat pumps vary across climate conditions?

A. Yes, but heat pumps can provide energy savings across the range of temperatures experienced in Rhode Island.

It is important to acknowledge that there is some variation in residential heat pump heater performance, especially common air-source heat pumps (ASHP), due to several factors. These factors include the availability of other heating systems, the variability of prices of fuels over a given timeframe, and variations in outside air temperatures. The Rhode Island Office of Energy Resources notes "Although ASHPs have traditionally been used in warmer climates, new cold-climate heat pumps can provide useful heating in temperatures as low as -15°F; however, at such temperatures, both capacity and efficiency are significantly reduced."[7]

Recently, The Cadmus Group, Inc. performed a study from 2014-2016 of 132 homes in Massachusetts and 20 Rhode Island homes which used ductless mini-split heat pumps, a common application of heat pump technology. The study did find some variability in operational cost-effectiveness to homeowners. While cost effectiveness varied across homes, these systems, when compared to propane, electric resistance, oil-fired systems

[7] www.energy.ri.gov/heating/heat-pumps/learn-about-heat-pumps.php

"proved more cost-effective on average for all outdoor air temperatures observed during winters in Massachusetts and Rhode Island." [8]

Q. Does changing from other heating alternatives to electric heat pumps align with state policies help to mitigate emissions related to climate change?

A Yes. Heat pump technologies do not burn fossil fuels to produce heat. National Grid notes this in its 2018 Energy Efficiency and System Reliability Procurement Plan, highlighting displaced emissions from fossil fuels, such as propane and oil boilers, and from increased efficiency as compared to electric resistance heating systems. The Rhode Island Greenhouse Gas Emissions Reduction Plan[9] (GHG Plan) aims to achieve objectives in the Resilient Rhode Island Act of 2014,[10] identifies electrification of heat as an opportunity for deep GHG mitigation. This report suggests deploying electric heat at scale, achieving 33% of residential and 30% of commercial main heating load met with electric heat pump systems by 2035.

The use of heat pumps, especially for home heating, can result in significant benefits for consumers and the environment. In National Grid's 2018-2010 Energy Efficiency and System Reliability Procurement Plan[11] filed in RIPUC Docket 4684, plan highlights

[8] Cadmus Group Inc. (2016). Ductless Mini-Split Heat Pump Impact Evaluation. *Prepared for the Electric and Gas Program Administrators of Massachusetts and Rhode Island, Part of the Residential Evaluation Program Area.* Pg. 21. Accessed via Massachusetts Energy Efficiency Advisory Council. http://ma-eeac.org/wordpress/wp-content/uploads/Ductless-Mini-Split-Heat-Pump-Impact-Evaluation.pdf
[9] Executive Climate Change Coordinating Council (EC4) (2016) http://climatechange.ri.gov/documents/riggerr16.pdf
[10] RI. Gen. Laws § 42-6.2
[11] National Grid http://www.ripuc.org/eventsactions/docket/4684-NGrid-3-YearPlan(8-30-17).pdf

"Carbon emission reduction strategies, including electrification of heating and increasing investments in delivered fuels efficiency offerings."[12] National Grid notes that 1/3 of Rhode Island homes use delivered fuels for heating, which offers significant opportunity for GHG reductions.

In a 2016 study of customer costs and emissions in Massachusetts, heat pump technologies used for heating produced significantly lower carbon dioxide emissions than natural gas, oil, propane, and electrical resistance heating. A Vermont study of the costs and benefits of converting from residential oil or propane to heating with ductless heat pumps in Vermont showed significant emissions benefits. [13]

Comparison: Percent Reductions in Carbon Dioxide Emissions in Vermont[8]		
	Heating Fuel Switch	
Baseline	Natural Gas	Electric Heat Pump
Oil	27%	34%
Propane	16%	26%

Environmental benefits and cost benefits increase with the heat efficiency rating of heat pumps. Heat efficiency is rated by a coefficient of performance. The coefficient of performance (COP) is a ratio measure of heat output to the amount of energy input needed

[12] Ibid, at pg. 2
[13] Adapted from Prefiled Testimony of Chris Neme, Docket 8180 June 12, 2014 - https://vtdigger.org/wp-content/uploads/2014/09/Prefiled-Testimony-of-Chris-Neme-on-behalf-of-VPIRG-6-12-14-.pdf ; Dennis, K. (2015). Environmentally beneficial electrification: electricity as the end-use option. *The Electricity Journal*, *28*(9), 100-112.

for a heat pump. Applications of higher efficiency heat pumps, those with a label COP of 3.5, resulted in both lowered costs and lowered emissions.[14]

The GHG reductions and environment benefits of electrification of heat will likely continue to grow as National Grid, and New England more broadly, continue to rely on an increasingly decarbonized mix of generation resources. Indeed, Rhode Island and the eight other Northeast states comprising the Regional Greenhouse Gas Initiative (RGGI) recently completed a review and extension of the RGGI program through which the states committed to reduce carbon dioxide emissions from the electric sector by a further 30% between 2020 and 2030.

Q. Can you briefly describe some non-energy benefits of efficient electric heat equipment?

Non-energy benefits of improved home heating are a significant, especially for low-income households. The installation of heating efficiency measures for low-income people in single-family homes has been studied in other jurisdictions. For example, the 2016 Massachusetts Special and Cross-Cutting Research Area: Low-Income Single-Family Health- and Safety-Related Non-Energy Impacts (NEIs) Study found that deploying

[14] Eversource, National Grid. Presentation: Residential Heat Pumps: Technology, Current Market, and Program Opportunities. Massachusetts Energy Efficiency Advisory Council Meeting, April 26, 2017. Pg. 4 http://ma-eeac.org/wordpress/wp-content/uploads/PA-Heat-Pump-Presentation.pdf

efficient heating systems, along with other home environment improvements, is associated with

a. Reduced asthma

b. Reduced thermal stress on occupants

c. Fewer missed days of work

d. Increased productivity at home due to improved sleep

e. Reduced carbon monoxide poisoning

f. Reduced risk of fire, and fire-related property damage[15]

Beneficial electrification of efficient electric heat can improve the lives of Rhode Islanders beyond energy.

III. EVALUATION OF NATIONAL GRID'S ELECTRIC HEAT INITIATIVE PROPOSAL

Q. What materials did you review to support your testimony about National Grid's

[15] NMR Group, Inc. (2016) Massachusetts Special and Cross-Cutting Research Area: Low-Income Single-Family Health- and Safety-Related Non-Energy Impacts (NEIs) Study. http://ma-eeac.org/wordpress/wp-content/uploads/Low-Income-Single-Family-Health-and-Safety-Related-Non-Energy-Impacts-Study.pdf

approach to the Electric Heating Initiative as proposed in this docket?

A. I focused primarily on Chapter 6 of National Grid's Power Sector Transformation Plan in this docket, and the National Grid 2018-2020 Energy Efficiency and System Reliability Procurement Plan.

Q. Please describe the individual programs within the proposed Electric Heat Initiative and indicate how those programs may be improved upon.

A. The EHI has four program components: a ground-source heat pump demonstration, equipment incentives for income eligible residential customers, improving community-based outreach, and training of oil/propane dealers. I will focus my testimony on the equipment incentives program.

Q. Please describe the Equipment Incentives program.

A. The intent of the equipment incentives program is to address upfront cost barriers for residential customers. This program is said to expand the scope of the energy efficiency programs to include other markets. This part of the proposed Electric Heat Initiative will coordinate with National Grid's energy efficiency program, focusing on coordination on "appropriate rebate targeting, clear customer communication, and dedicated outcome tracking." (pg. 123) Eligibility for the program is limited to residential customers with a projected societal cost test ratio greater than 1.

Q. What is your overall opinion of National Grid's equipment incentives program?

A. Converting heat systems for delivered fuel customers to efficient heat presents a strong case economically, and with regard to greenhouse gas emissions reductions. Grid's goals

of developing markets for efficient heat electrification are consistent with Rhode Island's policy goals.

However, at the scale proposed, the EHI programs are unlikely to significantly impact markets, and the programs do not directly address well-identified market barriers. I recommend two improvements:

(1) the programs, as presented in Chapter 6 of the PST, should clearly specify market barriers to adoption, and how programs are designed to overcome those barriers;

(2) Grid should expand the scale the incentives the relatively small scale of each program to achieve meaningful market transformation.

Q. Are National Grid's Electric Heat Initiative, and its programs, consistent with state policy objectives?

A. Yes. National Grid's equipment incentives are consistent with state policy objectives, and are designed to increase use of efficient electric heat technologies.

Q. Does the Equipment Incentives program explicitly address market barriers to adoption of efficient electric heat pumps?

A. No, but there is opportunity for program improvement. Grid's filing notes the importance of air source heat pumps as an important component of the Company's transition to a sustainable clean energy future (at pg. 3), but notes that heat pump adoption is "is not economical for natural gas customers in Rhode Island or elsewhere in New England." (Chapter 6, page 1).

I support addressing barriers identified within regional energy efficiency efforts, such as the work of the Northeast Energy Efficiency Partnership (NEEP). NEEP's Regional Air Source Heat Pump Market Transformation Strategy Report recommendations,[16] particularly in relation to air-source heat pumps (ASHP), as appropriate and within Commission jurisdiction. It is also my understanding that National Grid and representatives from Rhode Island state government were members of the Strategy Report's advisory committee. NEEP proposes the following strategies:

1. Increase consumer education and awareness

2. Increase installer/builder awareness of, and confidence in, ASHP through expanded training and education

3. Reduce upfront costs of installed systems through robust and aligned promotional programs and the support of alternative business models

4. Mobilize state and local policymakers to expand support for ASHPs

5. Promote advanced control technologies to allow automated coordination among multiple heating systems

6. Enable the promotion of climate-appropriate ASHPs through improved performance metrics

[16] Northeast Energy Efficiency Partnership (2017). Northeast/Mid-Atlantic Air-Source Heat Pump Market Strategies Report 2016 Update. www.neep.org/sites/default/files/NEEP_ASHP_2016MTStrategy_Report_FINAL.pdf; at pg. 51-68

7. Develop more accurate tools to predict energy, cost and GHG savings associated with ASHP installation through collection and analysis of real world performance data

Grid's plan as drafted acknowledges these barriers implicitly, and at some points explicitly. I would recommend that the analysis of the equipment incentives address these challenges directly. In evaluating the effectiveness of incentives, I believe a strong stakeholder community should continue to engage in evaluation efforts. The Commission should ensure EHI propose programs that are consistent with stakeholder recommendations.

Q. Is the equipment incentive program sufficient in scale to accelerate the deployment of efficient heat technologies?

A. Not as proposed. It is not clear that the programs will meaningfully accelerate efficient heat electrification for two reasons:

(1) the relatively small scale of the program seems insufficient for meaningful transformation; and

(2) the size of incentives

In respect to program scale, the incentives in the EHI amount to $842,670 over three program years, of which $708,750 is targeted at customer incentives. The proposed incentive structure aims at 20% of all-in costs, with all-in costs estimated at $3,200 per ASHP installation. Income Eligible Customers (IECs) are eligible for full cost incentives. For the sake of illustrating program impacts, I would note that using these estimates for quick calculation shows a small range of deployments. For example, if all funds where targeted towards IECs, the programs would result in 221 ASHP deployed in Rhode Island

homes.[17] If all funds went to market-rate incentives, the result would be a maximum of 1,107 deployed ASHP. Considering 1/3 of Rhode Island's 276,165 owner-occupied housing units[18] use delivered fuel heat systems, the scale seems unlikely to produce meaningful market impacts, and falls short of the potential for meaningful reductions in greenhouse gas emissions.

Q. Given the current state of the air source heat pump market, what is the role of the utilities today in delivering beneficial electrification service?

A. Utilities play an important role in accelerating beneficial electrification. I agree with the RIPUC Commission Staff's Initial Principles for Utility Proposals to Support Beneficial Electrification that "An electrification proposal should explain how the utility's role would support the program, achieve net benefits, and help ensure the achievement of state goals" and, further "a proposal should articulate what the utility expects to own, operate, execute, measure, and enable, as well as explain how the utility's role relates to the potential roles of other participants in the market."[19] The comments collected in developing the staff report provided suggestions for cost recovery mechanisms, implementation design and adaptive learning, and evaluation of the leveraging of ratepayer funds and utility sources to design effective programs.

[17] For income eligible customers = $708,750 total program funds / $3200 estimated all-in costs; For market-rate customers = $ $708,750 total program funds / $640; as 20% of estimated all-in costs

[18] US Census data 2016 = 462, 589 housing units, 57.9% owner-occupancy rate; https://www.census.gov/quickfacts/fact/table/RI/HSG010216#viewtop

[19] Staff of the RIPUC, September 15, 2017. Pg. 4. www.ripuc.org/utilityinfo/electric/Draft%20Initial%20Electrification%20Principles.pdf

The utility has policy and regulatory obligations to deliver cost effective energy programs. Rhode Island's Energy and Consumer Savings Act of 2006 established minimum energy efficiency standards for specific commercial and residential products. These programs, and others such as the property assessed clean energy financing programs, can continue to drive more beneficial electrification technologies (including heat pumps) into the marketplace for both space- and water heating.

It is also important to acknowledge that utility programs must align with the review of utility business models before the Commission, as required by 2010 House Bill 8082. As markets develop, the utility role(s) may shift. Acknowledging that beneficial electrification will continue to include evolving roles for utilities and third-parties, I recommend the Lawrence Berkeley National Laboratories Future Utility Regulation Report Value-Added Electricity Services: New Roles for Utilities and Third-Party Providers.[20]

IV. RECOMMENDATIONS AND CONCLUSIONS

Q. Do you recommend that the Commission approve the proposed Power Sector Transformation Provision, R.I.P.U.C. No. 4780, for Narragansett Electric and Power Sector Transformation Plan with respect to the proposed Equipment Incentives program of the Electric Heat Initiative?

A. National Grid Equipment Incentives program should be approved, conditional on addressing the limitations identified above. Given the limited size of the equipment

[20] Blansfield, J., Wood, L., Katofsky, R., Stafford, B., Waggoner, D., & Schwartz, L. C. (2017). Value-Added Electricity Services: New Roles for Utilities and Third-Party Providers. https://emp.lbl.gov/publications/value-added-electricity-services-new

incentive program, I am not confident that the program will drive meaningful acceleration for deployment of efficient electric heat technologies. National Grid should (a) improve program designs to specifically identify relevant market barriers to adoption; and (b) invest significantly more funding in equipment incentives programs to meaningfully accelerate adoption of efficient electric heat systems. National Grid's proposal, while encouraging, lacks detail as to which barriers may prove challenging for accelerating market development, and how those barriers may be addressed. There is much scholarship and stakeholder effort in identifying both barriers to market development, and appropriate incentive levels. The program plans can also be improved by evaluating programs considering regional challenges that serve as barriers to in each of the program areas, as identified by regional stakeholders.

Tab A

BENJAMIN A. STAFFORD

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Summary

Experienced business and policy analyst, with over 13 years of experience in business policy and regulation of the utility industry and energy markets, with emphasis on regulatory strategies and emerging energy technologies. Professional industry experience in government regulatory agencies, academia, an energy technology trade association, and in policy consulting.

Relevant Professional Experience

Current: Senior Consultant, 5Lakes Energy
Support research and analytics, policy and regulatory strategies, and government affairs.

Manager, 21st Century Electricity System and PUC Program; Manager, State Policy, Advanced Energy Economy/Advanced Energy Economy Institute, Washington DC – 2016-present
Advanced Energy 501(c)(6) trade association; 501(c)(3) research institute
Support research and analytics, and political engagement across state policy engagements. Regional project manager for Midwest states (Indiana, Illinois, Michigan, Ohio). AEE's mission is transforming public policy to enable rapid growth of advanced energy companies for secure, clean, affordable power.

Commissioner's Aide/Policy Aide, Public Utilities Commission of Ohio, Columbus, OH – 2009-2012
Policy Aide to Public Utilities Commissioner Paul Centolella
Development and implementation of objectives in public utility regulation, including ratemaking and business cases for infrastructure investment options. Specifically, this work focused on the advancement and development of markets and public policies impacting utilities and their customers including renewable portfolios, energy efficiency, environmental policy objectives, and ensuring just and reasonable rates for services in an evolving restructured market across two regional transmission organization markets (Midwest/Midcontinent ISO, PJM Interconnection).

Human Management Capital Analyst, Public Utilities Commission of Ohio 2004-2009
Developed and implemented training and development programs for staff of 375+ regulatory staff, ensuring workforce preparedness for utility regulatory obligations including ratemaking and rate case analysis, electricity law, utility regulation, etc.

Education

M.S.	**University of Minnesota, Carlson School of Management, 2016** Business Research, (as part of Ph.D. in Business Administration; passed written preliminary exams);
M.A.	**The Ohio State University, John Glenn College of Public Affairs, 2011** Public Policy and Management; *coursework emphasis on environmental and public utility regulatory policy*
M.L.H.R.	**The Ohio State University, Fisher College of Business 2009** Master of Labor and Human Resources
B.S.	**The Ohio State University, Fisher College of Business 2004** Business Administration, specialization in Management and Human Resources

Relevant Affiliations

- Securing America's Future Energy, Energy Security Fellow 2017-2018

- Citizens League (Minnesota)- Member, participant on Electrical Energy Project; signatory to Phase 2 Policy Framework to Optimize Efficiency of the Electrical Energy System; Invited working group presentation: Performance-Based Regulation

Supplementary Information

Notable **utility regulatory** policy achievements/projects:

- **Domain Expertise:** transportation electrification policy, demand response/reduction policy, community engagement, multi-institutional clean energy initiatives, industry/market development, clean energy technology integration, corporate access to advanced energy options.
- **Business and Energy Policymaking Strategies:** direct strategies for Indiana market, engaging government executives, legislators and elected officials, NGOs, and media. Strong emphasis on advanced energy market development and policy analysis.
- **Utility Business Models and Regulatory Reform:** Performance Based Regulation – facilitated framework for advancing utility regulation for a 21st century utility system in Pennsylvania, including alternative ratemaking, invited editorials in trade publications.
- **Emerging Clean Energy Technology Policy:** Facilitating stakeholders, development of policy strategies for advanced transportation, emphasizing scalable transportation electrification policies.
- **Stakeholder/Industry Engagement:** select speaking engagements – industry, regulatory, law, and educational conferences

Notable achievements/content: *(*Authored/contributed whitepapers, reports, and conference presentations)

- Presentation: National Association of Regulatory Utility Commissioners Winter Meetings 2010 – Smart Grid Information Clearinghouse (FERC/NARUC Smart Grid Collaborative)
- Whitepaper: Performance-Based Regulation for Pennsylvania: An Opportunity for Pennsylvania to Drive Innovation in the Utility Sector – Advanced Energy Economy Institute (contributor)
- Advanced Energy Economy 21st Century Electricity System Issue Briefs
- Economic Potential for Peak Demand Reduction in Michigan- Advanced Energy Economy Institute (contributor)
- *Conference Presentation:* "Data Analytics for Regulators" Analytics Connections 2016, Silver Spring Networks *(panel: Navigating Regulatory Hurdles for New Smart Grid Use Case Enablement)*
- *Conference Presentation: "*Current Trends in Energy Policy." University of Vermont Law School, Washington DC. October 6, 2017.
- Whitepaper: Cyber Security in a Distributed Energy Future. Advanced Energy Economy Institute (contributor)
- *Presentation:* National Association of Regulatory Utility Commissioners Winter Meetings 2017- We are Underutilized How DER Compensation and Value Identification Affects the Utilization of DER
- *Editorial - Utility Dive:* Stafford, B. and Frantzis, L. Performance-Based Regulation: Aligning utility incentives with policy objectives and customer benefits
- *Lawrence Berkeley National Laboratory, Future Electric Utility Regulation essay series:* Blansfield, J., Wood, L., Katofsky, R., Stafford, B., Waggoner, D., & Schwartz, L. C. (2017). Value-Added Electricity Services: New Roles for Utilities and Third-Party Providers. *LBNL Future Electric Utility Regulation essay series*
- *Conference Presentation*: Minnesota Solar Energy Industry Association Midwest Gateway to Solar Conference 2017. Topic: Grid Modernization.

Relevant Academic Research, Publications & Working Papers

- **Stafford, B. A.,** & Wilson, E. J. (2016). Winds of change in energy systems: Policy implementation, technology deployment, and regional transmission organizations. *Energy Research & Social Science*, *21*, 222-236.

Academic Conference Presentations/Proceedings

- **Stafford, B.**, Wilson, E.J. and Nelson-Marsh, N. Panel: Enhancing Electricity System Productivity: How Regional Transmission Organizations are Changing Technology, Markets, and the Future Energy System.
- Conference Paper: Wilson, E.J. and **Stafford, B.** The Social Side of Electrons: RTOs Shaping Renewable Energy Policy. (Initial findings of qualitative research). 2015 Association for Public Policy Analysis & Management Fall Conference.
- Wilson, E.J. and **Stafford, B.** Regional Transmission Organizations and Sustainability: Renewable Energy Integration, Industry Studies Association, Portland, Oregon, May 28-30, 2014
- Lenhart, S., **Stafford, B.**, Wilson, E., and Nelson-Marsh, N. Conference Paper: Institutional Innovations in Increasingly Dynamic Electricity Markets 2016 Industry Studies Association Conference
- **Stafford, B.** Nelson-Marsh, N., and Wilson, E. Conference Paper: Negotiating Innovations, Enabling Technological Production: The Dynamics of Power and Status within Interorganizational Collaborations. 2016 Industry Studies Association Conference
- Johnson, N., Yoo, K., and **Stafford, B.** Voting Networks in Regional Transmission Organizations: The Benefits and Burdens of Participation. 2016 Industry Studies Association Conference

Academic Experience & Invited Lectures/Presentations

Management 1001: Contemporary Management, *Fall 2014.* University of Minnesota, Carlson School of Management. *Recipient of 2014—2015 Ph.D. Excellence in Student Teaching Award.*

Invited Lecture: "The Business and Politics of Electricity Regulation." University of Minnesota, Hubert H. Humphrey School of Public Affairs. Public Administration 5721: Energy & Environmental Policy.