August 25, 2017

VIA ELECTRONIC FILING

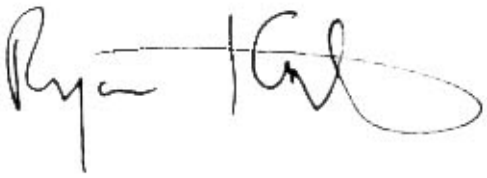
Hon. Kathleen H. Burgess
Secretary to the Commission
New York State Public Service Commission
Empire State Plaza, Agency Building 3
Albany, New York 12223-1350

Re: Case 17-E-0238 – Proceeding on Motion of the Commission as to the Rates, Charges, Rules, and Regulations of Niagara Mohawk Power Corporation d/b/a National Grid for Electric Service

Dear Secretary Burgess:

Advanced Energy Economy Institute (AEE Institute) hereby submits for filing in the above referenced proceeding direct testimony of Tim Woolf and Melissa Whited on National Grid's Earnings Adjustment Mechanisms proposal.

Respectfully Submitted,



Ryan Katofsky
Vice President, Industry Analysis

Before the
New York Public Service Commission

Proceeding on Motion of the Commission as to the Rates, Charges, Rules and Regulations of Niagara Mohawk Power Corporation for Electric Service	))))	Case 17-E-0238

Direct Testimony of
Tim Woolf & Melissa Whited

On the Topic of
Earnings Adjustment Mechanisms

On Behalf of
Advanced Energy Economy Institute

August 25, 2017

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1. INTRODUCTION AND QUALIFICATIONS

Q. Please state your name, title, and employer.

A. **Woolf:** My name is Tim Woolf. I am a Vice President at Synapse Energy Economics, located at 485 Massachusetts Avenue, Cambridge, MA 02139.

A. **Whited:** My name is Melissa Whited. I am a Principal Associate at Synapse Energy Economics, located at 485 Massachusetts Avenue, Cambridge, MA 02139.

Q. Please describe Synapse Energy Economics.

A. Synapse Energy Economics is a research and consulting firm specializing in electricity and gas industry regulation, planning, and analysis. Our work covers a range of issues, including economic and technical assessments of demand-side and supply-side energy resources; energy efficiency policies and programs; integrated resource planning; electricity market modeling and assessment; renewable resource technologies and policies; and climate change strategies. Synapse works for a wide range of clients, including state attorneys general, offices of consumer advocates, trade associations, public utility commissions, environmental advocates, the U.S. Environmental Protection Agency (EPA), U.S. Department of Energy (DOE), U.S. Department of Justice, the Federal Trade Commission, and the National Association of Regulatory Utility Commissioners. Synapse has over 25 professional staff with extensive experience in the electricity industry.

Q. Please summarize your professional and educational experience.

A. **Woolf:** Before joining Synapse Energy Economics, I was a commissioner at the Massachusetts Department of Public Utilities (DPU) from 2007 through 2011. In that

capacity, I was responsible for overseeing a substantial expansion of clean energy policies, including significantly increased ratepayer-funded energy efficiency programs; an update of the DPU energy efficiency guidelines; the implementation of decoupled rates for electric and gas companies; the promulgation of net metering regulations; review and approval of smart grid pilot programs; and review and approval of long-term contracts for renewable power. I was also responsible for overseeing a variety of other dockets before the Commission, including several electric and gas utility rate cases.

Prior to being a commissioner at the Massachusetts DPU, I was employed as the Vice President at Synapse Energy Economics; a Manager at Tellus Institute; the Research Director at the Association for the Conservation of Energy; a Staff Economist at the Massachusetts Department of Public Utilities; and a Policy Analyst at the Massachusetts Executive Office of Energy Resources.

I hold a Masters in Business Administration from Boston University, a Diploma in Economics from the London School of Economics, a BS in Mechanical Engineering and a BA in English from Tufts University. My resume, attached as Exhibit TW-MW-1, presents additional details of my professional and educational experience.

A. **Whited**: I have seven years of experience in economic research and consulting. At Synapse, I have worked extensively on issues related to utility regulatory models, rate design, policies to address distributed energy resources (DER), and market power. In 2015, I was the lead author of a report titled "Utility Performance Incentive Mechanisms: A Handbook for Regulators," and I have presented on performance incentive mechanisms to the National Association of Regulatory Utility Commissioners, National Governor's Association Learning Lab on New Utility Business Models, Midwest Governors'

Association, and the Minnesota e21 Initiative working group. I have sponsored testimony before the Massachusetts Department of Public Utilities, the Hawaii Public Utilities Commission, the Public Utility Commission of Texas, the Public Service Commission of Utah, and the Federal Energy Regulatory Commission.

I hold a Master of Arts in Agricultural and Applied Economics and a Master of Science in Environment and Resources, both from the University of Wisconsin-Madison. My resume is attached as Exhibit TW-MW-2.

Q. Please summarize your professional experience regarding the New York Reforming the Energy Vision proceedings and earnings adjustment mechanisms in general.

A. We have participated in the New York REV proceeding in several forums. We prepared a report for Advanced Energy Economy Institute on conducting benefit-cost analyses of distributed energy resources.[1] We helped prepare multiple comments and reply comments on behalf of the Natural Resources Defense Council and others in the proceedings on the Commission's Track One Straw Proposal, the Commission's Benefit-Cost Analysis White Paper, the Commission's Track Two White Paper, and the New York electric utilities' Distribution System Implementation Plans. We also prepared a white paper for multiple parties on the potential for implementing greater amounts of cost-effective energy efficiency resources in New York.[2]

[1] Synapse Energy Economics, *Benefit Cost Analysis for Distributed Energy Resources: A Framework for Accounting for All Relevant Costs and Benefits*, prepared for Advanced Energy Economy Institute, October 2014, available at: http://www.synapse-energy.com/project/benefit-cost-analysis-distributed-energy-resources

[2] Synapse Energy Economics, *Aiming Higher: Realizing the Full Potential of Cost-Effective Energy Efficiency in New York*, prepared for Natural Resources Defense Council, E4TheFuture, CLEAResult, Lime Energy, Association for Energy Affordability, and Alliance for Clean Energy New York, April 2016, available at: http://www.synapse-energy.com/project/support-ny-rev-track-2-changes-regulatory-designs-and-incentives-structures

We have been engaged in several other states in developing performance incentive mechanisms (i.e., earnings adjustment mechanisms), including Hawaii, Massachusetts, New Hampshire, and Rhode Island. We have also prepared a manual for regulators for how to design performance incentive mechanisms, which has been highly utilized throughout many states.[3]

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

A. We are testifying on behalf of Advanced Energy Economy Institute.

Q. Have you previously testified before the New York Public Service Commission?

A. **Woolf**: No.

A. **Whited**: No.

Q. What is the purpose of your testimony?

A. The purpose of our testimony is to review and critique the Earnings Adjustment Mechanisms (EAMs) proposed by Niagara Mohawk (Niagara Mohawk or the Company). We discuss the rationale and logic supporting several of the EAMs, describe some of the challenges with setting baselines and measuring EAMs, and offer recommendations for how to prioritize the financial incentive offered to the Company through each EAM.

[3] Synapse Energy Economics, *Performance Incentive Mechanisms: A Handbook for Regulators*, prepared for the Western Interstate Energy Board, March 9, 2015, available at: http://www.synapse-energy.com/project/performance-incentives-utilities

2. SUMMARY OF FINDINGS AND RECOMMENDATIONS

Q. Please summarize your primary findings.

A. We support many of the EAMs proposed by the Company. However, we identify several limitations and concerns about some of the EAMs, and we do not agree with the priorities that the Company has given to some of the EAMs as reflected in the basis points allocated to them. We also find that three important initiatives and resources are not sufficiently addressed by the EAMs proposed by Niagara Mohawk, and therefore warrant their own EAMs.

Q. Please summarize your primary recommendations.

A. Our recommendations are summarized as follows:

- The Commission should reject the proposed Substation Load Factor EAM.
- The Commission should require Niagara Mohawk to develop a new EAM to encourage the Company to achieve incremental demand savings from its Dynamic Load Management Programs.
- The Commission should require Niagara Mohawk to develop a new EAM to encourage the Company to enroll customers with electric vehicles on new or revised time-varying rates.
- The Commission should require Niagara Mohawk to develop a new EAM to encourage the Company to increase the efficiency savings from the NYSERDA energy efficiency programs.

- The Commission should require Niagara Mohawk to allocate fewer basis points to the Annual Peak Reduction, Customer Energy Intensity, Transactional Conversion Rate, and Customer Engagement Survey EAMs, while allocating more basis points to the Incremental Energy Efficiency, Customer Participation, and new EAMs.

3. COMPANY INITIATIVES RELATED TO EAMS

Q. Please summarize the initiatives that the Company is undertaking that will affect their EAMs.

A. The Company is proposing to undertake a variety of initiatives that will affect their ability to earn incentives through the EAMs. These include the following:

- Energy Storage Projects. The Company will install at least two storage projects to test the effects of battery storage on substation and system peak load.[4]

- Residential Solar Marketplace. Niagara Mohawk will operate an online marketplace where its customers can obtain information about solar technology and access to a network of local solar providers.[5]

- Current Demonstration Projects. The Company is currently engaged in four demonstration projects, including Fruit Belt Neighborhood Solar (targeting low- to moderate-income residential customers); the Potsdam Community Resilience projects (testing a community microgrid); the Distributed System Platform project

[4] Direct Testimony of the Electric Customer Panel, pages 9-10.
[5] Direct Testimony of the Electric Customer Panel, pages 12-13.

(testing how to engage customer-owned energy resources to manage customer demand); and the Clifton Park Demand Reduction project (seeking to reduce bills and peak demand through infrastructure upgrades and customer engagement).[6]

- New Demonstration Projects. Niagara Mohawk is planning to replace Schenectady's existing street lights with LED streetlights, along with the capability to provide internet access and other communication capabilities.[7]

- Dynamic Load Management (DLM) Programs. These include: the Direct Load Control Program (which allows the Company to remotely adjust participating residential and small business customers' thermostat and/or appliance settings); the Distribution Load Relief Program (which allows the Company to call for load relief from participating commercial customers to maintain reliability during contingencies and emergencies); and the Commercial System Relief Program (which allows participating commercial customers to contract to provide load relief during declared demand response events).[8]

- Potential Future Offerings. Niagara Mohawk has investigated several initiatives that were not included in the revenue requirement in this rate case, but might be explored or implemented later. This includes three programs to increase the adoption of electric vehicles (EVs) and support New York's zero emission vehicles and greenhouse gas emission goals: an EV Charging Host program; a Consumer EV Education program; and an EV Grid Integration program. In

[6] Direct Testimony of the Electric Customer Panel, pages 16-20.
[7] Direct Testimony of the Electric Customer Panel, page 21.
[8] Direct Testimony of the Electric Customer Panel, page 24.

addition, the Company is investigating an Electric Heat initiative encouraging customers to convert to efficient electric heating technologies and the eThink Innovation Center designed to increase customer awareness of energy savings and promote the development of strategic third-party partnerships.[9]

- Energy Efficiency. The Company offers a portfolio of efficiency programs to residential, small business, commercial, and industrial customers through its Electric and Gas Transition Implementation Plans (ETIP). The Company's current annual budget is $51.5 million, and it is requesting another $10.8 million for additional energy efficiency programs and to replace the funding for some efficiency costs that are being moved into base rates. The ETIP programs include the E-Commerce Platform project, which is an online marketplace where customers can shop for energy efficiency and demand response products. The Company is also proposing to add an LED street lighting program to its portfolio of current ETIP efficiency programs.[10]

Q. Why is it useful to summarize these initiatives at the outset of this discussion of EAMs.

A. The primary goal of EAMs is to encourage a utility to achieve certain outcomes (e.g., enhanced customer empowerment, market animation, system-wide efficiency, fuel and resource diversity, system reliability and resiliency, and reduction of carbon emissions). When designing and evaluating EAMs, it is useful to keep in mind how the utility will be

[9] Direct Testimony of the Electric Customer Panel, pages 28-32.
[10] Direct Testimony of the Electric Customer Panel, pages 33-40.

able to achieve those outcomes. Understanding the utility actions, programs, or initiatives that can achieve the desired EAM outcomes can help answer important questions such as: How much control does the utility have over a particular EAM? Which utility initiatives can the utility use to achieve which EAMs? Are there some initiatives that are encouraged by multiple EAMs? Are there some EAMs that can be achieved by multiple initiatives? We will return to some of these questions later in our testimony.

4. SYSTEM EFFICIENCY EAMS

Annual Peak Reduction

Q. Please summarize the Annual Peak Reduction EAM proposed by the Company.

A. The Annual Peak Reduction EAM is designed to encourage the Company to reduce annual distribution system peak demand through a variety of initiatives, including the ETIP efficiency programs, the DLM programs, incremental energy efficiency driven by the E-Commerce Platform, the energy storage projects, grid modernization efforts like the deployment of volt-var optimization ("VVO") technology, and increased penetration of DER.[11]

The proposed baseline for this EAM is the Company's 2016 weather-normalized system-peak of 6,846 MW.[12] The Company used its energy efficiency, demand response, solar PV, energy storage, and VVO forecasts as a starting point for the target for this EAM,

[11] Direct Testimony of the Electric Customer Panel, page 46, lines 1-5.
[12] Corrected baseline provided in response to DPS-022 MZS-3.

and the minimum, mid-point, and maximum targets were designed to exceed the historic performance of the Company in these areas.[13]

Q. Do you have any concerns about the Annual Peak Reduction EAM?

A. I have two primary concerns with this EAM. First, there are many factors outside the control of the Company that can affect peak demand. These include, for example, federal efficiency standards; changing consumer preferences for electronic devices; changing adoption rates for distributed solar technologies, electric vehicles, and electric heat pumps; naturally occurring improved efficiency in electronic equipment; and increased customer interest in mitigating carbon emissions. These external factors might make it especially easy, or especially difficult, for the Company to earn financial awards for this EAM.

Second, there are several other EAMs being proposed by the Company that will likely reduce annual peak demand, including the DER Utilization, Incremental Energy Efficiency, Energy Intensity, Demand Response Retention, and Customer Participation EAMs. Since all of these will influence the Annual Peak Reduction EAM, the Company may earn excessive financial awards for certain activities as a result of double-recovery from the EAMs.

[13] Direct Testimony of the Electric Customer Panel, page 47, lines 8-13.

Q. Does the fact that the peak demand is influenced by many external factors mean that it is inappropriate as an EAM?

A. No, not necessarily. An outcome-based, system-wide efficiency EAM such as the Annual Peak Reduction EAM could lead to benefits that are not offered by the other EAMs proposed by the Company. For example, the Annual Peak Reduction EAM could encourage the Company to support initiatives other than those covered by the EAMs, such as through support for third-party DER developers whose products reduce annual peak demand – an action that might not be directly rewarded by the other EAMs.

However, the fact that Annual Peak Reduction EAM is influenced by many external factors does mean that the Commission should be cautious about how many basis points to allocate to it. If this EAM is allocated too large a portion of the basis points, then the Company might be (a) over-rewarded for events and impacts that it was not responsible for, or (b) under-rewarded despite successful actions that it took to address peak demand outside of the other initiatives. Either outcome is inconsistent with the goal of EAMs, and the ultimate REV goals.

Q. Does the fact that the Annual Peak Reduction EAM rewards the Company for activities that are covered by other EAMs mean that it is an inappropriate as an EAM?

A. No, not necessarily. There may be benefits from allowing the Company to earn multiple rewards for a certain initiative. This is especially true if the initiative provides multiple benefits to customers. For example, the incremental ETIP programs will result in both energy (MWh) and peak demand (MW) savings, but the Incremental Energy Efficiency

EAM will award the Company for only the energy (MWh) savings. In such a case, it may be appropriate to reward the Company under both the Annual Peak Reduction and the Incremental Energy Efficiency EAMs.

However, the fact that the Annual Peak Reduction EAM rewards the Company for activities that are covered by other EAMs is another reason that the Commission should be cautious about how many basis points to allocate to it. If this EAM is allocated too large portion of the basis points, then the Company might be over-rewarded for certain initiatives. Such an outcome would not only be unfair to customers, it also dilutes the total impacts of the EAMs by reducing the rewards available for other utility initiatives and EAMs.

Q. What do you recommend regarding the Annual Peak Reduction EAM?

A. We recommend that the Commission allocate a smaller portion of the basis points to this EAM. Niagara Mohawk currently allocates 30 basis points for this EAM for 2020, which one-third of the total basis points for 2020. The Company has allocated this EAM many more basis points than any of the other EAMs. The EAMs with the closest basis points to this are the DER Utilization and Customer Intensity EAMs, which are allocated 10 basis points each.

Both of our concerns described above, the impact of external factors and the potential for double-recovery, suggest that the Commission should use caution when allocating basis points for this EAM. We recommend allocating a smaller number of basis points for this EAM than the 30 proposed by the Company. We address this recommendation in the context of the other EAMs in section 8 of our testimony.

We also recommend that the Commission require Niagara Mohawk to establish a new EAM focused on achieving incremental peak demand savings from its current DLM programs. A new DLM EAM would represent a more direct way to provide the Company with financial incentives for specific programs to achieve the ultimate goal of the Annual Peak Reduction EAM: to reduce peak demand. This new EAM is described below.

New: Incremental Demand Response

Q. Why do you recommend that the Commission require the Company to establish a new EAM focused on Incremental Demand Response?

A. This new EAM would be a program-based EAM to complement the system-wide Annual Peak Reduction EAM. It would provide a direct financial incentive to maximize the benefits of the DLM programs, in the same way that the Incremental Energy Efficiency EAM is designed to maximize the benefits of the ETIP programs. It would be designed to address some of the concerns with the Annual Peak Reduction EAM discussed above, by focusing on specific company actions and initiatives, relying on a baseline that is less uncertain and easier to measure and verify, and mitigating some of the risks of the Company over- or under-collecting financial incentives.

Q. How would the baseline and the targets for this new EAM be designed?

A. Ideally, the baseline for this EAM would include the demand savings (in MW) forecasted for the Company's DLM programs. The targets would then be based on reasonable increases in demand savings beyond those forecasts.

We recommend that the baseline and targets for this EAM be developed by the Company in consultation with NYSERDA and other relevant stakeholders. The Company could then provide the Commission with a detailed proposal for an EAM to begin mid-2018.

Substation Load Factor

Q. Please summarize the Substation Load Factor EAM proposed by the Company.

A. The Substation Load Factor EAM is designed to encourage the Company to improve the load factor at seven substations that (a) are currently highly utilized;[14] (b) lend themselves to accepting relatively high levels of DERs and connecting larger customers; and (c) have Supervisory Control and Data Acquisition (SCADA) capabilities for tracking and validating load information. The Company hopes to improve the average load factor at these seven substations by targeting them with demand response, other demand-side management technologies, storage solutions, and distributed solar technologies.[15]

The proposed baseline for this EAM is the average 2016 load factor at these seven substations of 48.1%. The improvement targets for this EAM are year-over-year percentage increases in the load factor. The improvement targets proposed by the Company are the equivalent of reducing the peak load at the substations by 3.5 MW (minimum), 6.9 MW (mid-point), and 10.1 MW (maximum).[16]

[14] The Company notes that the selected substations have peak forecasts between 90 percent and 100 percent of the summer normal rating in 2017. Direct Testimony of the Electric Customer Panel, page 48, lines 10-12.
[15] Direct Testimony of the Electric Customer Panel, page 48, lines 1-16.
[16] Direct Testimony of the Electric Customer Panel, page 49, lines 1-17.

Q. Do you have any concerns about the Substation Load Factor EAM?

A. Yes. While we agree with applying an EAM to promote more efficient use of substations, we disagree with using load factor as the metric for this purpose. The reduction in peak demand would be a much more direct metric, and would avoid the risk of unintended consequences or increased costs to customers. The load factor is driven by both peak demand and energy consumption. There are many actions that the Company or customers could undertake to *increase* energy consumption near these substations, thereby improving the load factor, without decreasing the peak demand at all. Such an outcome might increase customer costs and increase carbon emissions, without providing the improved system efficiency that the Commission seeks.

The best way to make heavily utilized substations (which these seven substations are by definition) more efficient is to reduce their peak demands. Doing so would more clearly lead to reduced costs to customers, is not likely to have the unintended consequence of increased energy consumption, and is not likely to reward the Company for an outcome that is not in customers' interest. The Company states in testimony that "focusing improvements on reducing *the peak* in these areas is likely to relieve system constraints" (emphasis added), and even provides the peak reduction values (in MW) associated with their proposed load factor improvements.[17] The new Incremental Demand Response EAM that we propose above is a better mechanism for encouraging the Company to achieve reductions in peak demand at key substations.

[17] Direct Testimony of the Electric Customer Panel, page 48, lines 13-14, and page 49, lines 14-17.

Q. What do you recommend regarding the Substation Load Factor EAM?

A. We recommend that the Commission reject the Substation Load Factor EAM proposed by the Company.

Distributed Energy Resource Utilization

Q. Please summarize the DER Utilization EAM proposed by the Company.

A. The DER Utilization EAM is designed to encourage the Company to promote the development of DERS in general throughout its service territory. This EAM does not include the impacts of the Company's demand response activities, nor does it include the impacts of the Company's energy efficiency programs. Instead, it covers the development of technologies such as distributed solar, energy storage, combined heat and power (CHP), fuel cells, and electric vehicles. The Company intends to promote these technologies through collaboration with third parties through initiatives such as the 3Vo upgrade proposal.[18]

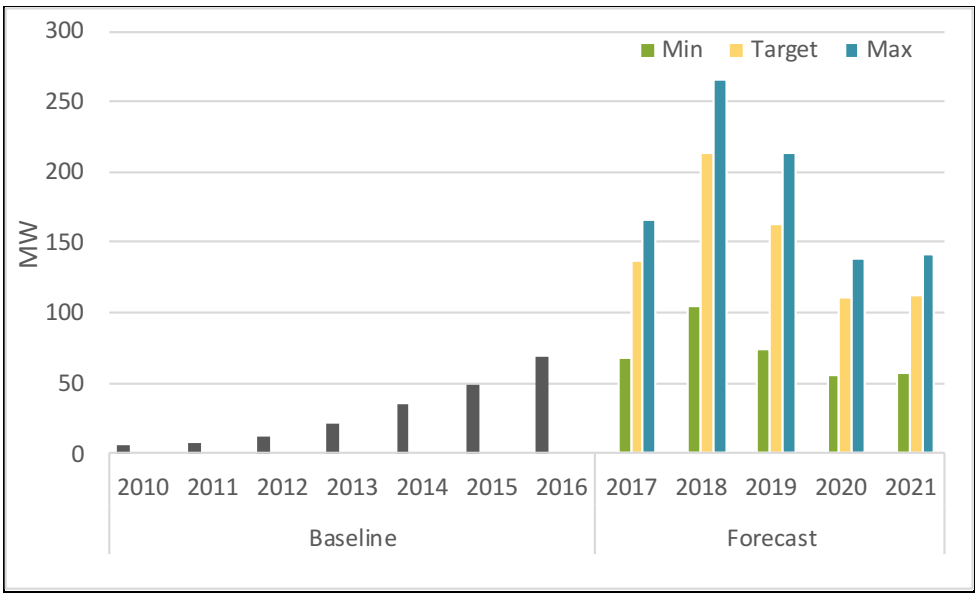
The proposed baseline for this EAM is the Company's projections of new installations of distributed solar, CHP, energy storage, fuel cells, and new EVs. The minimum targets for this EAM are equal to the Company's forecasts through 2018, and increase beyond those for 2019 and 2020.[19] The mid-point and maximum targets assume additional development of DERs beyond those forecasts of approximately 59 percent and 129 percent, respectively.[20]

[18] Direct Testimony of the Electric Customer Panel, page 50.
[19] Attachment 1 to DPS-379 RAC-8
[20] Attachment 1 to DPS-379 RAC-8, calculated as totals for 2017-2020.

Q. Do you have any concerns about the DER Utilization EAM?

A. Yes. While this EAM addresses an important set of resources and is relatively easy to measure and monitor, we are concerned that the Company's targets are not sufficiently ambitious, and are overly driven by performance of one resource – distributed solar. Approximately 95 percent of the target energy for this EAM is comprised of energy produced by rooftop and community solar photovoltaics (PV).[21] The Company's targets are based on estimates that show incremental PV installations continuing to rise rapidly through 2018, and then inexplicably slowing in 2019 through 2021. Indeed, the Company's minimum targets show incremental installations declining below current levels.

Figure 1. Annual Incremental Capacity from Installations of Rooftop and Community Solar



[21] Attachment 1 to DPS-379 RAC-8.

In contrast to the Company's targets, which are based on declining rates of growth for solar PV, more ambitious targets would be based on an increasing rate of growth in a variety of DERs, and provide more emphasis on other DERs, such as CHP and EVs. Electric utilities can have a significant impact on the development of both CHP and EVs, and these resources can help achieve the REV goals of reducing electricity costs and reducing carbon emissions.

Q. What do you recommend regarding the DER Utilization EAM?

A. We recommend that the Commission approve the Company's proposed DER Utilization EAM, but with more aggressive targets. In addition, we recommend that the Commission direct Niagara Mohawk to establish a new EAM designed to encourage the strategic development of electric vehicles. Electric vehicles are likely to have significant impacts on the electricity system in the coming years, and utilities should take actions to maximize the positive impacts and minimize the potential negative impacts of EVs on system utilization. This new EAM is described below.

<u>New: Electric Vehicles</u>

Q. Why do you recommend that the Commission require the Company to establish a new EAM focused on electric vehicles?

A. Electric vehicles are expected to have a large impact on the electric grid in the near- to mid-term future. EVs require a significant amount of electricity for charging, either at publicly-available charging stations or at customers' homes and businesses. Electric utilities should plan for and manage the development of EVs, for example by offering time-vary rates to mitigate the impact on local and system peak demand, and by

facilitating the development of charging stations in locations that minimize the costs imposed on the distribution system.

The Company's proposal to include the consumption from EVs in the DER Utilization EAM is an overly simplistic way to address the complexities associated with this resource/technology/consumer product. The DER Utilization EAM simply accounts for the amount of electricity consumption by EVs, but it does not address when or where the consumption occurs—both of which will significantly affect the costs that the EVs impose upon the electricity system. Therefore, it is important to establish an EV EAM that provides the Company with financial incentives to encourage optimal charging and discharging through time-varying rates, or to encourage optimal location of EV charging stations, or both.

Q. What aspect of EV development should be included in the EV EAM at this time?

A. We recommend that the EV EAM encourage the Company to enroll as many customers as possible on time-varying rates. It is our understanding that Niagara Mohawk has not developed a time-varying rate for EVs, but is likely to be required to do so by Assembly bill A228, which is awaiting the Governor's signature. Additionally, the Commission's Track Two Order[22] called for a process to revise current time-of-use rates. Once new or revised rates are approved by the Commission, this EAM could be designed to encourage the Company to enroll as large a portion as possible of the customers with EVs onto these rates.

[22] Order Adopting a Ratemaking and Utility Revenue Model Policy Framework ("Track Two Order"), May 19, 2016. Proceeding 14-M-0101. Page 134.

Q. How would the baseline and the targets for this new EAM be designed?

A. Ideally, the baseline for this EAM would include a forecast of the EV customers that are expected to voluntarily sign up for the EV rate. The targets would then be based on reasonable increases in customer enrollment beyond those forecasts.

We recommend that the baseline and targets for this EAM be developed by the Company in consultation with other relevant stakeholders. The Company could then provide the Commission with a detailed proposal for an EAM to begin mid-2018.

5. ENERGY EFFICIENCY EAMS

Incremental Energy Efficiency

Q. Please summarize the Incremental Energy Efficiency EAM proposed by the Company.

A. The Incremental Energy Efficiency EAM is designed to encourage the Company to exceed the minimum energy savings targets of its ETIP efficiency programs. Niagara Mohawk intends to exceed these targets through collaborative efforts with NYSERDA and local governments, as well as program cost savings through improved performance and market innovations.[23]

The baseline for this EAM is ETIP energy savings targets (MWh), as proposed in the June 2017 ETIP Filing. The minimum target accounts for the energy savings from the proposed ETIP budgets, plus the energy savings from the proposed LED street lighting program. The mid-point target is based on the assumption that the Company will be able

[23] Direct Testimony of the Electric Customer Panel, page 53.

to achieve higher efficiency savings through a 20 percent reduction in the cost of saved energy (i.e., the ETIP costs per MWh of efficiency savings). The maximum target is based on the assumption that the Company will be able to achieve a 35 percent reduction in the cost of saved energy.[24]

Q. Do you have any concerns about the Incremental Energy Efficiency EAM?

A. We do not have any concerns about the design of the Incremental Efficiency EAM. This EAM addresses an important set of resources, promotes initiatives that are within the Company's control, is relatively easy to measure and monitor, and poses few risks to customers.

However, we are concerned that the Company has not given this EAM sufficient priority in the allocation of basis points for the EAM rewards. Given the importance of these resources, and the fact that there are many actions the Company can take to facilitate their development, we recommend that this EAM be allocated more than the seven basis points that the Company has allocated to it.

Q. What do you recommend regarding the Incremental Energy Efficiency EAM?

A. We recommend that the Commission approve the Company's proposed Incremental Energy Efficiency EAM. We also recommend that the Commission increase the basis points allocated to this EAM. We address this recommendation in the context of the other EAMs in section 8 of our testimony.

[24] Direct Testimony of the Electric Customer Panel, page 54.

We also recommend that the Commission require the Company to establish a new EAM to provide financial incentives to maximize the benefits available from the NYSERDA efficiency programs targeted to low-income customers and local governments. This is described below.

Further, we recommend that the Commission require the Company to use advanced evaluation, measurement, and verification techniques for measuring efficiency savings, wherever it is cost-effective to do so. This will help support this important EAM, as well as provide useful information for energy efficiency program planning in general.

New: NYSERDA Energy Efficiency

Q. Why do you recommend that the Commission require the Company to establish a new EAM focused on NYSERDA Energy Efficiency?

A. The NYSERDA efficiency programs represent an important component of the efficiency services offered in the Company's territory, both because of the important customer sectors served and the potential magnitude of the savings from these customers. It is our understanding that the savings from the NYSERDA efficiency programs are not included in the Incremental Energy Efficiency EAM baselines or targets, and thus the Company does not receive financial incentives to optimize these programs.

A new EAM targeted at this important component of efficiency services could encourage the Company to support the NYSERDA programs by, for example, promoting the NYSERDA program through its ETIP marketing efforts, working with local community services agencies and municipal customers to advance the NYSERDA programs, working directly with NYSERDA to help identify potential customers, and generally

ensuring that there are no gaps between the Niagara Mohawk and the NYSERDA efficiency programs.

Q. How would the baseline and the targets for this EAM be designed?

A. Ideally, the baseline for this EAM would include the efficiency savings (in MWh) forecasted for the NYSERDA efficiency activities within the Niagara Mohawk service territory. The targets would then be based on reasonable increases in efficiency savings beyond those forecasts.

We recommend that the baseline and targets for this EAM be developed by the Company in consultation with NYSERDA and other relevant stakeholders. The Company could then provide the Commission with a detailed proposal for an EAM to begin mid-2018.

Customer Energy Intensity

Q. Please summarize the Customer Energy Intensity EAMs proposed by the Company.

A. The Customer Energy Intensity EAM is designed to encourage the Company to reduce customer energy intensity in terms of usage per customer. Within this category, the Company has proposed three separate Customer Intensity EAMs, for residential, commercial, and low-income customers.

The baseline for this EAM was developed by using historical energy intensities (from 2010 to 2016) to project future energy intensities (for 2017 to 2020). For each of the three customer groups, the Company projects the rate at which energy intensities are expected to improve in the future years, using econometric sales forecasts. These forecasts project a linear trend, where customer energy intensity is expected to improve each year, (i.e., the of usage-per-customer is expected to be reduced each year). The minimum, mid-point,

and maximum targets were determined by assuming that the Company could make the energy intensities improve faster than was forecast (i.e., could increase the rate of decline in the usage-per-customer).

For residential customers, the minimum target represents a 29 percent improvement in the trendline slope, the mid-point represents a 76 percent improvement, and the maximum target represents a 176 percent improvement. For commercial customers, the minimum target represents a 0.8 percent improvement in the trendline slope, the mid-point represents a 14 percent improvement, and the maximum target represents a 33 percent improvement.[25]

For low-income customers, there has been a slightly increasing trend in usage per customer in recent years. For this reason, and the need to coordinate with NYSERDA programs, minimum targets were set to represent only modest improvements over 2016 energy intensity, and mid-point targets were set to represent just over 0.5 percent reduction in year-to-year energy intensity.

Q. Do you have any concerns about the Customer Energy Intensity EAMs?

A. Yes, I have several concerns about this EAM. First, electric vehicles and high-efficiency electric heat pumps could lead to higher usage-per-customer levels. These are important types of DERs that can help reduce costs, increase efficiencies, reduce carbon emissions, and offer significant benefits to customers. The Customer Energy Intensity EAM could have the unintended consequence of providing the Company with financial disincentives

[25] ECP Testimony, p. 57

regarding these resources, or depriving the Company of financial awards for other activities that do improve customer intensity, or both.

Second, there are many factors outside the control of the Company that can affect customer energy intensities. These include, for example, federal efficiency standards; changing consumer preferences for electronic devices; changing adoption rates for distributed solar technologies electric vehicles, and electric heat pumps; naturally occurring improved efficiency in electronic equipment; and increased customer interest in mitigating carbon emissions. These external factors might make it especially easy, or especially difficult, for the Company to earn financial awards for this EAM.

Third, there are several other EAMs proposed by the Company that will likely reduce customer energy intensities, including the DER Utilization, Incremental Energy Efficiency, and Customer Participation EAMs. Since all of these will influence customer energy intensity, the Company may earn excessive financial awards for certain activities as a result of double-recovery from the EAMs.

Fourth, the targets for this EAM appear to be arbitrarily chosen by the Company. The minimum, mid-point, and maximum targets represent increasing rates of decline in the usage per customer, but it is not clear how these rates were decided upon and the Company has not provided any benefit-cost analysis to justify them.

Q. What do you recommend regarding the Customer Energy Intensity EAMs?

A. We recommend that the Commission approve the Customer Energy Intensity EAMs, given that it has some value as a system efficiency incentive. However, we propose two important modifications to the Company's proposal. First, the Company remove the

impact (in terms of MWh) of EVs and high-efficiency electric heat pumps from the baselines and the targets. Second, the Commission should allocate a smaller portion of the basis points than what was proposed by the Company, given the concerns listed above. We address this recommendation in the context of the other EAMs in section 8 of our testimony.

6. INTERCONNECTION EAM

Q. Please summarize the interconnection EAM proposed by the Company.

A. The Company has proposed one EAM related to interconnection: a developer satisfaction survey.

Q. Do you have any concerns about the developer satisfaction survey EAM?

A. Not at this time.

Q. What do you recommend regarding the developer satisfaction survey?

A. We recommend that the Commission approve the developer satisfaction EAM. Timely and successful interconnection of DERs does require some attention and resources from the Company, and is an important outcome that will help achieve the Commission's New York REV goals.

7. CUSTOMER ENGAGEMENT EAMS

Q. Please summarize the customer engagement EAMs proposed by the Company.

A. The Company has proposed four Customer Engagement EAMs:

- Demand Response Retention. This is designed to encourage the Company to keep customers enrolled in demand response programs as long as possible, including all of the Company's demand response programs: Connected Solutions, coolControl, Future Designated Areas, DLRP, and CSRP.[26]

- Customer Participation. This is designed to encourage the Company to increase the number of customers either making purchases or enrolling in programs through the CEMP, which consists of the E-Commerce Platform; the Residential Solar Marketplace; and the Company's DLM programs.

- Transactional Conversion Rate. This is designed to encourage Niagara Mohawk to increase the number of purchases that customers make, as a percentage of total visits, from the E-Commerce Platform or the Residential Solar Marketplace.

- Customer Survey. This survey will measure satisfaction from customers who make purchases from the E-Commerce and the Residential Solar Marketplace.

Q. Do you have any concerns about the Customer Engagement EAMs?

A. In general, we support the concept of providing guidance and incentives regarding customer engagement in various DER activities. Also, we agree with the Company's proposal to allocate a relatively small share of the basis points to this group of EAMs, reflecting that they are not as high a priority as some of the other EAMs, such as Annual Peak Reduction, DER Utilization, or Incremental Energy Efficiency.

[26] Direct Testimony of the Electric Customer Panel, pages 60-63.

However, we have one primary concern with this group of EAMs related to the allocation of basis points within the group. The Transactional Conversion Rate and the Customer Survey EAMs are allocated most of the basis points in this group of EAMs, yet both are limited to only the E-Commerce Platform and the Residential Solar Marketplace initiatives. The Company is also provided financial incentives for these initiatives through the Annual Peak Reduction, DER Utilization, Incremental Energy Efficiency, Customer Intensity, and Customer Participation EAMs. There is a risk of over-recovery of financial incentive for success from these two initiatives.

More importantly, we believe that the Customer Participation EAM should be given greater priority than the Transactional Conversion Rate and the Customer Survey EAMs, since it also includes participation in DLM programs. The Company should encourage broad participation in all of its DER-related initiatives and programs, and should encourage as many customers as possible to adopt all DERs that meet their needs and help reduce their electricity costs. Widespread customer adoption of DERs is the best way to achieve the REV goals, maximize the potential benefits of DERs, mitigate any cost-shifting that might occur as a result of DERs, and spread the benefits of DERs as broadly as possible around the customer base. For this reason, more emphasis should be placed on the Customer Participation EAM.

Q. What do you recommend regarding the Customer Engagement EAMs?

A. We recommend that the Commission approve the Customer Engagement EAMs, but that the basis points allocated to the Transactional Conversion Rate and the Customer Survey EAMs be reduced, and the basis points for the Customer Participation EAM be increased.

We address this recommendation in the context of the other EAMs in section 8 of our testimony.

8. ALLOCATION OF AWARDS ACROSS EAMS

Q. What are some of the key criteria to consider when allocating potential financial awards across a set of EAMs?

A. There are several factors to consider when establishing financial incentives for performance incentive mechanisms. These include:

- Importance of the outcome. Those initiatives and outcomes that are especially likely to help achieve the commission's REV goals (enhanced customer empowerment, market animation, system-wide efficiency, fuel and resource diversity, system reliability and resiliency, and reduction of carbon emissions) may warrant greater financial incentives than those with less of an impact on those goals.

- Benefit-cost analyses (BCA). Those initiatives and outcomes that are expected to be especially cost-effective might warrant greater financial incentives than those that are less cost-effective. Also, any financial incentive should be less than, and ideally a reasonable portion of, the net benefit of the initiative or outcome being incentivized.

- Countervailing financial incentives. In general, utilities have a financial incentive to make capital investments that will increase their rate base and result in higher amounts of authorized profits. DERs can reduce the need for utility capital

investments, and thus potentially reduce utility profits. The EAM financial incentive should be designed to help offset the financial disincentive for DERs.

- Design or structural issues of the EAM. Those EAMs that are well-designed, e.g., in terms of a predictable baseline or an easily measured and verified outcome, might warrant greater financial incentives than those that are less well-designed. If an EAM creates risks of unintended consequences, or over/under-recovery by the Company, then those risks can be mitigated by assigning that EAM smaller financial incentives.

- Ability of the utility to control the outcome. Those initiatives and outcomes that are well within the control of the utility might warrant greater financial incentives than those that are not. If an EAM creates risks of unintended consequences, or over/under-recovery by the Company, then those risks can be mitigated by assigning that EAM smaller financial incentives.

- Outside factors that might influence the outcome. Those outcomes that are significantly affected by factors outside the Company's control might warrant fewer financial incentives than those that are not. Again, risks of over- or under-recovery of financial rewards can be mitigated by assigning small financial incentives.

- Double-recovery. If certain initiatives or outcomes are covered by more than one EAM, then those EAMs might warrant relatively small financial incentives. Risks of double-recovery can be mitigated by assigning small financial incentives where double-recovery is possible.

Q. Is there a single formulaic approach to allocating basis points to different EAMs?

A. No. All of the factors listed above should be considered when determining the financial incentives for each EAM.

Q. Do you have any general concerns about the process used by the Company to allocate basis points across the EAMs?

A. Yes. As noted above, the cost-effectiveness of the programs, initiatives, and outcomes encouraged through the EAMs should play a large role in determining the magnitude of the financial incentive for each EAM. For example, it would be inappropriate to provide a financial incentive for a program, initiative, or outcome that is not cost-effective. Similarly, it would be inappropriate to provide a financial incentive that is so large that it mostly or entirely offsets the net economic benefits of an initiative, program, or outcome. Further, it would be inappropriate to award much greater financial incentives to EAMs that are not very cost-effective, relative to smaller financial incentives to EAMs that are very cost-effective.

However, the Company's BCA for the EAMs is not especially useful for making these determinations about the financial incentives to apply to the EAMs. While the Company provides a BCA for the entire set of EAMs, it does not break the BCA results out by each individual EAM, which is necessary for making decisions on each EAM.[27] The Company does provide more detail of its BCA in response to discovery requests, but even this does not provide much of the information needed for making decisions on the EAM financial incentives. There are many EAMs for which the Company did not provide any BCA.

[27] Direct Testimony of the Electric Customer Panel, Exhibit__(ECP-5CU), Schedule 8.

Some of the BCAs do not include the benefits of avoided distribution capacity, which is one of the central benefits of the EAM. The BCA analyses are often not matched up with the EAMs, but instead are for some of the initiatives that might affect the EAMs. Consequently, the Company's BCA is of limited use for this important purpose of establishing financial incentives for the EAMs.

While we have concerns about over-rewarding the utility in relation to the net benefits of an EAM, we also have concerns about under-rewarding the utility. As discussed earlier in this section, in order for these incentives to provide sufficient financial motivation to utilities to pursue these EAMs as a core business activity, they must provide sufficient earnings to overcome countervailing incentives. To determine whether the incentives are sufficient, they would need to be compared to the earnings that the utility would forgo if the EAMs are achieved. This information is unavailable.

Q. How many basis points do you recommend be applied to the EAMs in total.

A. We recommend that the total amount of the EAMs be set at 100 basis points, instead of the 90 basis points proposed by the Company. This is warranted because we have added two new EAMs, because of the importance of the many initiatives and outcomes promoted by the EAMs, and because the Company's benefit-cost analysis indicates that overall its EAMs will result in customer benefits that outweigh the costs.[28] Increasing the total basis points is in line with the Commission's Track Two Order, which authorized up to 100 basis points for EAMs.[29]

[28] Direct Testimony of the Electric Customer Panel, Exhibit__(ECP-5CU), Schedule 8.

[29] Track Two Order, Page 68. "As initial bounds on the first round of REV initiated EAMs, the maximum amount of earnings should not be more than 100 basis points total from all new incentives."

Q. Please summarize your recommendations regarding the allocation of financial incentives to the EAMs.

A. Table 1 provides a summary of our recommendations for allocating financial incentives to the EAMs, focusing on the maximum target for 2020. Our recommendations are presented next to the Niagara Mohawk proposals.

Table 1. Allocation of Financial Rewards Across EAMs

Earning Adjustment Mechanism:	NiMo bps Allocations	Recommended bps Allocations
	Maximum 2020	Maximum 2020
System Efficiency Subtotal	**45**	**50**
Annual Peak Reduction	30	20
New: Demand Response	---	15
Substation Load Factor	5	0
DER Utilization (MWh)	10	10
New: Electric Vehicles	---	5
Energy Efficiency Subtotal	**30**	**35**
Incremental Energy Efficiency	7	21
New: NYSERDA Energy Efficiency	---	5
Energy Intensity (Residential)	10	3
Energy Intensity (Commercial)	10	3
Energy Intensity (Low-Income)	3	3
Interconnection Subtotal	**5**	**5**
Developer Satisfaction Survey	5	5
Customer Engagement Subtotal	**10**	**10**
DR Retention (Res & Small Bus)	1	1
DR Retention (C&I)	1	1
Customer Participation (Res)	1	3
Customer Participation (C&I)	1	3
Transactional Conversion Rate	3	1
Survey	3	1
EAMs Total	**90**	**100**

Q. Please explain how you came up with the recommended financial incentives for the 2020 maximum targets, for each EAM.

A. In general, we considered the multiple factors listed above when determining financial incentives for each EAM. Our recommendations for each EAM are based on the following:

- Annual Peak Reduction. This EAM addresses an important outcome: reduced peak demand resulting from a wide variety of initiatives. Therefore, it should be given relatively high priority and receive a relatively large portion of basis points. However, we recommend reducing the allocation proposed by the Company because annual peak demand can be influenced by many external factors, and many other EAMs will help reduce the annual peak demand, creating a risk of over-recovery of incentives. Consequently, we recommend that the maximum basis points allocated to this EAM be reduced from 30 to 20.

- New: Incremental Demand Response. This EAM addresses an important initiative and an important outcome: reduced peak demands directly resulting from utility demand response programs. Further, this EAM helps to control for peak reductions that result from factors outside of the Company's control. Therefore, it should be given relatively high priority and receive a relatively large portion of basis points. On the other hand, the Annual Peak Reduction EAM also provides an incentive to reduce peak demands through the DLM programs, creating a risk of over-recovery of incentives. Consequently, we recommend allocating 15 basis points to the maximum target for this EAM.

- Substation Peak Reduction. We recommend that the Commission reject this EAM, for the reasons described above. Therefore, this EAM should be allocated zero basis points.

- DER Utilization. In general, the promotion of DERs should be given relatively high priority. However, the Company has focused the targets for this primarily on the adoption of distributed solar resources, and those targets are not especially ambitious. Therefore, we recommend allocating 10 basis points to the maximum target for this EAM.

- New: Electric Vehicles. In general, utility actions to maximize the benefits and minimize the costs from customer adoption of EVs over the near- to mid-term future should be given relatively high priority. On the other hand, the Company EV initiatives are still in early stages, and in most cases are still in the proposal stage.[30] Similarly, this EAM has not been as fully defined as some of the other EAMs proposed by the Company or us. Consequently, it may be premature to allocate a large portion of the basis points to this EAM. We recommend allocating 5 basis points to the maximum target for this EAM.

- Incremental Energy Efficiency. This EAM addresses an important initiative and an important outcome: reduced energy consumption (and, indirectly, reduced peak demand). Therefore, it should be given relatively high priority and receive a relatively large portion of basis points. This EAM also addresses an initiative that

[30] See the discussion of Potential Future Offerings in Section 3 of our testimony.

the Company has direct and significant control over, and that has the potential to provide a significant amount of cost-effective savings to customers.[31] Therefore, we recommend increasing the allocation of maximum basis points for this EAM from 7 to 21.

- New: Incremental NYSERDA Efficiency. This outcome addresses an important outcome: reduced energy consumption and peak demand from low-income and municipal customers. On the other hand, Niagara Mohawk can influence this outcome only indirectly, by coordinating and cooperating with NYSERDA in the planning and implementation of its programs. For this reason, this EAM warrants relatively few basis points. We recommend allocating 5 basis points to the maximum target for this EAM.

- Customer Energy Intensity. Reducing customer energy intensity is an important goal, but only to the extent that it does not hamper beneficial electrification. As currently defined, this EAM suffers from several limitations that suggest it should not be allocated a large number of basis points, including: there are some DERs that will increase customer energy intensity, customer energy intensity can be influenced by many external factors, and many other EAMs will help reduce customer energy intensity, creating a risk of over-recovery of incentives. Consequently, we recommend that the maximum basis points allocated to this EAM be reduced from a maximum of 10 to 3 for each customer segment.

[31] Synapse Energy Economics, *Aiming Higher: Realizing the Full Potential of Cost-Effective Energy Efficiency in New York*, prepared for Natural Resources Defense Council, E4TheFuture, CLEAResult, Lime Energy, Association for Energy Affordability, and Alliance for Clean Energy New York, April 2016.

- Interconnection. The Company has allocated relatively few basis points to the EAM, reflecting a low priority relative to the other EAMs. We agree with this proposal and recommend accepting the Company's proposal to allocate 5 basis points for the maximum target for this EAM.

- Customer Engagement. We agree with the Company's proposal to allocate a modest amount of basis points for this group of EAMs, given that there is a lot of overlap between these EAMs and the system efficiency and energy efficiency EAMs. However, we recommend that the Customer Participation EAMs be given a higher priority than the others, because of the equity benefits of promoting widespread adoption of DERs. Therefore, we recommend that the maximum basis points allocated to Customer Participation EAMs be increased to 3 each, and that the maximum basis points allocated to the other customer engagement EAMs be reduced to 1 each.

Q. Do you have any recommendations regarding the financial incentives awarded for achieving the minimum and mid-point targets?

A. For the sake of simplicity, we recommend that the basis points awarded for achieving the minimum and mid-point targets be determined by scaling them up or down by the same factor that the basis points for the maximum target is scaled up or down. For example, for the Annual Peak Reduction EAM we recommend reducing the basis points for achieving the maximum target from 30 to 20. Therefore, the basis points that the Company proposed for achieving the minimum and mid-point targets for this EAM should also be reduced by one-third.

729 **Q. Does this conclude your testimony?**

730 A. Yes, it does.

Exhibit TW-MW-1

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PROFESSIONAL EXPERIENCE

Synapse Energy Economics Inc., Cambridge, MA. *Vice President*, 2011 – present.

Provides expert consulting on the economic, regulatory, consumer, environmental, and public policy implications of the electricity and gas industries. The primary focus of work includes technical and economic analyses, electric power system planning, climate change strategies, energy efficiency programs and policies, renewable resources and related policies, power plant performance and economics, air quality, and many related aspects of consumer and environmental protection.

Massachusetts Department of Public Utilities, Boston, MA. *Commissioner*, 2007 – 2011.

Oversaw a significant expansion of clean energy policies as a consequence of the Massachusetts Green Communities Act, including an aggressive expansion of ratepayer-funded energy efficiency programs; the implementation of decoupled rates for electric and gas companies; an update of the DPU energy efficiency guidelines; the promulgation of net metering regulations; review of smart grid pilot programs; and review of long-term contracts for renewable power. Oversaw six rate case proceedings for Massachusetts electric and gas companies. Played an influential role in the development of price responsive demand proposals for the New England wholesale energy market. Served as President of the New England Conference of Public Utility Commissioners from 2009-2010. Served as board member on the Energy Facilities Siting Board from 2007-2010. Served as co-chair of the Steering Committee for the Northeast Energy Efficiency Partnership's Regional Evaluation, Measurement and Verification Forum.

Synapse Energy Economics Inc., Cambridge, MA. *Vice President*, 1997 – 2007.

Tellus Institute, Boston, MA. *Senior Scientist, Manager of Electricity Program*, 1992 – 1997.

Association for the Conservation of Energy, London, England. *Research Director*, 1991 – 1992.

Massachusetts Department of Public Utilities, Boston, MA. *Staff Economist*, 1989 – 1990.

Massachusetts Office of Energy Resources, Boston, MA. *Policy Analyst*, 1987 – 1989.

Energy Systems Research Group, Boston, MA. *Research Associate*, 1983 – 1987.

Union of Concerned Scientists, Cambridge, MA. *Energy Analyst*, 1982-1983.

EDUCATION

Boston University, Boston, MA
Master of Business Administration, 1993

London School of Economics, London, England
Diploma, Economics, 1991

Tufts University, Medford, MA
Bachelor of Science in Mechanical Engineering, 1982

Tufts University, Medford, MA
Bachelor of Arts in English, 1982

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Woolf, T. 2002. *Green Power and Energy Efficiency Opportunities for Municipalities in Massachusetts: Promoting Community Involvement in Energy and Environmental Decisions*. Synapse Energy Economics for the Massachusetts Energy Consumers Alliance.

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Woolf, T. 2001. *Repowering the Midwest: The Clean Energy Development Plan for the Heartland*. Synapse Energy Economics for the Environmental Law and Policy Center and a coalition of Midwest environmental advocates.

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Woolf, T. 1995. *Non-Price Benefits of BECO Demand-Side Management Programs*. Tellus Institute for Boston Edison Settlement Board. Tellus Study No. 93-174.

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TESTIMONY

Utah Public Service Commission (Docket No. 14-035-114): Direct and rebuttal testimony of Tim Woolf regarding the Pacificorp's analysis of the benefits and costs associated with distributed generation resources. On behalf of Utah Clean Energy. June 8, 2017 and July 25, 2017.

Massachusetts Department of Public Utilities (D.P.U. 17-05): Direct and surrebuttal testimony of Tim Woolf and Melissa Whited regarding performance-based regulation, the monthly minimum reliability contribution, storage pilots, and rate design in Eversource's petition for approval of rate increases and a performance-based ratemaking mechanism. On behalf of Sunrun and the Energy Freedom Coalition of America, LLC. April 28, 2017 and May 26, 2017.

Massachusetts Department of Public Utilities (D.P.U. 15-120, D.P.U. 15-121, D.P.U. 15-122/15-123): Direct testimony of Tim Woolf and Ariel Horowitz, PhD, regarding the petitions by National Grid, Unitil, NSTAR, and Eversource Energy for approval of their grid modernization plans. On behalf of Conservation Law Foundation. March 10, 2017.

Massachusetts Department of Public (D.P.U. 16-169): Direct testimony of Tim Woolf and Erin Malone regarding Nation Grid's petition for ruling regarding the provision of gas energy efficiency services. On behalf of the Cape Light Compact. November 2, 2016.

New Jersey Board of Public Utilities (Docket No. ER16060524): Direct testimony regarding Rockland Electric Company's proposed advanced metering program. On behalf of the New Jersey Division of Rate Counsel. September 9, 2016.

Colorado Public Utilities Commission (Proceeding No. 16AL-0048E): Answer testimony regarding Public Service Company of Colorado's rate design proposal. On behalf of Energy Outreach Colorado. June 6, 2016.

Georgia Public Service Commission (Docket No. 40161 and Docket No. 40162): Direct testimony regarding the demand-side management programs proposed by Georgia Power Company in its Certification, Decertification, and Amended Demand-Side Management Plan and its 2016 Integrated Resource Plan. On behalf of Sierra Club. May 3, 2016.

Massachusetts Department of Public Utilities (Docket No. 15-155): Joint direct and rebuttal testimony with M. Whited regarding National Grid's rate design proposal. On behalf of Energy Freedom Coalition of America, LLC. March 18, 2016 and April 28, 2016.

Maine Public Utilities Commission (Docket No. 2015-00175): Direct testimony on Efficiency Maine Trust's petition for approval of the Triennial Plan for Fiscal Years 2017-2019. On behalf of the Natural Resources Council of Maine and the Conservation Law Foundation. February 17, 2016.

Nevada Public Utilities Commission (Docket Nos. 15-07041 and 15-07042): Direct testimony on NV Energy's application for approval of a cost of service study and net metering tariffs. On behalf of The Alliance for Solar Choice. October 27, 2015.

New Jersey Board of Public Utilities (Docket No. ER14030250): Direct testimony on Rockland Electric Company's petition for investments in advanced metering infrastructure. On behalf of the New Jersey Division of Rate Counsel. September 4, 2015.

Utah Public Service Commission (Docket No. 14-035-114): Direct, rebuttal, and surrebuttal testimony on the benefit-cost framework for net energy metering. On behalf of Utah Clean Energy, the Alliance for Solar Choice, and Sierra Club. July 30, 2015, September 9, 2015, and September 29, 2015.

Nova Scotia Utility and Review Board (Matter No. M06733): Direct testimony on EfficiencyOne's 2016-2018 demand-side management plan. On behalf of the Nova Scotia Utility and Review Board. June 2, 2015.

Missouri Public Service Commission (Case No. ER-2014-0370): Direct and surrebuttal testimony on the topic of Kansas City Power and Light's rate design proposal. On behalf of Sierra Club. April 16, 2015 and June 5, 2015.

Missouri Public Service Commission (File No. EO-2015-0055): Rebuttal and surrebuttal testimony on the topic of Ameren Missouri's 2016-2018 Energy Efficiency Plan. On behalf of Sierra Club. March 20, 2015 and April 27, 2015.

Florida Public Service Commission (Dockets No. 130199-EI et al.): Direct testimony on the topic of setting goals for increasing the efficiency of energy consumption and increasing the development of demand-side renewable energy systems. On behalf of the Sierra Club. May 19, 2014.

Massachusetts Department of Public Utilities (Docket No. DPU 14-86): Direct and rebuttal Testimony regarding the cost of compliance with the Global Warming Solution Act. On behalf of the Massachusetts Department of Energy Resources and the Department of Environmental Protection. May 16, 2014.

Kentucky Public Service Commission (Case No. 2014-00003): Direct testimony regarding Louisville Gas and Electric Company and Kentucky Utilities Company's proposed 2015-2018 demand-side management and energy efficiency program plan. On behalf of Wallace McMullen and the Sierra Club. April 14, 2014.

Maine Public Utilities Commission (Docket No. 2013-168): Direct and surrebuttal testimony regarding policy issues raised by Central Maine Power's 2014 Alternative Rate Plan, including recovery of capital costs, a Revenue Index Mechanism proposal, and decoupling. On behalf of the Maine Public Advocate Office. December 12, 2013 and March 21, 2014.

Colorado Public Utilities Commission (Docket No. 13A-0686EG): Answer and surrebuttal testimony regarding Public Service Company of Colorado's proposed energy savings goals. On behalf of the Sierra Club. October 16, 2013 and January 21, 2014.

Kentucky Public Service Commission (Case No. 2012-00578): Direct testimony regarding Kentucky Power Company's economic analysis of the Mitchell Generating Station purchase. On behalf of the Sierra Club. April 1, 2013.

Nova Scotia Utility and Review Board (Matter No. M04819): Direct testimony regarding Efficiency Nova Scotia Corporation's Electricity Demand Side Management Plan for 2013 – 2015. On behalf of the Counsel to Nova Scotia Utility and Review Board. May 22, 2012.

Missouri Office of Public Counsel (Docket No. EO-2011-0271): Rebuttal testimony regarding IRP rule compliance. On behalf of the Missouri Office of the Public Counsel. October 28, 2011.

Nova Scotia Utility and Review Board (Matter No. M03669): Direct testimony regarding Efficiency Nova Scotia Corporation's Electricity Demand Side Management Plan for 2012. On behalf of the Counsel to Nova Scotia Utility and Review Board. April 8, 2011.

Rhode Island Public Utilities Commission (Docket No. 3790): Direct testimony regarding National Grid's Gas Energy Efficiency Programs. On behalf of the Division of Public Utilities and Carriers. April 2, 2007.

North Carolina Utilities Commission (Docket E-100, Sub 110): Filed comments with Anna Sommer regarding the Potential for Energy Efficiency Resources to Meet the Demand for Electricity in North Carolina. Synapse Energy Economics on behalf of the Southern Alliance for Clean Energy. February 2007.

Rhode Island Public Utilities Commission (Docket No. 3765): Direct and Surrebuttal testimony regarding National Grid's Renewable Energy Standard Procurement Plan. On behalf of the Division of Public Utilities and Carriers. January 17, 2007 and February 20, 2007.

Minnesota Public Utilities Commission (Docket Nos. CN-05-619 and TR-05-1275): Direct testimony regarding the potential for energy efficiency as an alternative to the proposed Big Stone II coal project. On behalf of the Minnesota Center for Environmental Advocacy, Fresh Energy, Izaak Walton League of America, Wind on the Wires and the Union of Concerned Scientists. November 29, 2006.

Rhode Island Public Utilities Commission (Docket No. 3779): Oral testimony regarding the settlement of Narragansett Electric Company's 2007 Demand-Side Management Programs. On behalf of the Division of Public Utilities and Carriers. November 24, 2006.

Nevada Public Utilities Commission (Docket Nos. 06-04002 & 06-04005): Direct testimony regarding Nevada Power Company's and Sierra Pacific Power Company's Renewable Portfolio Standard Annual Report. On behalf of the Nevada Bureau of Consumer Protection. October 26, 2006

Nevada Public Utilities Commission (Docket No. 06-06051): Direct testimony regarding Nevada Power Company's Demand-Side Management Plan in the 2006 Integrated Resource Plan. On behalf of the Nevada Bureau of Consumer Protection. September 13, 2006.

Nevada Public Utilities Commission (Docket Nos. 06-03038 & 06-04018): Direct testimony regarding the Nevada Power Company's and Sierra Pacific Power Company's Demand-Side Management Plans. On behalf of the Nevada Bureau of Consumer Protection. June 20, 2006.

Nevada Public Utilities Commission (Docket No. 05-10021): Direct testimony regarding the Sierra Pacific Power Company's Gas Demand-Side Management Plan. On behalf of the Nevada Bureau of Consumer Protection. February 22, 2006.

South Dakota Public Utilities Commission (Docket No. EL04-016): Direct testimony regarding the avoided costs of the Java Wind Project. On behalf of the South Dakota Public Utilities Commission Staff. February 18, 2005.

Rhode Island Public Utilities Commission (Docket No. 3635): Oral testimony regarding the settlement of Narragansett Electric Company's 2005 Demand-Side Management Programs. On behalf of the Division of Public Utilities and Carriers. November 29, 2004.

British Columbia Utilities Commission. Direct testimony regarding the Power Smart programs contained in BC Hydro's Revenue Requirement Application 2004/05 and 2005/06. On behalf of the Sierra Club of Canada, BC Chapter. April 20, 2004.

Maryland Public Utilities Commission (Case No. 8973): Oral testimony regarding proposals for the PJM Generation Attributes Tracking System. On behalf of the Maryland Office of People's Counsel. December 3, 2003.

Rhode Island Public Utilities Commission (Docket No. 3463): Oral testimony regarding the settlement of Narragansett Electric Company's 2004 Demand-Side Management Programs. On behalf of the Division of Public Utilities and Carriers. November 21, 2003.

California Public Utilities Commission (Rulemaking 01-10-024): Direct testimony regarding the market price benchmark for the California renewable portfolio standard. On behalf of the Union of Concerned Scientists. April 1, 2003.

Québec Régie de l'énergie (Docket R-3473-01): Direct testimony with Philp Raphals regarding Hydro-Québec's Energy Efficiency Plan: 2003-2006. On behalf of Regroupment national des Conseils régionaux de l'environnement du Québec. February 5, 2003.

Connecticut Department of Public Utility Control (Docket No. 01-10-10): Direct testimony regarding the United Illuminating Company's service quality performance standards in their performance-based ratemaking mechanism. On behalf of the Connecticut Office of Consumer Counsel. April 2, 2002.

Nevada Public Utilities Commission (Docket No. 01-7016): Direct testimony regarding the Nevada Power Company's Demand-Side Management Plan. On behalf of the Bureau of Consumer Protection, Office of the Attorney General. September 26, 2001.

United States Department of Energy (Docket Number-EE-RM-500): Comments with Bruce Biewald, Daniel Allen, David White, and Lucy Johnston of Synapse Energy Economics regarding the Department of Energy's proposed rules for efficiency standards for central air conditioners and heat pumps. On behalf of the Appliance Standards Awareness Project. December 2000.

US Department of Energy (Docket EE-RM-500): Oral testimony at a public hearing on marginal price assumptions for assessing new appliance efficiency standards. On behalf of the Appliance Standards Awareness Project. November 2000.

Connecticut Department of Public Utility Control (Docket No. 99-09-03 Phase II): Direct testimony regarding Connecticut Natural Gas Company's proposed performance-based ratemaking mechanism. On behalf of the Connecticut Office of Consumer Counsel. September 25, 2000.

Mississippi Public Service Commission (Docket No. 96-UA-389): Oral testimony regarding generation pricing and performance-based ratemaking. On behalf of the Mississippi Attorney General. February 16, 2000.

Delaware Public Service Commission (Docket No. 99-328): Direct testimony regarding maintaining electric system reliability. On behalf of Delaware Public Service Commission Staff. February 2, 2000.

Delaware Public Service Commission (Docket No. 99-328): Filed expert report ("Investigation into the July 1999 Outages and General Service Reliability of Delmarva Power & Light Company," jointly authored with J. Duncan Glover and Alexander Kusko). Synapse Energy Economics and Exponent Failure Analysis Associates on behalf the Delaware Public Service Commission Staff. February 1, 2000.

New Hampshire Public Service Commission (Docket No. 99-099 Phase II): Oral testimony regarding standard offer services. On behalf of the Campaign for Ratepayers Rights. January 14, 2000.

West Virginia Public Service Commission (Case No. 98-0452-E-GI): Rebuttal testimony regarding codes of conduct. On behalf of the West Virginia Consumer Advocate Division. July 15, 1999.

West Virginia Public Service Commission (Case No. 98-0452-E-GI): Direct testimony regarding codes of conduct and other measures to protect consumers in a restructured electricity industry. On behalf of the West Virginia Consumer Advocate Division. June 15, 1999.

Public Service Commission of West Virginia (Case No. 98-0452-E-GI): Filed expert report ("Measures to Ensure Fair Competition and Protect Consumers in a Restructured Electricity Industry in West Virginia," jointly authored with Jean Ann Ramey and Theo MacGregor) in the matter of the General Investigation to determine whether West Virginia should adopt a plan for open access to the electric power supply market and for the development of a deregulation plan. Synapse Energy Economics and MacGregor Energy Consultancy on behalf of the West Virginia Consumer Advocate Division. June 1999.

Massachusetts Department of Telecommunications and Energy (DPU/DTE 97-111): Direct testimony regarding Commonwealth Electric Company's energy efficiency plan, and the role of municipal aggregators in delivering demand-side management programs. On behalf of Cape and Islands Self-Reliance Corporation. January 1998.

Delaware Public Service Commission (DPSC 97-58): Direct testimony regarding Delmarva Power and Light's request to merge with Atlantic City Electric. On behalf of Delaware Public Service Commission Staff. May 1997.

Delaware Public Service Commission (DPSC 95-172): Oral testimony regarding Delmarva's integrated resource plan and DSM programs. On behalf of the Delaware Public Service Commission Staff. May 1996.

Colorado Public Utilities Commission (5A-531EG): Direct testimony regarding the impact of proposed merger on DSM, renewable resources and low-income DSM. On behalf of the Colorado Office of Energy Conservation. April 1996.

Colorado Public Utilities Commission (3I-199EG): Direct testimony regarding the impacts of increased competition on DSM, and recommendations for how to provide utilities with incentives to implement DSM. On behalf of the Colorado Office of Energy Conservation. June 1995.

Colorado Public Utilities Commission (5R-071E): Oral testimony on the Commission's integrated resource planning rules. On behalf of the Colorado Office of Energy Conservation. July 1995.

Colorado Public Utilities Commission (3I-098E): Direct testimony on the Public Service Company of Colorado's DSM programs and integrated resource plans. On behalf of the Colorado Office of Energy Conservation. April 1994.

Delaware Public Service Commission (Docket No. 96-83): Filed comments regarding the Investigation of Restructuring the Electricity Industry in Delaware (Tellus Institute Study No. 96-99). On behalf of the Staff of the Delaware Public Service Commission. November 1996.

Colorado Public Utilities Commission (Docket No. 96Q-313E): Filed comments in response to the Questionnaire on Electricity Industry Restructuring (Tellus Institute Study No. 96-130-A3). On behalf of the Colorado Governor's Office of Energy Conservation. October 1996.

State of Vermont Public Service Board (Docket No. 5854): Filed expert report (Tellus Institute Study No. 95-308) regarding the Investigation into the Restructuring of the Electric Utility Industry in Vermont. On behalf of the Vermont Department of Public Service. March 1996.

Pennsylvania Public Utility Commission (Docket No. I-00940032): Filed comments (Tellus Institute Study No. 95-260) regarding an Investigation into Electric Power Competition. On behalf of The Pennsylvania Office of Consumer Advocate. November 1995.

New Jersey Board of Public Utilities (Docket No. EX94120585Y): Initial and reply comments ("Achieving Efficiency and Equity in the Electricity Industry Through Unbundling and Customer Choice," Tellus Institute Study No. 95-029-A3) regarding an investigation into the future structure of the electric power industry. On behalf of the New Jersey Division of Ratepayer Advocate. September 1995.

ARTICLES

Woolf, T., E. Malone, C. Neme, R. LeBaron. 2014. "Unleashing Energy Efficiency." *Public Utilities Fortnightly,* October, 30-38.

Woolf, T., A. Sommer, J. Nielson, D. Berry, R. Lehr. 2005. "Managing Electricity Industry Risk with Clean and Efficient Resources." *The Electricity Journal* 18 (2): 78–84.

Woolf, T., A. Sommer. 2004. "Local Policy Measures to Improve Air Quality: A Case Study of Queens County, New York." *Local Environment* 9 (1): 89–95.

Woolf, T. 2001. "Clean Power Opportunities and Solutions: An Example from America's Heartland." *The Electricity Journal* 14 (6): 85–91.

Woolf, T. 2001. "What's New With Energy Efficiency Programs." *Energy & Utility Update, National Consumer Law Center*: Summer 2001.

Woolf T., B. Biewald. 2000. "Electricity Market Distortions Associated With Inconsistent Air Quality Regulations." *The Electricity Journal* 13 (3): 42–49.

Ackerman, F., B. Biewald, D. White, T. Woolf, W. Moomaw. 1999. "Grandfathering and Coal Plant Emissions: the Cost of Cleaning Up the Clean Air Act." *Energy Policy* 27 (15): 929–940.

Biewald, B., D. White, T. Woolf. 1999. "Follow the Money: A Method for Tracking Electricity for Environmental Disclosure." *The Electricity Journal* 12 (4): 55–60.

Woolf, T., B. Biewald. 1998. "Efficiency, Renewables and Gas: Restructuring As if Climate Mattered." *The Electricity Journal* 11 (1): 64–72.

Woolf, T., J. Michals. 1996. "Flexible Pricing and PBR: Making Rate Discounts Fair for Core Customers." *Public Utilities Fortnightly,* July 1996.

Woolf, T., J. Michals. 1995. "Performance-Based Ratemaking: Opportunities and Risks in a Competitive Electricity Industry." *The Electricity Journal* 8 (8): 64–72.

Woolf, T. 1994. "Retail Competition in the Electricity Industry: Lessons from the United Kingdom." *The Electricity Journal* 7 (5): 56–63.

Woolf, T. 1994. "A Dialogue About the Industry's Future." *The Electricity Journal* 7 (5).

Woolf, T., E. D. Lutz. 1993. "Energy Efficiency in Britain: Creating Profitable Alternatives." *Utilities Policy* 3 (3): 233–242.

Woolf, T. 1993. "It is Time to Account for the Environmental Costs of Energy Resources." *Energy and Environment* 4 (1): 1–29.

Woolf, T. 1992. "Developing Integrated Resource Planning Policies in the European Community." *Review of European Community & International Environmental Law* 1 (2) 118–125.

PRESENTATIONS

Woolf, T., M. Whited. 2016. "Show Me the Numbers: A Framework for Balanced Distributed Solar Policies." Presentation for Consumers Union Webinar, December 2016.

Woolf, T. 2016. "Show Me the Numbers: Balancing Solar DG with Consumer Protection." Public workshop on solar distributed generation for the Federal Trade Commission, June 2016.

Woolf, T. 2016. "Rate Designs for Distributed Generation: State Activities & A New Framework." Presentation at the NASUCA 2016 Mid-Year Meeting, June 2016.

Woolf, T., M. Whited. 2016. "3rd Annual 21st Century Electricity System Workshop – Implications of Different Rate Designs." Presentation at the Advanced Energy Economy Institute, April 2016.

Woolf, T., M. Whited. 2016. "Decoupling in Pennsylvania: Advantages, Disadvantages, and Design Issues." Presentation to Pennsylvania Decoupling Stakeholders, February 2016.

Woolf, T. 2016. "Earnings Impact Mechanisms: Energy Efficiency." Presentation at the New York REV Technical Conference, January 2016.

Lowry, M. N., T. Woolf. 2015. "Performance-Based Regulation in a High Distributed Energy Resources Future." Webinar on January 2016.

Woolf, T. 2015. "Performance Incentive Mechanisms: A Catalyst for Change." Webinar for Power Sector Transformation Group, December 2015.

Woof, T. 2015. "Energy Efficiency Valuation: Boogie Men, Time Warps, and other Terrifying Pitfalls." Presentation at ACEEE Conference on Energy Efficiency as a Resource, September 2015.

Woolf, T., M. Whited, A. Napoleon. 2015. "Thoughts on How to Design Clean Energy Performance Incentive Mechanisms." Webinar for the Western Clean Energy Advocates, April 2015.

Woolf, T. 2015. "Properly Valuing the Benefits and Costs of Energy Efficiency." Presentation at the 2015 National Efficiency Advocates Meeting, April 2015.

Woolf, T. 2015. "Non-Energy Benefits & Efficiency Program Screening." Presentation for Georgia DSM Work Group, March 2015.

Woolf, T. 2014. “Performance Incentive Mechanisms And Their Role in New Regulatory Models.” Presentation at Acadia Center Conference, Envisioning Our Energy Future, December 2014.

Woolf, T., M. Whited., A. Napoleon. 2014. “Guiding Utility Performance: A Handbook for Regulators.” Webinar for the Western Interstate Energy Board, December 2014.

Woolf, T. 2014. “Planning for Distributed Energy Resources.” Presentation for Advanced Energy Economy Webinar, November 2014.

Woolf, T. 2014. “Benefit-Cost Analysis for Distributed Energy Resources in New York: A Framework for Accounting for All Relevant Costs and Benefits.” Presentation to NARUC ERE Committee, November 2014.

Woolf, T. 2014. “Presenting the Full Value of Energy Efficiency: Creating a Better Message.” Presentation at Sierra Club Beyond Coal Conference, October 2014.

Woolf, T., C. Neme. 2014. “Regulatory Policies to Support Energy Efficiency in Virginia.” Presentation for the 2014 Virginia Energy Efficiency Workshop, October 2014.

Woolf, T. 2014. “Benefit-Cost Analysis for Distributed Energy Resources in New York: A Framework for Accounting for All Relevant Costs and Benefits.” Presentation for Advanced Energy Economy Institute, October 2014.

Woolf, T. 2014. “Performance Incentive Mechanisms: Digging Deeper Into Performance-Based Regulation.” Presentation for National Governor’s Association Conference: Utility Business Models That Align with State Clean Energy Goals, September 2014.

Woolf, T. 2014. “The Resource Value Framework: Reforming Energy Efficiency Cost-Effectiveness Screening.” Presentation at the ACEEE Summer Study, August 2014.

Woolf, T. 2014. “Cost-Effectiveness of Demand Response.” Presentation at MADRI Working Group Meeting #34, July 2014.

Woolf, T. 2014. “Time to Overhaul Our Energy Efficiency Screening Practices.” Presentation for U.S. Environmental Protection Agency Energy Efficiency Cost-Effectiveness Webinar, January 2014.

Woolf, T. 2013. “Survey of Energy Efficiency Screening Practices in the Northeast and Mid-Atlantic.” Presentation for Northeast Energy Efficiency Partnerships EM&V Forum Annual Public Meeting, December 2013.

Woolf, T. 2013. “Recommendations for Reforming Energy Efficiency Cost-Effectiveness Screening in the United States.” Presentation at the National Association of Regulatory Commissioners Annual Meeting, November 2013.

Woolf, T. 2013. “Energy Efficiency Program Screening: Let’s Get Beyond the TRC Test.” Presentation for 7th Annual ENERGY STAR Certified Homes Utility Sponsor Meeting, October 2013.

Woolf, T. 2013. “Decoupling in Maine: Why Decoupling is in Consumers’ Interest.” Presentation for Office of Public Advocate- Decoupling Debate, October 2013.

Woolf, T. 2013. “NHPC Efficiency Screening Initiative: Unleashing the Potential for Energy Efficiency.” Presentation for Advocates Meeting, September 2013.

Woolf, T. 2013. “Energy Efficiency: Rate, Bill and Participation Impacts.” Presentation for ACEEE’s Energy Efficiency as a Resource Conference, September 2013.

Woof, T. 2013. “Energy Efficiency Screening: Challenges and Opportunities.” Presentation for NARUC Summer Meeting Consumer Affairs Panel, July 2013.

Woolf, T., R. Sedano. 2013. “Decoupling Overview.” Presentation for Finding Common Ground Meeting, July 2013.

Woolf, T. 2013. “Utility Incentives for Energy Efficiency.” Presentation for Finding Common Ground Meeting, July 2013.

Woolf, T. 2013. “Energy Efficiency: Rate, Bill and Participation Impacts.” Presentation for State Energy Efficiency Action Webinar, June 2013.

Woolf, T., B. Biewald, and J. Migden-Ostrander. 2013. “NARUC Risk Workshop for Regulators.” Presentation at the Mid-Atlantic Conference of Regulatory Utility Commissioners, June 2013.

Woolf, T. 2013. “Energy Efficiency Screening: Accounting for ‘Other Program Impacts’ & Environmental Compliance Costs.” Presentation for the Consortium for Energy Efficiency Summer Meeting, May 2013.

Woolf, T. 2013. “Best Practices in Energy Efficiency Program Screening.” Presentation at ACI National Home Performance Conference, May 2013.

Woolf, T. 2013. “Utility Shareholder Incentives to Support Energy Efficiency Programs.” Presentation to Common Ground, May 2013.

Woolf, T. 2013. “Energy Efficiency Screening: Accounting for ‘Other Program Impacts’ & Environmental Compliance Costs.” Presentation for Regulatory Assistance Project Webinar, March 2013.

Woolf, T. 2013. “Energy Efficiency: Rates, Bills, Participants, Screening, and More.” Presentation at Connecticut Energy Efficiency Workshop, March 2013.

Woolf T. 2013. “Best Practices in Energy Efficiency Program Screening.” Presentation for SEE Action Webinar, March 2013.

Woolf, T. 2013. “Energy Efficiency: Rates, Bills and Participants.” Presentation for Rhode Island Energy Efficiency Collaborative, February 2013.

Woolf, T. 2013. “Energy Efficiency Screening: Application of the TRC Test.” Presentation for Energy Advocates Webinar, January 2013.

Woolf, T. 2012. “Best Practices in Energy Efficiency Program Screening.” Presentation for American Council for an Energy-Efficient Economy Webinar, December 2012.

Woolf, T. 2012. Indian Point Replacement Analysis: A Clean Energy Roadmap. Presentation for Natural Resource Defenses Council and Environmental Entrepreneurs, November 2012.

Woolf, T. 2012. “In Pursuit of All Cost-Effective Energy Efficiency.” Presentation at Sierra Club Boot Camp, October 2012.

Woolf, T. 2012. “Best Practices in Energy Efficiency Program Screening.” Webinar for Northeast Energy Efficiency Partnerships, September 2012.

Woolf, T., L. Schwartz. “What Remains to be Done with Demand Response? A National Forum from the FERC National Action Plan on Demand Response Tries to Give an Answer.” Presentation at NARUC National Town Meeting on Demand Response, July 2012.

Woolf, T. 2012. “Best Practices in Energy Efficiency Program Screening.” Presentation at NARUC Summer Meetings – Energy Efficiency Cost-Effectiveness Breakfast, July 2012.

Woolf, T. 2012. “Avoided Cost of Complying with Environmental Regulations in MA.” Presentation for Mass Energy Consumer’s Alliance, January 2012.

Woolf, T. 2011. “Energy Efficiency Cost-Effectiveness Tests.” Presentation at the Northeast Energy Efficiency Partnerships Annual Meeting, October 2011.

Woolf, T. 2011. “Why Consumer Advocates Should Support Decoupling.” Presentation at the 2011 ACEEE National Conference on Energy Efficiency as a Resource, September 2011.

Woolf, T. 2011. “A Regulator’s Perspective on Energy Efficiency.” Presentation at the Efficiency Maine Symposium *In Pursuit of Maine’s Least-Cost Energy*, September 2011.

Woolf, T. 2010. “Bill Impacts of Energy Efficiency Programs: The Importance of Analyzing and Managing Rate and Bill Impacts.” Presentation at the Energy in the Northeast Conference, Law Seminar International, September 2010.

Woolf, T. 2010. “Bill Impacts of Energy Efficiency Programs: The Implications of Bill Impacts in Developing Policies to Motivate Utilities to Implement Energy Efficiency.” Presentation to the State Energy Efficiency Action Network, Utility Motivation Work Group, November 2010.

Woolf, T. 2010. “Bill Impacts of Energy Efficiency Programs.” Presentation to the Energy Resources and Environment Committee at the NARUC Winter Meetings, February 2010.

Woolf, T. 2009. “Price-Responsive Demand in the New England Wholesale Energy Market: Description of NECPUC’s Limited Supply-Side Proposal.” Presentation at the NEPOOL Markets Committee Meeting, November 2009.

Woolf, T. 2009. “Demand Response in the New England Wholesale Energy Market: How Much Should We Pay for Demand Resources?” Presentation at the New England Electricity Restructuring Roundtable, October 2009.

Woolf, T. 2008. “Promoting Demand Resources in Massachusetts: A Regulator’s Perspective.” Presentation at the Energy Bar Association, Northeast Chapter Meeting, June 2008.

Woolf, T. 2008. “Turbo-Charging Energy Efficiency in Massachusetts: A DPU Perspective.” Presentation at the New England Electricity Restructuring Roundtable, April 2008.

Woolf T. 2002. “A Renewable Portfolio Standard for New Brunswick.” Presentation to the New Brunswick Market Design Committee, January 10, 2002.

Woolf, T. 2001. “Potential for Wind and Renewable Resource Development in the Midwest.” Presentation at WINDPOWER 2001 in Washington DC, June 7, 2001.

Woolf T. 1999. “Challenges Faced by Clean Generation Resources Under Electricity Restructuring.” Presentation at the Symposium on the Changing Electric System in Florida and What it Means for the Environment in Tallahassee, FL, November 1999.

Woolf, T. 2000. “Generation Information Systems to Support Renewable Portfolio Standards, Generation Performance Standards and Environmental Disclosure.” Presentation at the Massachusetts Restructuring Roundtable on behalf of the Union of Concerned Scientists, March 2000.

Woolf, T. 1998. “New England Tracking System Project: An Electricity Tracking System to Support a Wide Range of Restructuring-Related Policies.” Presentation at the Ninth Annual Energy Services Conference and Exposition in Orlando, FL, December 1998.

Woolf, T. 2000. “Comments of the Citizens Action Coalition of Indiana.” Presentation at Workshop on Alternatives to Traditional Generation Resources, June 2000.

Woolf, T. 1996. “Overview of IRP and Introduction to Electricity Industry Restructuring.” Training session provided to the staff of the Delaware Public Service Commission, April 1996.

Woolf, T. 1995. “Competition and Regulation in the UK Electric Industry.” Presentation at the Illinois Commerce Commission's workshop on Restructuring the Electric Industry, August 1995.

Woolf, T. 1995. “Competition and Regulation in the UK Electric Industry.” Presentation at the British Columbia Utilities Commission Electricity Market Review, February 1995.

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Exhibit TW-MW-2

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PROFESSIONAL EXPERIENCE

Synapse Energy Economics, Cambridge MA. *Principal Associate,* 2017 – present*, Senior Associate,* 2015 – 2017*, Associate*, 2012 – 2015

Conduct research, author reports, and assist in preparation of expert testimony. Consult on issues related to distributed energy resources, rate design, cost-benefit analysis, integrated resource planning, utility regulation, water use and conservation, and market power.

University of Wisconsin - Madison, Department of Agricultural and Applied Economics, Madison, WI. *Teaching Assistant – Environmental Economics*, 2011 – 2012

Developed teaching materials and led discussions on cost-benefit analysis, carbon taxes and cap-and-trade programs, management of renewable and non-renewable resources, and other topics.

Public Service Commission of Wisconsin, Water Division, Madison, WI. *Program and Policy Analyst - Intern*, Summer 2009

Researched water conservation programs nationwide to develop a proposal for Wisconsin's state conservation program. Developed spreadsheet model to calculate avoided costs of water conservation in terms of energy savings and avoided emissions.

Synapse Energy Economics, Cambridge, MA. *Communications Manager*, 2005 – 2008

Developed technical proposals for state and federal agencies, environmental and public interest groups, and businesses. Edited reports on energy efficiency, integrated resource planning, greenhouse gas regulations, renewable resources, and other topics.

EDUCATION

University of Wisconsin, Madison, WI
Master of Arts in Agricultural and Applied Economics, 2012.
Certificate in Energy Analysis and Policy.
National Science Foundation Fellow.

University of Wisconsin, Madison, WI
Master of Science in Environment and Resources, 2010.
Certificate in Humans and the Global Environment (CHANGE).
Nelson Distinguished Fellowship.

Southwestern University, Georgetown, TX
Bachelor of Arts in International Studies, *Magna cum laude,* 2003.

ADDITIONAL SKILLS

- Econometric Modeling – Linear and nonlinear modeling including time-series, panel data, logit, probit, and discrete choice regression analysis
- Nonmarket Valuation Methods for Environmental Goods – Hedonic valuation, travel cost method, and contingent valuation
- Cost-Benefit Analysis
- Input-Output Modeling for Regional Economic Analysis

FELLOWSHIPS AND AWARDS

- Winner, M. Jarvin Emerson Student Paper Competition, Journal of Regional Analysis and Policy, 2010
- Fellowship, National Science Foundation Integrative Graduate Education and Research Traineeship (IGERT), University of Wisconsin – Madison, 2009
- Nelson Distinguished Fellowship, University of Wisconsin – Madison, 2008

PUBLICATIONS

Whited, M., T. Vitolo. 2017. Reply comments in District of Columbia Public Service Commission Formal Case No. 1130: *Reply Comments of the Office of the People's Counsel for the District of Columbia Regarding Pepco's Comments on the Office of the People's Counsel's Value of Solar Study.* Prepared by Synapse Energy Economics. July 24, 2017.

Whited, M., A. Horowitz, T. Vitolo, W. Ong, T. Woolf. 2017. *Distributed Solar in the District of Columbia: Policy Options, Potential, Value of Solar, and Cost-Shifting*. Synapse Energy Economics for the Office of the People's Counsel for the District of Columbia.

Whited, M., E. Malone, T. Vitolo. 2016. *Rate Impacts on Customers of Maryland's Electric Cooperatives: Impacts on SMECO and Choptank Customers*. Synapse Energy Economics for Maryland Public Service Commission.

Woolf, T., M. Whited, P. Knight, T. Vitolo, K. Takahashi. 2016. *Show Me the Numbers: A Framework for Balanced Distributed Solar Policies.* Synapse Energy Economics for Consumers Union.

Whited, M., T. Woolf, J. Daniel. 2016. *Caught in a Fix: The Problem with Fixed Charges for Electricity*. Synapse Energy Economics for Consumers Union.

Lowry, M. N., T. Woolf, M. Whited, M. Makos. 2016. *Performance-Based Regulation in a High Distributed Energy Resources Future*. Pacific Economics Group Research and Synapse Energy Economics for Lawrence Berkley National Laboratory.

Woolf, T., M. Whited, A. Napoleon. 2015-2016. *Comments and Reply Comments in the New York Public Service Commission Case 14-M-0101: Reforming the Energy Vision*. Comments related to Staff's (a) a benefit-costs analysis framework white paper, (b) ratemaking and utility business models white paper,

and (c) Distributed System Implementation Plan guide. Prepared by Synapse Energy Economics on behalf of Natural Resources Defense Council and Pace Energy and Climate Center.

Luckow, P., B. Fagan, S. Fields, M. Whited. 2015. *Technical and Institutional Barriers to the Expansion of Wind and Solar Energy.* Synapse Energy Economics for Citizens' Climate Lobby.

Wilson, R., M. Whited, S. Jackson, B. Biewald, E. A. Stanton. 2015. *Best Practices in Planning for Clean Power Plan Compliance.* Synapse Energy Economics for the National Association of State Utility Consumer Advocates.

Whited, M., T. Woolf, A. Napoleon. 2015. *Utility Performance Incentive Mechanisms: A Handbook for Regulators*. Synapse Energy Economics for the Western Interstate Energy Board.

Stanton, E. A., S. Jackson, B. Biewald, M. Whited. 2014. *Final Report: Implications of EPA's Proposed "Clean Power Plan."* Synapse Energy Economics for the National Association of State Utility Consumer Advocates.

Peterson, P., S. Fields, M. Whited. 2014. *Balancing Market Opportunities in the West: How participation in an expanded balancing market could save customers hundreds of millions of dollars.* Synapse Energy Economics for the Western Grid Group.

Woolf, T., M. Whited, E. Malone, T. Vitolo, R. Hornby. 2014. *Benefit-Cost Analysis for Distributed Energy Resources: A Framework for Accounting for All Relevant Costs and Benefits.* Synapse Energy Economics for the Advanced Energy Economy Institute.

Peterson, P., M. Whited, S. Fields. 2014. *Synapse Comments on FAST Proposals in ERCOT.* Synapse Energy Economics for Sierra Club.

Hornby, R., N. Brockway, M. Whited, S. Fields. 2014. *Time-Varying Rates in the District of Columbia.* Synapse Energy Economics for the Office of the People's Counsel for the District of Columbia, submitted to Public Service Commission of the District of Columbia in Formal Case No. 1114.

Peterson, P., M. Whited, S. Fields. 2014. *Demonstrating Resource Adequacy in ERCOT: Revisiting the ERCOT Capacity, Demand and Reserves Forecasts*. Synapse Energy Economics for Sierra Club – Lone Star Chapter.

Stanton, E. A., M. Whited, F. Ackerman. 2014. *Estimating the Cost of Saved Energy in Utility Efficiency Programs.* Synapse Energy Economics for the U.S Environmental Protection Agency.

Ackerman, F., M. Whited, P. Knight. 2014. "Would banning atrazine benefit farmers?" *International Journal of Occupational and Environmental Health* 20 (1): 61–70.

Ackerman, F., M. Whited, P. Knight. 2013. *Atrazine: Consider the Alternatives.* Synapse Energy Economics for Natural Resources Defense Council (NRDC).

Whited, M., F. Ackerman, S. Jackson. 2013. *Water Constraints on Energy Production: Altering our Current Collision Course.* Synapse Energy Economics for Civil Society Institute.

Whited, M. 2013. *Water Constraints on Energy Production: Altering our Current Collision Course – Policy Brief.* Synapse Energy Economics for Civil Society Institute.

Hurley, D., P. Peterson, M. Whited. 2013. *Demand Response as a Power System Resource: Program Designs, Performance, and Lessons Learned in the United States.* Synapse Energy Economics for Regulatory Assistance Project.

Whited, M., D. White, S. Jackson, P. Knight, E.A. Stanton. 2013. *Declining Markets for Montana Coal*. Synapse Energy Economics for Northern Plains Resource Council.

Woolf, T., M. Whited, T. Vitolo, K. Takahashi, D. White. 2012. *Indian Point Energy Center Replacement Analysis: A Plan for Replacing the Nuclear Plant with Clean, Sustainable, Energy Resources.* Synapse Energy Economics for National Resources Defense Council and Riverkeeper.

Whited, M., K. Charipar, G. Brown. *Demand Response Potential in Wisconsin.* Nelson Institute for Environmental Studies, Energy Analysis & Policy Capstone for the Wisconsin Public Service Commission.

Whited, M. 2010. "Economic Impacts of Irrigation Water Transfers in Uvalde County, Texas." *Journal of Regional Analysis and Policy* 40 (2): 160–170.

Grabow, M., M. Hahn and M. Whited. 2010. *Valuing Bicycling's Economic and Health Impacts in Wisconsin*. Nelson Institute for Environmental Studies, Center for Sustainability and the Global Environment (SAGE) for State Representative Spencer Black.

Whited, M., D. Bernhardt, R. Deitchman, C. Fuchsteiner, M. Kirby, M. Krueger, S. Locke, M. Mcmillen, H. Moussavi, T. Robinson, E. Schmitz, Z. Schuster, R. Smail, E. Stone, S. Van Egeren, H. Yoshida, Z. Zopp. 2009. *Implementing the Great Lakes Compact: Wisconsin Conservation and Efficiency Measures Report.* Department of Urban and Regional Planning, University of Wisconsin-Madison, Extension Report 2009-01.

Whited, M. 2009. *2009 Wisconsin Water Fact Sheet*. Public Service Commission of Wisconsin.

Whited, M. 2003. *Gender, Water, and Trade*. International Gender and Trade Network Washington, DC.

TESTIMONY

Utah Public Service Commission (Docket No. 14-035-114): Direct testimony of Melissa Whited regarding Pacificorp's proposed rates for customers with distributed generation. On behalf of Utah Clean Energy. June 8, 2017.

Texas Public Utilities Commission (SOAH Docket No. 473-17-1764, PUC Docket No. 46449): Cross-rebuttal testimony evaluating Southwestern Electric Power Company's proposed revisions to its Distributed Renewable Generation tariff. On behalf of Sierra Club and Dr. Lawrence Brough. May 19, 2017.

Massachusetts Department of Public Utilities (Docket No. 17-05): Direct and surrebuttal testimony of Tim Woolf and Melissa Whited regarding performance-based regulation, the monthly minimum

reliability contribution, storage pilots, and rate design in Eversource's petition for approval of rate increases and a performance-based ratemaking mechanism. On behalf of Sunrun and the Energy Freedom Coalition of America, LLC. April 28, 2017 and May 26, 2017.

Public Utilities Commission of Hawaii (Docket No. 2015-0170): Direct testimony regarding Hawaiian Electric Light Company's proposed performance incentive mechanisms. On behalf of the Division of Consumer Advocacy. April 28, 2017.

Massachusetts Department of Public Utilities (Docket No. 15-155): Joint direct and rebuttal testimony with T. Woolf regarding National Grid's rate design proposal. On behalf of Energy Freedom Coalition of America, LLC. March 18, 2016 and April 28, 2016.

Federal Energy Regulatory Commission (Docket No. EC13-93-000): Affidavit regarding potential market power resulting from the acquisition of Ameren generation by Dynegy. On behalf of Sierra Club. August 16, 2013.

Wisconsin Senate Committee on Clean Energy: Joint testimony with M. Grabow regarding the importance of clean transportation to Wisconsin's public health and economy. February 2010.

TESTIMONY ASSISTANCE

Colorado Public Utilities Commission (Proceeding No. 16AL-0048E): Answer testimony of Tim Woolf regarding Public Service Company of Colorado's rate design proposal. On behalf of Energy Outreach Colorado. June 6, 2016.

Nevada Public Utilities Commission (Docket Nos. 15-07041 and 15-07042): Direct testimony on NV Energy's application for approval of a cost of service study and net metering tariffs. On behalf of The Alliance for Solar Choice. October 27, 2015.

Missouri Public Service Commission (Case No. ER-2014-0370): Direct and surrebuttal testimony on the topic of Kansas City Power and Light's rate design proposal. On behalf of Sierra Club. April 16, 2015 and June 5, 2015.

Wisconsin Public Service Commission (Docket No. 05-UR-107): Direct and surrebuttal testimony of Rick Hornby regarding Wisconsin Electric Power Company rate case. On behalf of The Alliance for Solar Choice. August 28, 2014 and September 22, 2014.

Maine Public Utilities Commission (Docket No. 2013-00519): Direct testimony of Richard Hornby and Martin R. Cohen on GridSolar's smart grid coordinator petition. On behalf of the Maine Office of the Public Advocate. August 28, 2014.

Maine Public Utilities Commission (Docket No. 2013-00168): Direct and surrebuttal testimony of Tim Woolf regarding Central Maine Power's request for an alternative rate plan. December 12, 2013 and March 21, 2014.

Massachusetts Department of Public Utilities (Docket No. 14-04): Comments of Massachusetts Department of Energy Resources on investigation into time varying rates. On behalf of the Massachusetts Department of Energy Resources. March 10, 2014.

State of Nevada, Public Utilities Commission of Nevada (Docket No. 13-07021): Direct testimony of Frank Ackerman regarding the proposed merger of NV Energy, Inc. and MidAmerican Energy Holdings Company. On behalf of the Sierra Club. October 24, 2013.

PRESENTATIONS

Whited, M. 2016. "Energy Policy for the Future: Trends and Overview." Presentation to the National Conference of State Legislators' Capitol Forum, Washington, DC, December 8.

Whited, M. 2016. "Ratemaking for the Future: Trends and Considerations." Presentation to the Midwest Governors' Association, St. Paul, MN, July 14.

Whited, M. 2016. "Performance Based Regulation." Presentation to the NARUC Rate Design Subcommittee. September 12.

Whited, M. 2016. "Demand Charges: Impacts and Alternatives (A Skeptic's View)." EUCI 2nd Annual Residential Demand Charges Summit, Phoenix, AZ, June 7.

Whited, M. 2016. "Performance Incentive Mechanisms." Presentation to the National Governors Association, Wisconsin Workshop, Madison WI, March 29.

Whited, M., T. Woolf. 2016. "Caught in a Fix: The Problem with Fixed Charges for Electricity." Webinar presentation sponsored by Consumers Union, February.

Whited, M. 2015. "Performance Incentive Mechanisms." Presentation to the National Governors Association, Learning Lab on New Utility Business Models & the Electricity Market Structures of the Future, Boston, MA, July 28.

Whited, M. 2015. "Rate Design: Options for Addressing NEM Impacts." Presentation to the Utah Net Energy Metering Workgroup, Workshop 4, Salt Lake City, UT, July 8.

Whited, M. 2015. "Performance Incentive Mechanisms." Presentation to the e21 Initiative, St. Paul, MN, May 29.

Whited, M., F. Ackerman. 2013. "Water Constraints on Energy Production: Altering our Current Collision Course." Webinar presentation sponsored by Civil Society Institute, September 12.

Whited, M., G. Brown, K. Charipar. 2011. "Electricity Demand Response Programs and Potential in Wisconsin." Presentation to the Wisconsin Public Service Commission, April.

Whited, M. 2010. "Economic Impact of Irrigation Water Transfers in Uvalde County, Texas." Presentation at the Mid-Continent Regional Science Association's 41st Annual Conference/IMPLAN National User's 8th Biennial Conference in St. Louis, MO, June

Whited, M., M. Grabow, M. Hahn.2009. “Valuing Bicycling’s Economic and Health Impacts in Wisconsin.” Presentation before the Governor’s Coordinating Council on Bicycling, December.

Whited, M., D. Sheard. 2009. “Water Conservation Initiatives in Wisconsin.” Presentation before the Waukesha County Water Conservation Coalition Municipal Water Conservation Subgroup, July.

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