

**STATE OF NEW HAMPSHIRE  
BEFORE THE  
PUBLIC UTILITIES COMMISSION**

_____	)	
<b>2024–2026 TRIENNIAL ENERGY</b>	)	
<b>EFFICIENCY PLAN</b>	)	<b>Docket DE 23-068</b>
_____	)	

**Direct Testimony of  
Tim Woolf and Danielle Goldberg**

**On Behalf of  
The Office of the Consumer Advocate**

**September 12, 2023**

## Table of Contents

I.	INTRODUCTION AND QUALIFICATIONS.....	1
II.	SUMMARY OF CONCLUSIONS AND RECOMMENDATIONS.....	5
III.	THE 2024–2026 STATEWIDE ENERGY EFFICIENCY PLAN COMPLIES WITH HOUSE BILL 549.....	7
	Funding Requirements .....	9
	Savings Requirements .....	12
	Cost-Effectiveness.....	13
IV.	RECOMMENDED IMPROVEMENTS TO THE TRIENNIAL PLAN .....	17
V.	THE BENEFITS OF ENERGY EFFICIENCY .....	26
VI.	MARKET BARRIERS .....	31
VII.	DISCOUNT RATES .....	38

Schedule TWDG-1: Resume of Tim Woolf

Schedule TWDG-2: Resume of Danielle Goldberg

1       **I. INTRODUCTION AND QUALIFICATIONS**

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

3       **A Mr. Woolf:** My name is Tim Woolf. I am a Senior Vice President at Synapse Energy  
4       Economics (“Synapse”), located at 485 Massachusetts Avenue #3, Cambridge, MA  
5       02139.

6       **A Ms. Goldberg:** My name is Danielle Goldberg. I am a Senior Associate at Synapse  
7       Energy Economics, located at 485 Massachusetts Avenue #3, Cambridge, MA 02139.

8       **Q Please describe Synapse Energy Economics.**

9       **A** Synapse is a research and consulting firm specializing in electricity and gas industry  
10       regulation, planning, and analysis. Our work covers a range of issues, including economic  
11       and technical assessments of demand-side and supply-side energy resources, energy  
12       efficiency policies and programs, integrated resource planning, electricity market  
13       modeling and assessment, renewable resource technologies and policies, and climate  
14       change strategies. Synapse works for a wide range of clients, including attorneys general,  
15       offices of consumer advocates, public utility commissions, environmental advocates, the  
16       U.S. Environmental Protection Agency, the U.S. Department of Energy, the U.S.  
17       Department of Justice, the Federal Trade Commission, and the National Association of  
18       Regulatory Utility Commissioners. Synapse has over 35 professional staff with extensive  
19       experience in the electricity industry.

1       **Q Please summarize your professional and educational experience.**

2       **A Mr. Woolf:** I have over 40 years of experience analyzing technical, economic, and policy  
3 aspects of electric utility planning and regulation. In recent years, I have focused on many  
4 topics related to power sector transformation, including energy efficiency, distributed  
5 energy resources, performance-based regulation, new utility business models, grid  
6 modernization, and distribution system planning. I also address a variety of related  
7 ratemaking issues, such as rate design, net metering rates, decoupling, and dynamic  
8 pricing.

9 Before joining Synapse Energy Economics, I was a commissioner at the Massachusetts  
10 Department of Public Utilities (DPU) from 2007 through 2011. In that capacity, I was  
11 responsible for overseeing a substantial expansion of clean energy policies, including  
12 significantly increased ratepayer-funded energy efficiency programs, an update of the  
13 DPU energy efficiency guidelines, the implementation of decoupled rates for electric and  
14 gas companies, the promulgation of net metering regulations, review and approval of  
15 smart grid pilot programs, and review and approval of long-term contracts for renewable  
16 power. I was also responsible for overseeing a variety of other dockets before the DPU,  
17 including several electric and gas utility rate cases.

18 I have testified as an expert witness in more than 45 state regulatory proceedings and  
19 have authored more than 60 reports on electricity industry regulation and restructuring. I  
20 represent clients in collaboratives, task forces, and settlement negotiations, and I have  
21 published articles on electric utility regulation in *Energy Policy*, *Public Utilities*

1           *Fortnightly, The Electricity Journal, Local Environment, Utilities Policy, Energy and*  
2           *Environment, and The Review of European Community and Environmental Law.*

3           I hold a Master's in Business Administration from Boston University, a Diploma in  
4           Economics from the London School of Economics, as well as a BS in Mechanical  
5           Engineering and a BA in English from Tufts University. My resume, attached as  
6           Schedule TWDG-1, presents additional details of my professional and educational  
7           experience.

8           **A Ms. Goldberg:** I have over six years of experience in research and consulting at Synapse.  
9           While at Synapse, my work has focused on energy efficiency topics, including cost-  
10          effectiveness analysis, best practices for energy efficiency program design, electrification  
11          strategies, and equitable distribution of benefits. Most of my energy efficiency experience  
12          is in Massachusetts. However, I have also reviewed energy efficiency policies across all  
13          50 states; supported energy efficiency modeling in Vermont, New Hampshire, and  
14          Connecticut; and critiqued energy efficiency plans or policy in Kansas, New Jersey, Nova  
15          Scotia, Minnesota, Wisconsin, Missouri, Illinois, Iowa, Ohio, Indiana, and Puerto Rico. I  
16          hold a Bachelor of Science in Mechanical Engineering from Northeastern University. My  
17          resume, attached as Schedule TWDG-2, presents additional details of my professional  
18          and educational experience.

1       **Q Have you previously testified before the New Hampshire Public Utilities**  
2       **Commission?**

3       **A Mr. Woolf:** Yes. I sponsored written testimony before the New Hampshire Public  
4       Utilities Commission (the Commission) in Docket DE 99-099 Phase II on January 14,  
5       2000, and in Docket DE 20-161 on August 19, 2022.

6       **A Ms. Goldberg:** Yes, I sponsored written testimony before the New Hampshire Public  
7       Utilities Commission in Docket DE 20-092 on April 19, 2022.

8       **Q On whose behalf are you testifying in this case?**

9       **A** We are testifying on behalf of the Office of the Consumer Advocate (OCA).

10      **Q What is the purpose of your testimony?**

11      **A** The purpose of our testimony is to explain why the OCA generally supports the NHSaves  
12      2024–2026 Plan proposal (the Triennial Plan) submitted jointly by Liberty Utilities  
13      (Granite State Electric) Corp. d/b/a Liberty, New Hampshire Electric Cooperative  
14      (NHEC), Public Service Company of New Hampshire d/b/a Eversource Energy, Unitil  
15      Energy Systems, Inc., Liberty Utilities (EnergyNorth Natural Gas) Corp d/b/a Liberty,  
16      and Northern Utilities, Inc. (Northern) (collectively, the “Utilities”). Specifically, we  
17      address the Triennial Plan’s compliance with House Bill 549 (“HB 549”) (codified in  
18      relevant part as RSA 374-F:3, VI-a(d)), offer some recommended improvements to the  
19      Triennial Plan, explain our support for the Granite State Test for cost-effectiveness, and  
20      reinforce the longstanding view of the OCA that ratepayer-funded energy efficiency  
21      programs are critically important for the state’s residential utility customers. We also

1 address some critical aspects of energy efficiency resource planning, including the market  
2 barriers to energy efficiency measures and the appropriate discount rate to use in benefit-  
3 cost analysis of energy efficiency resources.

4 **Q What materials did you rely on to develop your testimony?**

5 **A** The sources for our testimony and exhibits are relevant New Hampshire legislation,  
6 previous Commission orders, the Triennial Plan, responses to discovery requests, public  
7 documents, and our professional knowledge and experience.

8 **Q Was your testimony prepared by you or under your direction?**

9 **A** Yes. Our testimony was prepared by us or under our direct supervision and control.

10 **II. SUMMARY OF CONCLUSIONS AND RECOMMENDATIONS**

11 **Q Please summarize your primary conclusions.**

12 **A** Our primary conclusions are as follows:

- 13 1. The Triennial Plan meets the requirements of HB 549.
- 14 2. The energy efficiency programs in the Triennial Plan are cost-effective under the  
15 Granite State Test, which is the primary test to use for this purpose according to HB  
16 549. For every dollar spent on energy efficiency programs there will be \$2.3 in  
17 benefits experienced by utility customers. In aggregate, all the utility programs  
18 combined are expected to result in \$283 million in net benefits to utility customers.
- 19 3. There is room for improvement in the Triennial Plan, specifically additional  
20 opportunities for more proactive efforts to integrate federal funding from the *Inflation*

1            *Reduction Act* (“IRA”) and recognition of additional barriers that may exist for  
2            vulnerable or other underserved customers.

3            4. The Triennial Plan will help overcome the market barriers that inhibit customers from  
4            adopting energy efficiency measures on their own.

5            5. The Triennial Plan uses the appropriate discount rate because it is consistent with the  
6            discount rate used in New Hampshire since 1999; is consistent with the Benefit-Cost  
7            Working Group recommendations from Docket DE 17-136, which were approved by  
8            the Commission in December 2019; and is consistent with the principles and  
9            guidance provided by the *National Standard Practice Manual for Assessing Cost-*  
10           *Effectiveness of Energy Efficiency Resources* .

11           **Q Please summarize your primary recommendations.**

12           **A** Our primary recommendations are as follows:

13           1. We recommend that the Commission approve the Triennial Plan.

14           2. We recommend that, as part of the approval of the Triennial Plan, the Commission  
15           direct the Utilities to adopt the further improvements to the Triennial Plan described  
16           in our testimony.

17           3. We recommend that the Commission explicitly acknowledge the findings of the  
18           DVM Market Barriers Study and find that the programs in Triennial Plan are  
19           reasonably designed to overcome the market barriers facing customers in New  
20           Hampshire.

1           4. We recommend that the Commission reaffirm that the discount rate used in the  
2           Triennial Plan is appropriate, and that the Utilities should continue to use the same  
3           method for determining the discount rate for future energy efficiency plans.

4           **III. THE 2024–2026 STATEWIDE ENERGY EFFICIENCY PLAN COMPLIES WITH**  
5           **HOUSE BILL 549**

6           **Q Please summarize HB 549 with respect to the Triennial Plan filing.**

7           **A** HB 549, as signed into law by Governor Sununu on February 24, 2022, amended RSA  
8           374-F:3, VI to include the following key provisions for the Triennial Plan:

- 9           • The energy efficiency portions of the electric utilities’ System Benefits Charge  
10           (“SBC”) and the natural gas utilities’ Local Distribution Adjustment Charge  
11           (“LDAC”) are set at 2020 levels and then increased every year, starting on  
12           January 1, 2023, using the 3-year average of the Consumer Price Index.<sup>1</sup>
- 13           • The Utilities are required to direct up to \$400,000 of annual SBC revenues to  
14           New Hampshire’s Department of Energy to promulgate the benefits of energy  
15           efficiency.
- 16           • A maximum of five percent of the overall program budget may be allocated to  
17           Evaluation, Measurement, and Verification (“EM&V”) studies.

<sup>1</sup> This language reflects the revision from Senate Bill 113 to modify the originally adopted automatic inflation adjustment within the SBC and LDAC calculations.

- 1           • At least 20 percent of the annual SBC funds must be used for funding low-income  
2           energy efficiency programs.
- 3           • The Utilities are also required to continue to seek alternative sources of funding to  
4           supplement these charges.
- 5           • For electric utilities, 65 percent of overall planned annual energy savings are  
6           required to come from electric system savings.<sup>2</sup>
- 7           • The Granite State Test (“GST”) is defined as the primary cost-effectiveness test  
8           and the Total Resource Cost (“TRC”) test is defined as the secondary test. The  
9           primary inputs to these tests are the *Avoided Energy Supply Components for New*  
10          *England* (“AESC”) study, any EM&V studies commissioned by the state’s  
11          Department of Energy or joint utilities, and savings that incorporate free-ridership  
12          where impacts are material.

13          **Q Does the Triennial Plan comply with HB 549?**

14          **A** Yes. In the testimony that follows we will describe how the Triennial Plan meets the  
15          requirements of HB 549.

<sup>2</sup> This language reflects the revision from Senate Bill 113 to clarify that 65 percent of overall planned *annual* energy savings funded by the SBC must come from electric system savings.

1        **Funding Requirements**

2        **Q What are the funding requirements for HB 549?**

3        **A** There are five primary funding requirements for HB 549:

- 4                    1. The energy efficiency portions of the SBC and LDAC are set at 2020 levels and  
5                    then increased every year, starting on January 1, 2023, using the 3-year average of  
6                    the Consumer Price Index;
- 7                    2. Up to \$400,000 shall be allocated for the New Hampshire Department of Energy  
8                    to promulgate the benefits of energy efficiency;
- 9                    3. No more than five percent of program budget shall be spent on EM&V;
- 10                   4. At least 20 percent of the funds collected shall be spent on low-income energy  
11                   efficiency; and
- 12                   5. The Utilities should investigate additional funding sources for energy efficiency.

13        **Q Do the energy efficiency portions of the SBC and LDAC rates in the Triennial Plan**  
14        **comply with HB 549?**

15        **A** Yes. HB 549 sets the energy efficiency portions of the SBC and LDAC at the same rate  
16        as approved in 2020 and adjusted by the consumer price index. Table 1 displays the SBC  
17        for 2023, 2024, 2025, and 2026. The SBC rate is set consistent with the directives in HB  
18        549.

19        **Table 1. SBC charges for 2023, 2024, 2025, and 2026—all utilities**

Year	SBC Rate (EE Portion) (\$/kWh)
2023	\$0.00550

<b>2024</b>	\$0.00577
<b>2025</b>	\$0.00603
<b>2026</b>	\$0.00619

1 *Sources: Triennial Plan Attachment E3, Attachment F3, Attachment, G3, Attachment H3.*

2 Table 2 displays the energy efficiency portion of the LDAC for 2023, 2024, 2025, and  
3 2026, broken out by customer segment. The LDAC rates for Northern and EnergyNorth  
4 are calculated consisted with the directives in HB 549.

5 **Table 2. LDAC charges for 2023, 2024, 2025 and 2026, by utility and customer segment**

Year	LDAC (EE Portion) (\$/therm)	
	Northern	EnergyNorth
<b>2023</b>	Res: 0.0520 C&I: 0.0257	Res: 0.0667 C&I: 0.0444
<b>2024</b>	Res: 0.0545 C&I: 0.0269	Res: 0.0699 C&I: 0.0466
<b>2025</b>	Res: 0.0570 C&I: 0.0282	Res: 0.0731 C&I: 0.0487
<b>2026</b>	Res: 0.0585 C&I: 0.0289	Res: 0.0750 C&I: 0.0500

6 *Sources: Triennial Plan Attachment J3, Direct Testimony of Tyler Culbertson page 5.*

7 **Q Did the Utilities set aside up to \$400,000 of SBC funds for the New Hampshire**  
8 **Department of Energy?**

9 **A** Yes. As indicated in Section 1.3.1 of the Triennial Plan, the electric utilities account for  
10 their share of the \$400,000 of SBC charges by reducing the amount of funding available  
11 for their total program budgets.

12 **Q Do EM&V costs comprise of 5 percent or less of the total energy efficiency budget?**

13 **A** Yes. Table 3 below displays the combined electric and gas energy efficiency budgets, by  
14 sector, for Program Years 2024, 2025, and 2026. The EM&V costs as a percent of the  
15 total budget range from 4.5 to 5.0 percent, complying with HB 549.

1 **Table 3. EM&V costs as a percent of total**

Sector by Year	Total Program Costs	EM&V Costs	EM&V Costs as a % of Total
<b>2024</b>	<b>\$79,113,966</b>	<b>\$3,873,388</b>	<b>4.9%</b>
A - Residential	\$27,576,397	\$1,358,590	4.9%
B - Income Eligible	\$15,759,417	\$730,185	4.6%
C - Commercial & Industrial	\$35,778,152	\$1,784,614	5.0%
<b>2025</b>	<b>\$81,856,554</b>	<b>\$3,795,871</b>	<b>4.6%</b>
A - Residential	\$29,007,359	\$1,341,033	4.6%
B - Income Eligible	\$16,679,590	\$750,834	4.5%
C - Commercial & Industrial	\$36,169,605	\$1,704,005	4.7%
<b>2026</b>	<b>\$84,494,366</b>	<b>\$3,919,303</b>	<b>4.6%</b>
A - Residential	\$30,568,656	\$1,428,492	4.7%
B - Income Eligible	\$17,314,417	\$785,471	4.5%
C - Commercial & Industrial	\$36,611,293	\$1,705,340	4.7%
<b>Total (2024–2026)</b>	<b>\$245,464,886</b>	<b>\$11,588,563</b>	<b>4.7%</b>

2 *Source: Utilities Benefit-Cost Models. Primary Data Tab.<sup>3</sup>*

3 **Q Is at least 20 percent of the total energy efficiency budget allocated for low-income**  
4 **programs?**

5 **A** Yes. Table 4 displays the combined electric and gas energy efficiency budget for each  
6 customer sector and as a percent of the total energy efficiency budget. For 2024, 2025,  
7 and 2026, the low-income budget comprises 20 percent of the total budget.

8 **Table 4. Low-income budget as a percent of total**

Sector	2024		2025		2026	
	Total Program Budgets	Percent of Total Budget	Total Program Budgets	Percent of Total Budget	Total Program Budgets	Percent of Total Budget
<b>A - Residential</b>	\$27,576,397	35%	\$29,007,359	35%	\$30,568,656	36%
<b>B - Low-Income</b>	\$15,759,417	20%	\$16,679,590	20%	\$17,314,417	20%
<b>C - Commercial &amp; Industrial</b>	\$35,778,152	45%	\$36,169,605	44%	\$36,611,293	43%
<b>Total</b>	<b>\$79,113,966</b>	<b>100%</b>	<b>\$81,856,554</b>	<b>100%</b>	<b>\$84,494,366</b>	<b>100%</b>

9 *Source: Utilities Benefit-Cost Models. Primary Data Tab.<sup>4</sup>*

<sup>3</sup> Utilities live Excel Benefit-Cost Models as filed in conjunction with the Plan filing (Plan Narrative and Attachments) filed on June 30, 2023. Data obtained from Primary Data Tab.

<sup>4</sup> *Ibid.*

1       **Q Did the Utilities investigate alternative sources of funding and financing for energy**  
2       **efficiency?**

3       **A** Yes. Before the 2022–2023 Energy Efficiency Plan, the Utilities commissioned a report  
4       in January 2020 to investigate external funding and partnership opportunities.<sup>5</sup> The report  
5       did not uncover meaningful opportunities for external funding.

6       The Utilities continue to offer all customer segments a variety of financing options to  
7       support investments in energy efficiency. These include partnering with local lenders to  
8       provide low-interest loans for residential customers, buying down interest rates to zero  
9       percent for moderate-income customers, and connecting customers to private financing  
10      options.

11      Lastly, in Section 1.3.3 of the Triennial Plan the Utilities state that they are engaged with  
12      community partners and the New Hampshire Department of Energy to identify  
13      opportunities to leverage funds from the federal *Infrastructure Investment and Jobs Act*  
14      and the IRA.

15      Please see Section IV of this testimony for recommendations regarding federal funding.

16      **Savings Requirements**

17      **Q What are the savings requirements for HB 549?**

18      **A** HB 549 requires that, for electric utility energy efficiency programs, at least 65 percent of  
19      annual energy savings come from electric energy savings.

<sup>5</sup> NHSaves 2022-2023 Plan, March 1, 2022. Attachment O.

1 **Q Do the electric utilities comply with these savings requirements?**

2 **A** Yes. Table 5 below summarizes annual electric savings as a percent of total annual  
 3 savings for each utility in the Utilities’ Triennial Plan. For all three years, annual electric  
 4 savings as a percent of total annual energy savings exceed 65 percent. Percentages range  
 5 from 71 percent to 86 percent.

6 **Table 5. Electric savings as a percent of total energy savings**

Utility	Net annual electric savings (MWh)	Net annual non-electric savings (MWh)	Electric savings as a percent of total energy savings (%)
<b>2024</b>	<b>101,025</b>	<b>16,979</b>	<b>86%</b>
Eversource	75,002	12,000	86%
Liberty	7,254	1,671	81%
NH Elec Coop	7,335	2,886	72%
Unitil	11,434	422	96%
<b>2025</b>	<b>100,393</b>	<b>18,550</b>	<b>84%</b>
Eversource	74,305	13,428	85%
Liberty	6,790	1,645	80%
NH Elec Coop	7,855	3,054	72%
Unitil	11,443	422	96%
<b>2026</b>	<b>99,543</b>	<b>19,474</b>	<b>84%</b>
Eversource	74,091	14,310	84%
Liberty	6,306	1,604	80%
NH Elec Coop	7,700	3,138	71%
Unitil	11,447	422	96%
<b>Total (2024–2026)</b>	<b>101,025</b>	<b>16,979</b>	<b>86%</b>

7

8 **Cost-Effectiveness**

9 **Q What does HB 549 require for Commission review of cost-effectiveness?**

10 **A** HB 549 requires the Commission to use the GST as the primary cost-effectiveness test in  
 11 its review of the NHSaves programs. It also allows the Commission to use the TRC test  
 12 as a secondary test. The legislation further directs the Commission to base its review  
 13 upon the latest AESC study for New England, as well as EM&V results, including for  
 14 free-ridership.

1       **Q What is the difference between a primary and a secondary cost-effectiveness test?**

2       **A** The purpose of a primary test is to inform whether the Utilities' proposed investments in  
3       energy efficiency create more benefits than costs and therefore merit approval by the  
4       Commission. The primary test is the main determinant of whether an energy efficiency  
5       program should be included in the Triennial Plan.

6       A secondary test is meant to support the primary test by helping to enhance the overall  
7       understanding of the energy efficiency impacts. The additional information from a  
8       secondary test can help to prioritize energy efficiency programs and to inform decisions  
9       regarding marginally cost-effective programs and allocation of resources. The secondary  
10      test is not intended to undermine the purpose or the application of the primary test.<sup>6</sup>

11      **Q Please describe the Granite State Test.**

12      **A** The GST is a jurisdiction-specific cost-effectiveness test that compares the present value  
13      of the future stream of benefits to the present value of the future stream of costs for  
14      energy efficiency programs over their useful lives. If the present value of benefits is  
15      greater than the present value of costs to deliver those programs, then it is determined to  
16      be cost-effective (i.e., it has a benefit-cost ratio of 1.0 or above).

17      The GST includes all utility system impacts. For electric utilities, utility system impacts  
18      include those associated with the generation, transmission, and distribution of electricity

<sup>6</sup> National Energy Screening Project (NESP), *National Standard Practice Manual for Benefit-Cost Analysis of Distributed Energy Resources* (NSPM for DERs), August 2020, page. 3-16. Available at: <https://www.nationalenergyscreeningproject.org/national-standard-practice-manual/>.

1 services. For gas utilities, utility system impacts include those related to the  
2 transportation, storage, and distribution of gas services. The GST also includes non-utility  
3 system impacts related to other fuels (i.e., oil and propane), water, low-income  
4 participants, and the environmental fossil fuel savings impact based on the Regional  
5 Greenhouse Gas Initiative.<sup>7</sup>

6 Table 6 shows the GST impacts currently quantified within the Utilities' benefit-cost  
7 assessment models and their source.

8 There are additional benefits within the GST that are currently described in a qualitative  
9 manner and not currently included in the Utilities' benefit-cost assessment models. These  
10 benefits include avoided credit and collection costs, increased reliability, and market  
11 transformation.

<sup>7</sup> Synapse Energy Economics, *New Hampshire Cost-Effectiveness Review: Application of the National Standard Practice Manual to New Hampshire*, prepared for the New Hampshire Evaluation, Measurement, and Verification Working Group, October 2019, Chapter 5.

1

**Table 6. Quantified Granite State Test impacts within the Triennial Plan**

Category	Impact	Source
Utility System Costs	Measure costs (utility portion)	Triennial Plan Budget
	Other financial or technical support costs	Triennial Plan Budget
	Other program and administrative costs	Triennial Plan Budget
	EM&V costs	Triennial Plan Budget
	Performance incentives	Triennial Plan Budget
Utility System Benefits	Avoided energy costs	2021 AESC <sup>8</sup>
	Avoided generating capacity costs	2021 AESC
	Avoided reserves	2021 AESC
	Avoided transmission costs	2021 AESC
	Avoided distribution costs	Utility-specific calculations
	Avoided transmission and distribution line losses	2021 AESC
	Avoided ancillary services	2021 AESC
	Intrastate price suppression effects (DRIPE)	2021 AESC
	Avoided compliance with RPS requirements	2021 AESC
	Avoided environmental compliance costs (embedded)	2021 AESC
Reduced Risk	2021 AESC	
Non-Utility System Impacts	Other fuel	2021 AESC
	Water resource	Average of Manchester, NH and Concord, NH water and sewer costs per gallon from July 2016. <sup>9</sup>
	Income eligible (participant)	Home Energy Assistance Program Evaluation Report <sup>10</sup>
	New Hampshire Environmental fossil fuel proxy	Regional Greenhouse Gas Initiative's dollar per ton carbon dioxide

2

3 **Q How is the GST applied?**

4 **A** The GST is applied to each program in the Triennial Plan that is designed to save energy.

5 The GST requires that each program be cost-effective. While there is no requirement for

<sup>8</sup> Synapse Energy Economics. *Avoided Energy Supply Components in New England: 2021 Report*, amended May 14, 2021. Available at [https://www.synapse-energy.com/sites/default/files/AESC%202021\\_20-068.pdf](https://www.synapse-energy.com/sites/default/files/AESC%202021_20-068.pdf).

<sup>9</sup> Utilities live Excel Benefit-Cost Models as filed in conjunction with the Plan filing (Plan Narrative and Attachments) filed on March 1, 2022.

<sup>10</sup> Opinion Dynamics. Home Energy Assistance Program Evaluation Report 2016-2017, Final, July 29, 2020. <https://puc.nh.gov/Electric/Monitoring%20and%20Evaluation%20Reports/20200729-NHSaves-HEA-Evaluation-Report-FINAL.pdf>.

1 individual measures and projects to be cost-effective, on average, they must be cost-  
2 effective to allow for the overall program to be cost-effective. The GST is used both  
3 prospectively to assess cost-effectiveness of the Triennial Plan, and retrospectively as  
4 part of annual and term reporting. Certain programs and initiatives are exempt from cost-  
5 effectiveness, including evaluation or other research, education, pilots, programs in early  
6 stages, and investments in income-eligible programs and customers.<sup>11</sup>

7 **Q Does the Triennial Plan comply with HB 549, and the GST?**

8 **A** Yes. As shown in Triennial Plan Attachments E1, F1, G1, H1, I1, and J1, each electric  
9 and natural gas program for each utility is cost-effective under the GST.<sup>12</sup> We also  
10 reviewed the Utilities' live Excel benefit-cost models as filed in conjunction with the  
11 Triennial Plan filing (Plan Narrative and Attachments) and found that the relevant  
12 impacts of the GST were applied accurately.

#### 13 **IV. RECOMMENDED IMPROVEMENTS TO THE TRIENNIAL PLAN**

14 **Q Do you have any recommended enhancements to improve the Triennial Plan?**

15 **A** Yes. We recommend the following enhancements:

- 16 1. A more proactive plan to integrate federal funding from the IRA into the  
17 NHSaves program during the period of 2024 to 2026.

<sup>11</sup> NHSaves. Cost Effectiveness Testing 2021-2023. Presented to the New Hampshire Public Utilities Commission on March 16, 2020. Available at: <https://www.puc.nh.gov/EESE%20Board/Meetings/2020/20200316Mtg/20200316-EERS-NHSaves-Cost-Effectiveness-2021-2023.pdf>.

<sup>12</sup> Proposed Plan Attachments. Attachment E1, Bates 51-53; Attachment F1, Bates 103-106; Attachment G1, Bates 142-144; Attachment H1, Bates 268-270; Attachment I1, Bates 167-169; Attachment J1, Bates 187-189.

1           2. Recognition of additional barriers that may exist that inhibit vulnerable or  
2           underserved customers from participating in the NHSaves programs.

3           **Q How have the Utilities characterized their access to IRA funds?**

4           **A** The Utilities state that they have not identified federal funding opportunities that they can  
5           obtain directly, but rather the vast majority of funds need to be accessed and distributed  
6           through the New Hampshire New Hampshire Department of Energy.<sup>13</sup>

7           **Q Have the Utilities identified what areas would benefit from IRA funds?**

8           **A** The Utilities have not identified specific areas where federal funding could be  
9           particularly advantageous to NHSaves.<sup>14</sup>

10          **Q Do you think federal funding opportunities should be incorporated into the**  
11          **Triennial Plan?**

12          **A** Yes. The Utilities should be prepared to use federal funding as soon as they have access.  
13          Accordingly, we suggest including priority investments in the Triennial Plan to avoid an  
14          additional delay in benefits to ratepayers. While there is uncertainty on timing when the  
15          state's Department of Energy will make federal funding available to the Utilities, the  
16          Utilities should be prepared to incorporate federal funding between 2024 and 2026. The  
17          IRA incentives are available for a ten-year period from January 2023 through December  
18          2032.<sup>15</sup>

<sup>13</sup> Utilities Response to OCA 1-021.

<sup>14</sup> Utilities Response to OCA 1-021.

<sup>15</sup> H.R.5376 -117th Congress (2021-2022): Inflation Reduction Act of 2022. (2022, August 16).  
<http://www.congress.gov/>.

1 We recommend that the Commission encourage, and coordinate with, the Department of  
2 Energy to take all reasonable steps to pursue and acquire federal funds to support energy  
3 efficiency as quickly as possible. A failure to access these funds during the Triennial Plan  
4 period would result in New Hampshire customers paying higher electricity and gas bills  
5 than necessary.

6 Similarly, we recommend the Utilities draft a plan for how to incorporate those federal  
7 funds into the NHSaves programs when the funds become available. This plan should be  
8 drafted with input from the intervenors in this docket and should be filed with the  
9 Commission in this docket no later than January 1, 2024.

10 **Q In addition to reducing electric and gas costs, are there other reasons why the**  
11 **Utilities should access the federal funds to support the energy efficiency programs?**

12 **A** The Utilities are limited in their ability to implement all cost-effective energy efficiency.  
13 HB 549 specifies that electric savings must constitute 65 percent of total savings. Federal  
14 funds would provide the Utilities with flexibility to implement the strongest possible  
15 programs for New Hampshire ratepayers because they would not be subject to the  
16 restrictions that pertain to existing funding sources.<sup>16</sup> The federal funds could be used to  
17 pay the costs of non-electric savings for the electric utilities and non-gas savings for the  
18 gas utilities.

<sup>16</sup> Utilities Response to OCA 1-021.

1       **Q Do you have suggestions the Utilities could incorporate into their Triennial Plan?**

2       **A** Yes. We see several key areas of the Triennial Plan where federal funding can have a  
3       meaningful and positive impact on ratepayers. The key areas include:

4               1. Incentives for programs that encourage cost-effective fuel-switching.

5               2. Expansion of access to weatherization.

6       **Q Why do you identify fuel-switching as an area that would benefit from federal**  
7       **funds?**

8       **A** In accordance with HB 549, the Utilities are required to plan for 65 percent of total annual  
9       savings funded by the SBC to be from avoided electricity consumption. This provision  
10       restricts the Utilities' ability to offer fuel-switching measures. Fuel-switching measures  
11       increase electricity consumption but decrease usage of other fuels, resulting in net energy  
12       reduction and improved efficiency. The most popular high-efficiency fuel-switching  
13       measures are heat pumps.

14       The Utilities currently offer all residential customers high-efficiency heat pump  
15       incentives.<sup>17</sup> However, the incentives are designed only to promote high-efficiency models  
16       over less efficient heat pumps. The Utilities claim savings from heat pump measures based  
17       only on the delta between a high-efficiency heat pump and a low-efficiency heat pump,  
18       rather than the delta between a high-efficiency heat pump and a non-electric heating system  
19       replacement. The small savings delta corresponds with a small incentive which is likely  
20       insufficient to encourage fuel-switching.<sup>18</sup>

21       Heat pumps are a key focus area within the IRA.<sup>19</sup> See Table 7 for a list of incentives  
22       available through the IRA's High-Efficiency Energy Home Rebate Act (HEEHRA). The

<sup>17</sup> Utilities Response to OCA 1-011.

<sup>18</sup> Utilities Response to OCA 1-012.

<sup>19</sup> H.R.5376 -117th Congress (2021-2022): Inflation Reduction Act of 2022. (2022, August 16).

1 incentives include rebate amounts that scale based on income (left side of the table) and  
2 tax credits that can benefit customers with sufficient tax burden (right side of the table). If  
3 the Utilities can leverage funds through the New Hampshire Department of Energy and/or  
4 provide supplemental educational material to consumers regarding tax benefits, New  
5 Hampshire residents could see notable benefits. As the main point of contact with  
6 customers installing energy efficiency measures, the Utilities are in the optimal position to  
7 help customers access these benefits.

8 **Table 7. Tax credit and High-Efficiency Electric Home Rebate Act (HEEHRA) rebate amount<sup>20</sup>**

High-efficiency electric home rebate			25C tax credit	
	Requirement	Rebate caps	Requirement	Credit caps
Overall	Household <150% AMI	\$14,000	Pay taxes (not refundable)	\$1,200 per year (except per below)
Overall % of measure cost		50% except 100% for households <80% AMI		30% (includes labor to install equipment but not for components)
<b>Equipment</b>				
Heat pumps	ENERGY STAR electric	\$8,000	Highest CEE Tier	\$2,000 <sup>3</sup>
Heat pump water heaters	ENERGY STAR electric	\$1,750	Highest CEE Tier	\$2,000
Central air conditioner, water heater, furnace, or boiler			Highest CEE Tier	\$600
Stove, cooktop, range, or oven		\$840		
Heat pump clothes dryer	ENERGY STAR electric	\$840		
Biomass (wood) stove or boiler			>75% HHV efficiency	\$2,000
<b>Components</b>				
Insulation and air sealing	ENERGY STAR	\$1,600 <sup>4</sup>	IECC (of two years before)	\$1,200
Windows and skylights			ENERGY STAR Most Efficient	\$600 (total)
Doors			ENERGY STAR	\$500 (\$250 per door)
Electric panels/load service centers		\$4,000	Enables qualifying equipment	\$600 <sup>5</sup>
Electric wiring		\$2,500		
<b>Measures</b>				
Energy audit			IRS to specify	\$150

HHV = higher heating value. Highest Consortium for Energy Efficiency (CEE) Tier does not include an "advanced tier." For multifamily buildings, half of households must meet Area Median Income (AMI) requirements. States may be able to set lower caps or more stringent requirements for the Electric Home Rebate.

9  
10

<sup>20</sup> Ungar, L., Nadel, S. 2022. *Home Energy Upgrade Incentives: Programs in the Inflation Reduction Act and Other Recent Federal Laws*. American Council for an Energy-Efficient Economy. Available at: <https://www.aceee.org/policy-brief/2022/09/home-energy-upgrade-incentives-programs-inflation-reduction-act-and-other>

1       **Q Why are fuel-switching incentives beneficial to New Hampshire residents?**

2       **A** Fuel-switching to efficient technologies, such as high-efficiency heat pumps, is expected  
3       to reduce costs for customers long term, reduce customer reliance on volatile and high-  
4       cost fossil fuel use, and decrease greenhouse gas emissions.<sup>21</sup> Increased incentives for  
5       fuel-switching technologies would expand customers' options without compromising the  
6       savings requirements of HB 549. The incentives currently offered in the Triennial Plan  
7       are unlikely to be sufficient to support customers who are interested in fuel-switching to  
8       electric end uses.<sup>22</sup> Federal funding can bridge the gap for customers who want to pursue  
9       cost-effective fuel-switching.

10       **Q How can the IRA expand access to weatherization measures?**

11       **A** Table 7 displays the rebate and tax incentives for weatherization measures (including  
12       insulation, window and skylights, and doors) in addition to the heat pump incentives. The  
13       Utilities are limited both by the SBC and LDAC caps and the 65 percent provisions in  
14       HB 549, and therefore lack sufficient funds to weatherize all New Hampshire homes that  
15       currently have insufficient weatherization. The IRA incentives can help support this  
16       effort and expand the number of households that can take advantage of weatherization  
17       measures.

<sup>21</sup> Navigant Consulting. 2019. *Energy Optimization through Fuel Switching Study. Prepare for the New Hampshire EM&V Working Group*. Pages 30-31 (Bates 42-43). Available at: [https://www.puc.nh.gov/%5C/Regulatory/Docketbk/2017/17-136/LETTERS-MEMOS-TARIFFS/17-136\\_2019-10-31\\_STAFF\\_NH\\_ENERGY\\_OPTIMIZATION\\_STUDY.PDF](https://www.puc.nh.gov/%5C/Regulatory/Docketbk/2017/17-136/LETTERS-MEMOS-TARIFFS/17-136_2019-10-31_STAFF_NH_ENERGY_OPTIMIZATION_STUDY.PDF)

<sup>22</sup> Utilities Response to OCA 1-012.

1       **Q Why are weatherization measures beneficial to households and ratepayers?**

2       **A** Weatherization measures are critical to successful efficiency programs because they not  
3       only contribute to direct energy savings, but they also increase the efficiency of other  
4       space heating, water heating, or cooling equipment. These measures are the foundation of  
5       high-performing buildings and deliver long-term savings. Efficiency funds for  
6       weatherization are used most effectively when measures are delivered in a fuel-blind  
7       approach, which is the approach implemented by leading energy efficiency states  
8       including Maine, Vermont, and Massachusetts.<sup>23</sup> Energy auditors can recommend  
9       weatherization measures for all under-weatherized homes, rather than exclusively homes  
10      with electric heating systems. Delivering weatherization measures to all under-  
11      weatherized homes would help maximize program savings per home energy audit and  
12      reduce the likelihood of lost opportunities. While it is important to protect electric  
13      ratepayers from shouldering disproportionate costs of efficiency, it is also important that  
14      all electric ratepayers have access to the efficiency programs they help fund—regardless  
15      of whether they reap the benefits through their electric bill savings or their other fuel bill  
16      savings. Further, weatherization of existing buildings is one of the critical options for  
17      reducing greenhouse gases now and in the future.

<sup>23</sup> See weatherization offerings from Efficiency Maine, available at: <https://www.energymaine.com/at-home/weatherization/>, Efficiency Vermont, available at: <https://www.energivermont.com/rebates/list/home-performance-with-energy-star/>, and Mass Save, available at: <https://www.masssave.com/saving/residential-rebates/home-insulation>.

1       **Q What is your second recommendation for improvements to the Triennial Plan?**

2       **A** We recommend the Utilities investigate whether there are vulnerable or underserved  
3       populations within New Hampshire beyond the existing income criteria.

4       **Q Have the Utilities identified vulnerable or underserved communities?**

5       **A** Somewhat. The Utilities identify and serve low- and moderate-income households  
6       through their programs and partnerships with community organizations, the New  
7       Hampshire Department of Energy, and other nonprofit organizations.<sup>24</sup> The Utilities have  
8       commissioned the “NH Electric Efficiency Opportunities for Low- and Moderate-Income  
9       Customers” study to find additional opportunities to support income-eligible customers.  
10      The study is scheduled to be completed by the end of 2023.<sup>25</sup>

11      The Utilities have not identified vulnerable or underserved populations on any basis other  
12      than income with respect to the Triennial Plan.<sup>26</sup>

13      **Q What are some examples of vulnerable or underserved communities that may exist**  
14      **in New Hampshire?**

15      **A** In some cases, factors other than income can impact whether a customer is more or less  
16      likely to be served by a utility program.<sup>27</sup> Factors such as ownership status (e.g., renters),  
17      race, English language proficiency, or location (e.g., rural) are examples of customer

<sup>24</sup> Utilities Response to OCA 1-005.

<sup>25</sup> Utilities Response to OCA 1-006.

<sup>26</sup> Utilities Response to OCA 1-006, LISTEN 1-001, and CLF 1-007.

<sup>27</sup> Amann, J., C. Tolentino, D. York. ACEEE. *Toward More Equitable Energy Efficiency Programs for Underserved Households* (May 2023). Available at: <https://www.aceee.org/sites/default/files/pdfs/B2301.pdf>

1 characteristics that can be considered when assessing whether program benefits are  
2 equitably distributed throughout New Hampshire.<sup>28</sup>

3 **Q Why is it important to consider vulnerable or underserved populations beyond the**  
4 **existing income criteria?**

5 **A** It would be valuable to understand whether the efforts the Utilities have made to target  
6 low- and moderate-income customers are reaching customers within each of the groups  
7 described above, or whether certain groups remain underserved by the NHSaves  
8 programs.

9 **Q What recommendations do you have for the Utilities with respect to vulnerable or**  
10 **underserved communities?**

11 **A** We recommend the Utilities use the available participation and household data from the  
12 NHSaves program as well as any publicly available datasets from the Census Bureau to  
13 identify whether certain groups have been historically excluded from participating in  
14 NHSaves. We recommend the results of the analysis be made public so stakeholders can  
15 recommend strategies for improving engagement with vulnerable or underserved  
16 communities going forward.

<sup>28</sup> *Id.* Page 4.

1 **V. THE BENEFITS OF ENERGY EFFICIENCY**

2 **Q Please provide an overview of the benefits of energy efficiency to New Hampshire.**

3 **A** Energy efficiency can provide substantial benefits to New Hampshire electric and natural  
4 gas customers, the economy, and the environment.

5 Cost-effective energy efficiency programs will lower system-wide electricity and natural  
6 gas costs, leading to reductions in customers' energy bills. Energy efficiency can avoid  
7 investments in transmission and distribution (T&D) infrastructure by creating reductions  
8 in peak demand. These demand savings reduce stress on local T&D systems, potentially  
9 deferring expensive upgrades or mitigating local transmission congestion problems.

10 These avoided costs are enjoyed by all customers, regardless of whether they participate  
11 in energy efficiency programs.

12 Energy efficiency also provides the Commission, the Utilities, and utility customers an  
13 opportunity to mitigate the impacts of high and volatile prices of wholesale electricity  
14 and gas. In the past several years, the default energy service prices in New Hampshire  
15 have been volatile and reached as high as 22.6 cents/kWh in August 2022 for  
16 Eversource.<sup>29</sup> There are few things that the Commission, the Utilities, or the utility  
17 customers can do to protect against high wholesale electricity and gas prices because  
18 those prices are driven by trends in national and global energy markets. In contrast,  
19 energy efficiency resources provide an opportunity for customers to mitigate the bill

<sup>29</sup> Direct Testimony of Tim Woolf and Ben Havumaki, on behalf of the New Hampshire Office of Consumer Advocate, Docket No. DE 20-161, August 2022, page 15.

1 impacts of high and volatile energy prices by directly reducing electricity and gas  
2 consumption.

3 New Hampshire's energy efficiency programs also provide significant benefits to the  
4 local economy.<sup>30</sup> Energy efficiency creates local jobs ranging from electricians, HVAC  
5 technicians, and insulation contractors, to engineers and architects. Energy efficiency also  
6 promotes local economic development and job creation by increasing the disposable  
7 income of citizens and making businesses and industries more competitive. Energy  
8 efficiency in public buildings (schools, hospitals, government buildings) can also help  
9 reduce the tax burden on all customers by reducing government's annual operating costs.

10 **Q Please provide a summary of the specific benefits of the programs proposed in the**  
11 **Triennial Plan.**

12 **A** The energy efficiency programs proposed in the Triennial Plan are all cost-effective  
13 according to the GST. For every dollar spent on the programs there will be \$2.3 dollars in  
14 benefits experienced by both program participants and other customers.<sup>31</sup> All the electric  
15 and gas programs across all the utilities are expected to generate a total of \$283 million in  
16 net benefits from measures installed over the three years of the plan.<sup>32</sup>

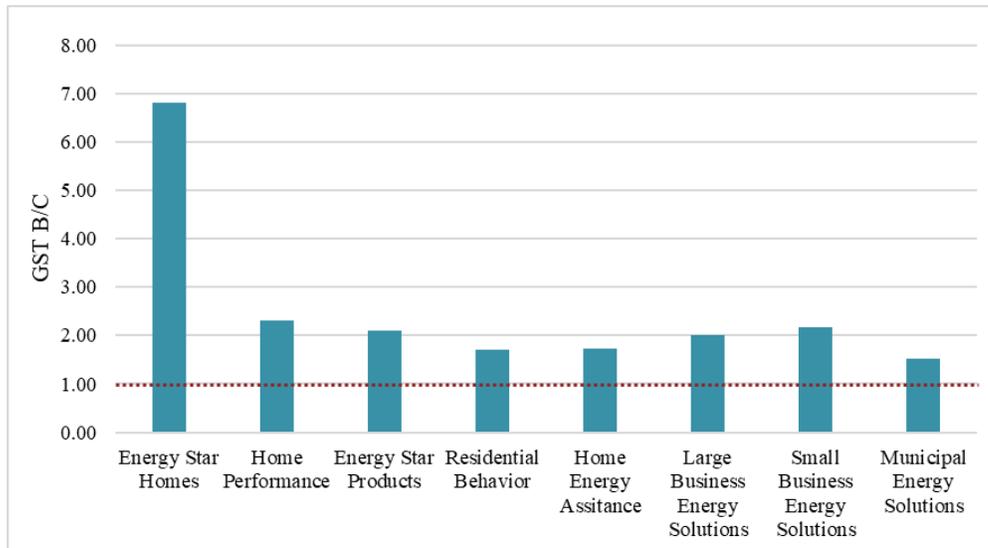
<sup>30</sup> Triennial Plan, Attachment N, *Economic Impact of NHSaves Programs*.

<sup>31</sup> Triennial Plan, page 6.

<sup>32</sup> This information was generated by compiling information from all the benefit-cost analysis models of the Utilities' Triennial Plans.

1 Figure 1 presents the benefit-cost ratios for the electricity efficiency programs for all the  
2 utilities combined for the three years of the plan. As indicated, each electricity program  
3 exceeds the threshold benefit-cost ratio of 1.0 by a significant margin.

4 **Figure 1. Benefit-cost ratios of electricity efficiency programs, 2024–2026<sup>33</sup>**



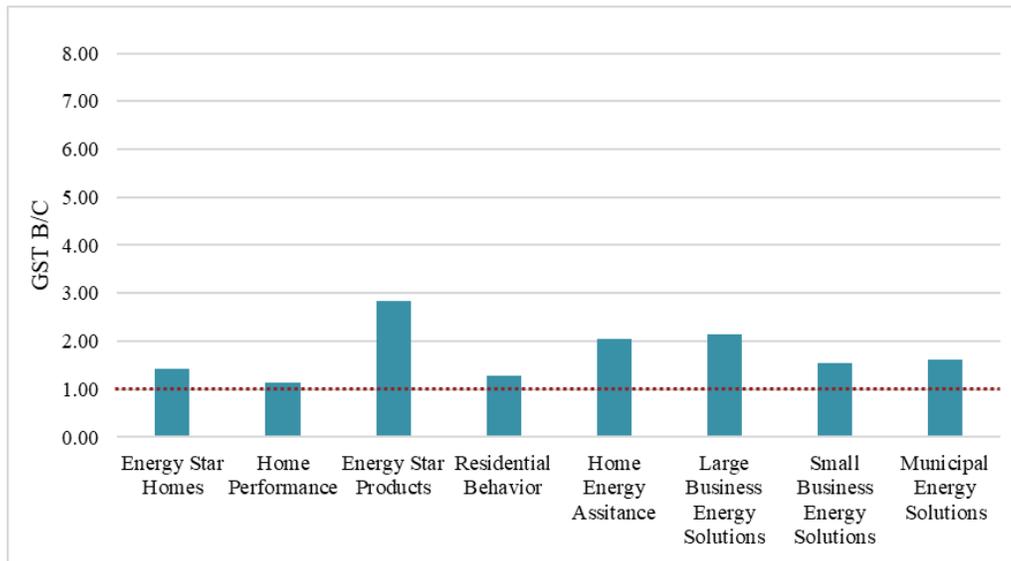
5  
6 Figure 2 presents the benefit-cost ratios of the gas efficiency programs for all the utilities  
7 combined for the three years of the plan. As indicated, each gas program exceeds the  
8 threshold benefit-cost ratio of 1.0 by a significant margin.

9

<sup>33</sup> This information was generated by compiling information from all the benefit-cost analysis models of the Utilities' Triennial Plans.

1

**Figure 2. Benefit-cost ratios of gas efficiency programs, 2024–2026<sup>34</sup>**



2

3

Figure 3 presents the benefits, costs, and net benefits of the electricity efficiency

4

programs combined for the three years of the plan. In aggregate across all programs, the

5

costs of the program are expected to be \$194 million, the benefits are expected to be \$447

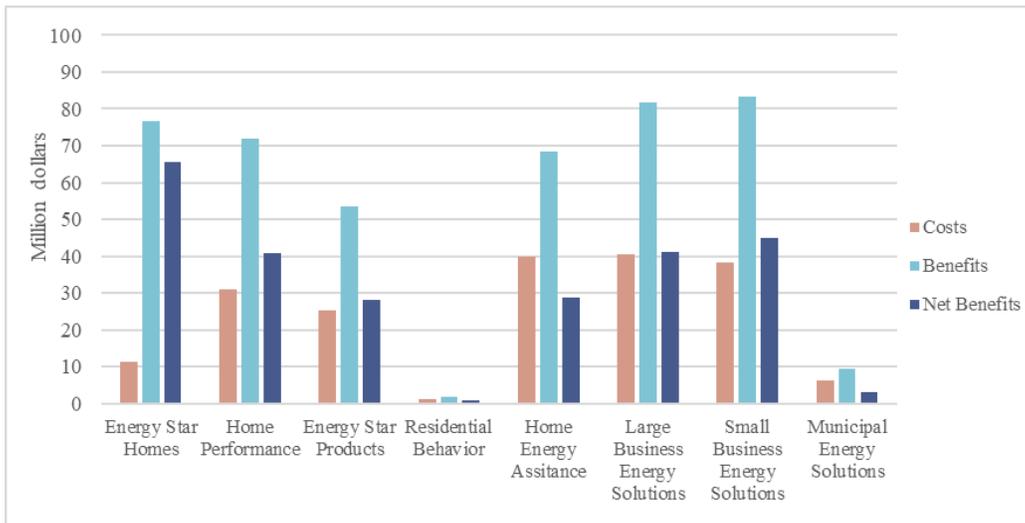
6

million, and the net benefits are expected to be \$253 million.

<sup>34</sup> This information was generated by compiling information from all the benefit-cost analysis models of the Utilities' Triennial Plans.

1

**Figure 3. Costs, benefits, and net benefits of electricity efficiency programs, 2024–2026<sup>35</sup>**



2

3

4

5

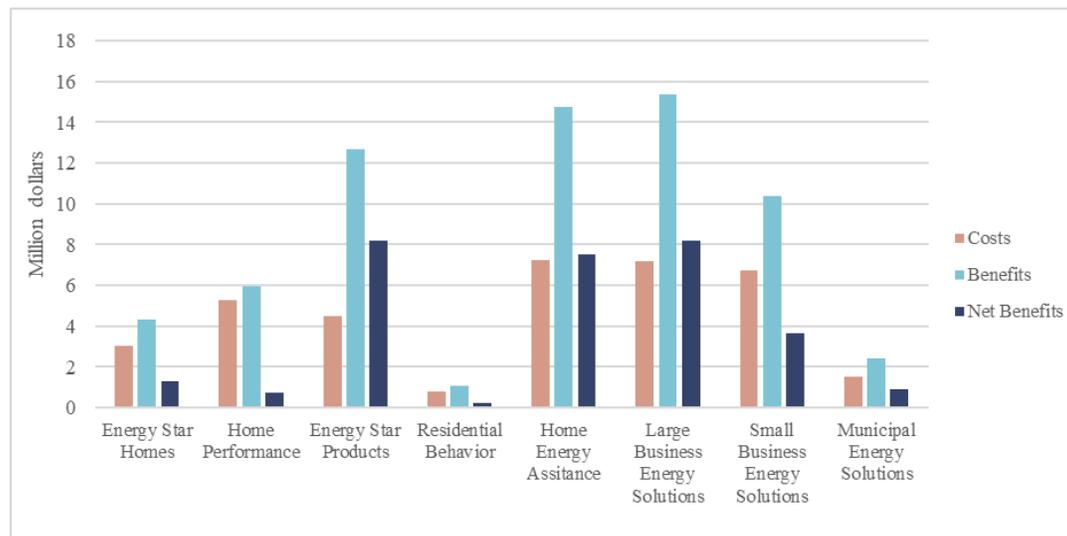
6

Figure 4 presents the benefits, costs, and net benefits of the gas efficiency programs combined for the three years of the plan. In aggregate across all programs, the costs of the program are expected to be \$36 million, the benefits are expected to be \$67 million, and the net benefits are expected to be \$31 million.

<sup>35</sup> This information was generated by compiling information from all the benefit-cost analysis models of the Utilities' Triennial Plans.

1

**Figure 4. Costs, benefits, and net benefits of electric and gas efficiency programs, 2024–2026<sup>36</sup>**



2

### 3 **VI. MARKET BARRIERS**

4 **Q Please describe what is meant by market barriers to energy efficiency.**

5 **A** Market barriers refer to real-world obstacles that hinder electricity and natural gas  
6 customers from adopting energy efficiency measures on their own. In a perfectly  
7 functioning economy, all customers would adopt efficiency measures that result in long-  
8 term financial gains and product availability would directly follow product demand. In  
9 reality, markets for energy and for energy efficiency goods and services are imperfect and  
10 hence fail to produce an efficient outcome.

11 **Q Does the Triennial Plan address market barriers?**

12 **A** Yes. The Triennial Plan explains that the NHSaves programs are designed to overcome  
13 the market barriers that inhibit customers from adopting cost-effective energy efficiency

<sup>36</sup> This information was generated by compiling information from all the benefit-cost analysis models of the Utilities' Triennial Plans.

1 in their homes and businesses. Some of the key market barriers addressed in the Triennial  
2 Plan include:

3 reducing first-cost obstacles by providing customer incentives; increasing  
4 stocks of energy efficient equipment at retailers, distributors, and  
5 suppliers; training and recruiting installers and other market actors in  
6 highly efficient design and installation; and educating customers about the  
7 benefits of energy efficiency.<sup>37</sup>

8 The Triennial Plan also explains that in 2023 the Utilities commissioned an independent  
9 analysis of the impact of market barriers on customer adoption of energy efficiency and  
10 how energy efficiency programs can intervene, circumvent, and address these barriers.<sup>38</sup>

11 **Q What were the primary objectives of the DNV Market Barriers Study?**

12 **A** The primary objectives of the DNV Market Barriers Study were to: “(1) identify and  
13 detail the market barriers addressed by the NHSaves programs, (2) assess the extent to  
14 which selected energy efficiency programs such as those in New Hampshire have  
15 overcome such barriers, and (3) identify how New Hampshire’s programs could continue  
16 to do so going forward.”<sup>39</sup>

17 **Q How does the DNV Market Barriers Study describe market barriers?**

18 **A** The DNV Market Barriers Study explains that the market barriers to energy efficiency  
19 are multi-faceted, complex, and affect different customers and different technologies

<sup>37</sup> Triennial Plan, page 18.

<sup>38</sup> Triennial Plan, page 18, and Attachment N: *Market Barriers to Energy Efficiency*, prepared by DNV, submitted to the New Hampshire Evaluation, Measurement, and Verification Working Group, March 27, 2023 (DNV Market Barriers Study).

<sup>39</sup> DNV Market Barriers Study, page 5.

1 differently. Consequently, the solutions to address market barriers are manyfold and need  
2 to be tailored differently to different technologies and customer types. The study also  
3 explains that the energy efficiency market is ever-changing, and so are the barriers to  
4 energy efficiency. Consequently, the initiatives to address market barriers need to evolve  
5 as well.

6 The DNV Market Barriers Study provides several categories of market barriers, based on  
7 the literature for this topic. These categories include:

- 8 • Financial – barriers associated with end users’ financial costs of adopting energy  
9 efficiency, including limited access to financing, internal competition for capital  
10 resources, and transaction costs such as time and labor for project installation.
- 11 • Informational – barriers associated with obtaining information or lacking sufficient  
12 information, such as limited awareness of savings potential or limited access to  
13 information to assess and verify vendor claims of performance.
- 14 • Organizational – barriers associated with the structure or practices of end-user  
15 organizations, including split incentives whereby owners or landlords decide whether  
16 to install efficient equipment, rather than occupants who pay energy bills.
- 17 • Supply and provision – barriers associated with energy efficiency suppliers’ resources  
18 and practices, including workforce capacity and training limitations, and limited  
19 product availability.

- 1           • Behavioral – barriers associated with the behavioral patterns of end users, which can  
2           include factors such as end user habits, skepticism or lack of trust in the benefits of  
3           energy efficiency, or social group dynamics limiting adoption.
- 4           • Public policy – barriers associated with public policies (or lack thereof) causing  
5           distortion in market prices or behaviors, including externalities or costs that are  
6           associated with transactions, but are not reflected in the transaction price (e.g., the  
7           potentially harmful consequences of economic activities on the environment).”<sup>40</sup>

8           **Q How did the DNV Market Barrier Study identify and describe the market barriers**  
9           **addressed by the NHSaves programs?**

10          **A** The DNV Market Barriers Study provides a summary of the types of energy efficiency  
11          program interventions that are typically used by energy efficiency program administrators  
12          to overcome market barriers. These include, for example: (a) financial incentives, such as  
13          discounts and rebates; (b) information and promotion, such as marketing and educational  
14          materials; and (c) technical assistance, such as engineering, design, and other technical  
15          support services.<sup>41</sup>

16          The DNV Market Barrier Study then conducted several case studies of the NHSaves  
17          programs offered in the 2022–2023 EE Plan. It reviews several programs that collectively  
18          address all the market barriers expected in that plan, including Residential Retail  
19          Lighting, Residential Weatherization, Residential New Construction, C&I Lighting  
20          Controls, and Industrial Process programs. For each program, the study characterizes the

<sup>40</sup> DNV Market Barriers Study, page 2.

<sup>41</sup> DNV Market Barriers Study, page 3, Table 1-1.

1 market barriers and summarizes the remaining savings opportunities available if the  
2 market barriers can be addressed.<sup>42</sup>

3 **Q What were the key findings of the DNV Market Barriers Study?**

4 **A** The DNV Market Barriers Study found that the NHSaves programs “vary in the extent to  
5 which they have circumvented or eliminated market barriers.”<sup>43</sup> The Residential Retail  
6 Lighting program has “helped eliminate market barriers, and program interventions are  
7 no longer needed in most cases.”<sup>44</sup> Accordingly, the Utilities are discontinuing this  
8 program in the Triennial Plan.

9 However, the DNV Market Barriers Study finds the efficiency measures offered by all  
10 the other NHSaves programs “still face a range of barriers and savings opportunities that  
11 justify continued program intervention.”<sup>45</sup> The study identified the Residential  
12 Weatherization and C&I Lighting Controls programs as presenting the greatest  
13 opportunities for savings from the NHSaves program.<sup>46</sup>

14 **Q Are the findings of the DNV Market Barrier Study consistent with your**  
15 **understanding of the market barriers that inhibit customer adoption of cost-**  
16 **effective energy efficiency measures?**

17 **A** Yes. The DNV Market Barriers Study is consistent with many other studies of the market  
18 barriers to energy efficiency measures. The existence of market barriers to cost-effective

<sup>42</sup> DNV Market Barriers Study, page 5, Table 1-2.

<sup>43</sup> DNV Market Barriers Study, page 7.

<sup>44</sup> DNV Market Barriers Study, page 7.

<sup>45</sup> DNV Market Barriers Study, page 7.

<sup>46</sup> DNV Market Barriers Study, page 7.

1 energy efficiency savings has been analyzed throughout the industry for over 30 years.  
2 As far back as 1988, a study conducted for the National Association of Regulatory Utility  
3 Commissioners by the Lawrence Berkeley National Laboratory identified and defined  
4 these market barriers and clearly articulated why utility-funded energy efficiency  
5 programs are needed to overcome them.<sup>47</sup>

6 These barriers are the reason why utility-funded energy efficiency programs exist in the  
7 first place; if customers were able to adopt cost-effective energy efficiency measures on  
8 their own, there would not be a need for utility-funded energy efficiency programs in any  
9 state. The fact that nearly every state in the United States offers utility-funded energy  
10 efficiency programs clearly indicates that legislators, commissions, and other decision-  
11 makers around the country recognize that market barriers to energy efficiency still  
12 exist.<sup>48</sup>

13 **Q Do restructured electricity markets with competitive wholesale generation help to**  
14 **overcome these market barriers to energy efficiency adoption?**

15 **A** No. Since 1998, decades of experience have shown that ratepayer-funded energy  
16 efficiency is still critically important in restructured electric markets. Competitive  
17 electricity generation markets help to promote more efficient and economic *wholesale*  
18 *generation* of electricity but do very little to help with the provision of *energy efficiency*  
19 *services at the retail, end-use level*, because they do not address the many market barriers

<sup>47</sup> National Association of Regulatory Commissioners, *Least-Cost Utility Planning Handbook for Public Utility Commissioners, Volume 2, the Demand Side: Conceptual and Methodological Issues*, prepared by Lawrence Berkeley National Laboratory, December 1988. See especially Chapter II.

<sup>48</sup> American Council for an Energy-Efficient Economy, *2022 State Energy Efficiency Scorecard*, December 2022. See especially Table 7.

1 facing energy efficiency. These barriers exist in restructured and regulated markets alike  
2 and require utility-funded energy efficiency programs and supporting regulatory policies  
3 to overcome them.

4 A prime example can be found with New York State’s Reforming the Energy Vision  
5 (“REV”) initiative. As part of REV, New York transitioned away from utility mandates  
6 to a market-based approach for energy efficiency and many other utility services. The  
7 initiative sought to enable a competitive market for energy efficiency that would be  
8 driven by the value it creates, with the utilities acting as Distribution System Platform  
9 Providers.<sup>49</sup> Despite an aggressive promotion of the efficiency market through the New  
10 York REV process, the competitive market for energy efficiency products and services  
11 did not materialize. In recognition of the importance of achieving robust energy  
12 efficiency savings and the limitations of the competitive energy efficiency markets, in  
13 2018 the New York Public Service Commission issued an Accelerated Efficiency Order  
14 directing the enhancement and acceleration of energy efficiency by investor-owned  
15 utilities. The Order dramatically increased the savings targets and funding for utility-run  
16 energy efficiency programs.<sup>50</sup>

17 Additional examples can be seen with the number of restructured states in the Northeast  
18 and across the country that still have ratepayer-funded energy efficiency programs  
19 implemented by either utilities or third-party program administrators. In fact, many of the

<sup>49</sup> NYS Department of Public Service Staff Report and Proposal. 2014. Case 14-M-0101.

<sup>50</sup> Case 18-M-0084. Order Authorizing Utility Energy Efficiency and Building Electrification Portfolios through 2025. January 16, 2020.

1 most successful energy efficiency programs in the country are currently offered by states  
2 in regions with wholesale competitive electricity markets. Nine of the top ten states  
3 offering energy efficiency programs are in regions with competitive wholesale markets:  
4 including California (#1), Massachusetts (#2), New York (#3), Vermont (#4), Maine (#5),  
5 Washington DC (#6), Rhode Island (#7), Maryland (#8), and Connecticut (#9).<sup>51</sup> This  
6 “top ten” list includes all the states in New England except for New Hampshire.

7 **VII. DISCOUNT RATES**

8 **Q What discount rate do the Utilities use to calculate the present value of the costs and**  
9 **benefits of the energy efficiency programs?**

10 **A** The Utilities use a real discount rate of 2.78 percent.<sup>52</sup>

11 **Q How is this discount rate derived?**

12 **A** The Utilities start with a nominal discount rate based on the nominal U.S. prime rate on  
13 or around June 1 of the year preceding the year analyzed in the EE Plan. In June 2023  
14 this value was 8.25 percent.<sup>53</sup>

15 The Utilities then determine a real discount rate by removing the effect of inflation from  
16 the nominal rate. The inflation rate for the period between Q1 2022 and Q1 2023 was  
17 5.33 percent. When this inflation effect is removed from the nominal discount rate, the

<sup>51</sup> American Council for an Energy-Efficient Economy, *2022 State Energy Efficiency Scorecard*, December 2022.  
See especially Table 3.

<sup>52</sup> Triennial Plan, page 87.

<sup>53</sup> Triennial Plan, page 87.

1 real discount rate equals 2.78 percent.<sup>54</sup> The Utilities then apply the real discount rate to  
2 the costs and benefits in real dollars, to determine the present values of costs and benefits.

3 **Q Do you agree with the Utilities that this is the most appropriate discount rate to use**  
4 **for the Triennial Plan?**

5 **A** Yes. This is consistent with practice used by the Utilities since 1999, based on the Final  
6 Energy Efficiency Working Group Report in Docket DR 96-150. It is also consistent with  
7 the Benefit-Cost Working Group recommendations from Docket DE 17-136, which were  
8 approved by the Commission in December 2019 in that docket. Further, it is consistent  
9 with the guidance on discount rates provided in the *National Standard Practice Manual*  
10 *for Assessing Cost-Effectiveness of Energy Efficiency Resources* (NSPM for EE)<sup>55</sup> and  
11 the *National Standard Practice Manual for Benefit-Cost Analysis of Distributed Energy*  
12 *Resources* (NSPM for DERs).<sup>56</sup>

13 **Q Please summarize the guidance from the NSPM for EE and the NSPM for DERs on**  
14 **discount rates.**

15 **A** The NSPM for EE and the NSPM for DERs do not prescribe a specific discount rate that  
16 should be used in each state or jurisdiction. Instead, they offer several principles to use

<sup>54</sup> Triennial Plan, page 87.

<sup>55</sup> National Efficiency Screening Project, *The National Standard Practice Manual for Assessing Cost-Effectiveness of Energy Efficiency Resources*, May 2017, Chapter 9. Mr. Woolf was the lead technical author of this report.

<sup>56</sup> National Efficiency Screening Project, *The National Standard Practice Manual for Benefit-Cost Analysis of Distributed Energy Resources*, August 2020, Appendix G. Mr. Woolf was the lead technical author of this report. In general, the NSPM for DERs was intended to supplant the NSPM for EE. However, the discussion of discount rates is more expansive in the NSPM for EE, so we refer to that manual frequently here.

1 for determining which discount rate might be appropriate for each jurisdiction. These  
2 include:<sup>57</sup>

- 3 • The discount rate represents a time preference for the value of money in the short  
4 term versus the value of money in the long term.
- 5 • The choice of discount rate is a policy decision that should be informed by each  
6 jurisdiction’s energy policies and goals.
- 7 • Discount rates can reflect a variety of different perspectives, e.g., the utility  
8 perspective, the customer perspective, or the societal perspective. The choice of a  
9 discount rate for assessing energy efficiency programs should be informed by the  
10 “regulatory perspective,” which reflects the perspective of commissions or other  
11 agents that oversee the utility energy efficiency programs. The regulatory perspective  
12 is guided by the jurisdiction’s energy policies and goals, established in laws,  
13 regulations, orders, or other forms. The regulatory perspective should balance the  
14 interests of utility investors, utility management, utility customers, and other  
15 stakeholders affected by the energy efficiency programs.
- 16 • The choice of a discount rate should be consistent with the goal of the benefit-cost  
17 analysis. In general, the goal of benefit-cost analysis for energy efficiency programs  
18 is to identify those programs that are most likely to best serve customers over the long  
19 term, while also achieving the energy policy goals of the jurisdiction. In other words,

<sup>57</sup> NSPM for EE, Section 9.1.

1           the goal of the benefit-cost analysis is to identify those energy efficiency programs  
2           that will promote low-cost, safe, reliable utility services to customers.

3           **Q Is the utility weighted average cost of capital (WACC) an appropriate discount rate**  
4           **to use for assessing the cost-effectiveness of energy efficiency?**

5           **A** No. The utility WACC represents the time preference of utility investors, i.e., its  
6           shareholders and bondholders. It is a good way to represent the cost of capital to utility  
7           investors, as well as the risk that investors face regarding the value of money today  
8           versus in the future. However, the WACC does not reflect the time preference of utility  
9           customers, nor does it reflect a reasonable time preference from the regulatory  
10          perspective.<sup>58</sup>

11          A discount rate based on the utility WACC is not consistent with the goals of the energy  
12          efficiency benefit-cost analysis. Using a discount rate based on the utility WACC will  
13          help identify energy efficiency programs that will maximize investor value. But  
14          maximizing investor value is not the goal of the energy efficiency programs or of the  
15          benefit-cost analysis of them. The goal of the energy efficiency programs is to provide  
16          low-cost, safe, reliable utility services to customers. This goal will not be served using  
17          the WACC as a discount rate.

18          Further, the Utilities do not use debt or equity to fund their energy efficiency programs.  
19          Instead, they use the revenues obtained through the System Benefits Charge and the

<sup>58</sup> NSPM for EE, Section 9.5.

1           Local Distribution Adjustment Charge, which are simply passed on to customers as an  
2           expense. This is a very low-risk source of funding for the utilities.

3           **Q The WACC is the conventional approach that unregulated, for-profit companies use**  
4           **to set discount rates for benefit-cost analysis. Why is it not appropriate for**  
5           **regulated, investor-owned utilities to use WACC as a discount rate?**

6           **A** This is one of the most important questions regarding the determination of discount rates.  
7           It is a common misperception that regulated, investor-owned utilities should follow the  
8           conventional practice of unregulated, for-profit companies when setting discount rates.  
9           However, the choice of discount rates is one area where regulated utilities should not  
10          follow conventional practices of unregulated companies.

11          • For unregulated, for-profit companies, the WACC is a good indication of their time  
12          preference because the primary objective of making investments is to maximize  
13          shareholder value. In contrast, the primary objectives of regulated utilities are set by  
14          legislation and regulators, not utility investors. The primary objectives are to provide  
15          safe, reliable, low-cost energy services to all customers over the long term, not to  
16          maximize shareholder value.

17          • For unregulated, for-profit companies, the WACC represents the cost of capital for  
18          the investment being considered. In contrast, utility energy efficiency programs are  
19          not funded by capital or debt.

20          • For unregulated, for-profit companies, the WACC reflects the risks to the company of  
21          making the investment, i.e., the risk associated with putting money into one capital

1 investment versus a different one. In contrast, the risk to regulated, investor-owned  
2 utilities of energy efficiency investments is very low.

3 In sum, unregulated, for-profit companies have very different time preferences than  
4 regulated, investor-owned utilities, and these different time preferences dictate different  
5 discount rates.<sup>59</sup>

6 **Q Is the utility customer cost of capital an appropriate discount rate to use for**  
7 **assessing the cost-effectiveness of energy efficiency?**

8 **A** No. First, the cost of capital is only one factor that will influence a customer's time  
9 preference. Customers are interested in several aspects of utility services other than just  
10 the costs, such as reliability, resilience, price volatility, and power quality.<sup>60</sup> The value of  
11 these aspects is not reflected in a customer cost of capital.

12 Second, the customer cost of capital can vary widely across customer classes and within  
13 customer classes. Some commercial and industrial customers might have relatively low  
14 cost of capital, whereas residential customers might have higher cost of capital depending  
15 upon their financial circumstances. Low-income customers, who might have to rely upon  
16 credit card debt for new capital, might have a much higher cost of capital than an affluent  
17 homeowner who can get a second mortgage to get more capital. This higher cost of  
18 capital for low-income customers should not result in a higher discount rate for them,

<sup>59</sup> NSPM for EE, Section 9.5, page 77.

<sup>60</sup> NSPM for EE, Section 9.7.

1 because this would imply that the future value of low-income efficiency programs is  
2 lower than the future value of non-low-income efficiency programs, all else being equal.

3 Third, the regulatory perspective is generally aligned with the time preferences for all  
4 utility customers in aggregate. According to the NSPM for EE:

5 In some ways, the time preference from a regulatory perspective is  
6 aligned with utility customers' time preference. In both cases, time  
7 preference should be consistent with the objective of identifying those  
8 resources that will best serve customers. The time preference from the  
9 regulatory perspective, however, captures two additional considerations.  
10 First, regulators/other decision-makers have a responsibility to ensure that  
11 utility resources will meet applicable policy goals. Second, regulators  
12 have a responsibility to consider both current and future customer  
13 interests. For both of these reasons, the regulatory perspective should  
14 place a higher value on long-term costs and benefits than the utility  
15 customer perspective.<sup>61</sup>

16 **Q Is a social discount rate appropriate for assessing the cost-effectiveness of energy**  
17 **efficiency?**

18 **A** A social discount rate might be appropriate for assessing the cost-effectiveness of energy  
19 efficiency in some settings. As noted above, the discount rate should reflect the goal of  
20 the benefit-cost analysis, and that goal should reflect the energy policies of the state or  
21 jurisdiction. If the goals of the energy efficiency program are to achieve social benefits in  
22 addition to energy benefits (such as reduced bills for low-income customers, reduced  
23 criteria air emissions, reduced greenhouse gas emissions, reduced reliance upon imported

<sup>61</sup> NSPM for EE, Section 9.7, page 79.

1 fuels, or increased jobs in the state), then a social discount rate might be appropriate.  
2 Even if a social discount rate is not specifically chosen for the purpose, the discount rate  
3 used to assess energy efficiency programs could be chosen to be lower than it would  
4 otherwise be to reflect some of these societal goals.<sup>62</sup>

5 **Q In its procedural order issued in this docket on September 1, 2023, the Commission**  
6 **asks the Utilities to conduct several sensitivity analyses using different discount**  
7 **rates. One of the questions asked for a sensitivity based on the Discount Rate Policy**  
8 **of White House Circular A-94 of the Office of Management and Budget. The**  
9 **request asks the Utilities to “[r]e-run all B/C models using the 7 percent real (social)**  
10 **discount rate referred to in Section 8.c(3).” Is this an appropriate discount rate to**  
11 **use for the benefit-cost analyses of the NHSaves programs?**

12 **A** No, a 7 percent real discount rate is not appropriate for the benefit-cost analyses of the  
13 NHSaves program. This question misinterprets the guidance in Circular A-94 and has  
14 focused on a discount rate that is not relevant for regulated utility investments in energy  
15 efficiency resources.

16 **Q What is the scope and purpose of OMB Circular A-94?**

17 **A** OMB Circular A-94 provides guidance for benefit-cost analysis of federal programs, as  
18 indicated in the title of the circular.<sup>63</sup> This circular does not explicitly address the  
19 question of discount rates for benefit-cost analysis of regulated, investor-owned utilities  
20 or unregulated, for-profit companies. OMB Circular A-94 does, nonetheless, provide  
21 useful guidance on the choice of discount rates for certain types of benefit-cost analyses.

<sup>62</sup> NSPM for EE, Section 9.9, page 82.

<sup>63</sup> The U.S. Office of Management and Budget, *Circular A-94: Guidelines and Discount Rates for Benefit-Cost Analysis of Federal Programs* (OMB Circular A-94).

1 But it is critical to be careful in interpreting the guidance because it covers different types  
2 of benefit-cost analyses.

3 **Q Which type of benefit-cost analyses does OMB Circular A-94 address?**

4 **A** OMB Circular A-94 provides guidance on benefit-cost analyses for public investments,  
5 regulatory analyses, and various types of government spending. Public investments  
6 include programs that provide benefits and costs to the general public.<sup>64</sup> Regulatory  
7 analyses assess the costs and benefits imposed on society of government regulations,  
8 such as environmental regulations established by the U.S. Environmental Protection  
9 Agency.<sup>65</sup> Various government spending initiatives include internal government  
10 investments, asset sale analysis, and lease-purchase analyses.<sup>66</sup>

11 **Q Which type of investment does Section 8(c)3 of OMB Circular A-94 address?**

12 **A** Section 8.c(3) refers specifically to internal government investments, as indicated in the  
13 title of the section. This section recommends the use of a 7 percent real discount rate,  
14 based on the discussion in Section 8.b of the circular.

15 Section 8.b of the circular refers to public investments and regulatory analyses and  
16 explains that these “displace both *private* investment and consumption” (emphasis  
17 added). Here, the term “private” refers to non-governmental, non-public investments,  
18 which can include investments by for-profit companies or private individuals. For such

<sup>64</sup> OMB Circular A-94 Section 8(b).

<sup>65</sup> OMB Circular A-94 Section 8(b).

<sup>66</sup> OMB Circular A-94 Section 8(b).

1 private investments, a real discount rate of 7 percent might be appropriate if it reflects the  
2 time preferences of the investors. But the key issue here is that the perspective of private  
3 investors is not consistent with the regulatory perspective, as described above. Therefore,  
4 this guidance from OMB Circular A-94 should not be used to set the discount rate for the  
5 NHSaves program.

6 **Q Is there other guidance from OMB Circular A-94 that is relevant to this discussion**  
7 **of discount rates?**

8 **A** Yes. Sections 8c(1), 8c(2), and 8c(4) provide guidance on cost-effectiveness analyses in  
9 general, on lease-purchase analyses, and on asset sale analyses, respectively. Each of  
10 these sections recommend using a comparable-maturity US Treasury borrowing rate for a  
11 discount rate, which reflects a low-risk cost of capital. In this way, the US Treasury  
12 borrowing rate is comparable to the federal prime rate; they both represent low-risk  
13 investment options. In fact, the first part of Section 8c(3), the section referred to by the  
14 Commission request, also recommends the use of a comparable-maturity US Treasury  
15 rate for internal government investments. It is only in the instance of some federal  
16 activities that affect private investors where a 7 percent real discount rate is appropriate.

17 In sum, several sections of OMB Circular A-94 recommend using a low-risk discount  
18 rate, consistent with the discount rate used for the NHSaves program. Except in the case  
19 of government initiatives that affect private investors—a situation that does not apply to  
20 benefit-cost analyses of energy efficiency programs funded by customers of regulated  
21 utilities.

1       **Q Does a 7 percent real discount rate reflect a “social” discount rate, as indicated in**  
2       **the Commission’s request quoted above?**

3       **A** No. Social discount rates tend to be much lower than 7 percent because they generally  
4       reflect lower risks, lower costs of capital to society, a greater emphasis on long-term  
5       impacts, diverse societal perspectives, and relevant societal goals. Real social discount  
6       rates can vary significantly but tend to be in the range of roughly 3 percent to negative  
7       percent values.<sup>67</sup>

8       The OMB has another circular that provides guidance on social discount rates. OMB  
9       Circular A-4 provides guidance on many aspects of benefit-cost analysis of government  
10      regulations.<sup>68</sup> This circular includes some high-level guidance on setting discount rates  
11      for this purpose. This circular states that the real “rate of return on long-term U.S.  
12      government debt provides a fair approximation of the social rate of time preference” and  
13      that this should be the default approach for setting a social discount rate for government  
14      regulatory analysis.

15      Further, OMB Circular A-4 states that “it is advisable to carefully consider the types of  
16      effects that need to be discounted. Depending on the effects that you are analyzing, you  
17      may be discounting using rates reflecting either society’s perspective or a private entity’s  
18      perspective.”<sup>69</sup> This statement is consistent with our recommendation above that the  
19      choice of discount rate should reflect the objective of the benefit-cost analysis being

<sup>67</sup> NSPM for EE

<sup>68</sup> The U.S. Office of Management and Budget, *Circular A-4: Regulatory Analysis*, draft for public review, April 6, 2023 (OMB Circular A-4).

<sup>69</sup> OMB Circular A-4, Section 12.b.

1           conducted and consideration of the parties experiencing the costs and benefits. In this  
2           context, the regulatory perspective is most relevant.

3           **Q Given your answers above about the utility WACC, customer cost of capital, and**  
4           **the social discount rate, what do you think is the best discount rate to use for**  
5           **evaluating the energy efficiency programs in New Hampshire?**

6           **A** A low-risk discount rate is the best option for evaluating the New Hampshire energy  
7           efficiency programs. A low-risk discount rate is consistent with the goals of the energy  
8           efficiency programs, reflects the interests of all customers in aggregate, and is consistent  
9           with the regulatory perspective.

10          A low-risk discount rate can be determined using several indicators of risk. Some of the  
11          most common indicators of low risks are the U.S. prime interest rate and the interest rate  
12          on long-term US Treasury bonds. The Utilities choice of using the U.S. prime interest  
13          rate is a good choice for this purpose.

14          **Q Does this conclude your testimony?**

15          **A** Yes, it does.

## Tim Woolf, Senior Vice President

---

Synapse Energy Economics | 485 Massachusetts Avenue, Suite 3 | Cambridge, MA 02139 | 617-453-7031  
twoolf@synapse-energy.com

### PROFESSIONAL EXPERIENCE

**Synapse Energy Economics Inc.**, Cambridge, MA. *Senior Vice President*, 2019 – Present, *Vice President*, 2011 – 2019.

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, distributed energy resources, renewable resources and related policies, benefit-cost analysis, 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, including 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.

**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

## REPORTS

Synapse Energy Economics, Climable, Brown University Climate and Development Lab. 2023. *Power Play: Actions for New England's Equitable Energy Transition*. Full report. Climable.org.

Woolf, T., C. Lane, D. Goldberg, E. Camp, A. Takasugi, M. Chang, M. Whited, K. Parmenter, D. Violette. 2022. *Methods, Tools, and Resources: A Handbook for Quantifying Distributed Energy Resource Impacts for Benefit-Cost Analysis*. Synapse Energy Economics for the National Energy Screening Project.

Malone, E., D. Goldberg, S. Kwok, T. Woolf. 2022. *The Cape Light Compact's Low-Income Energy Efficiency Programs: Challenges and Opportunities*. Synapse Energy Economics for The Cape Light Compact.

Kallay, J., A. Napoleon, K. Takahashi, E. Sinclair, T. Woolf. 2021. *Opportunities for Evergy Kansas to Address Energy Equity Within its Integrated Resource Plan and Other Planning Processes*. Synapse Energy Economics for Union of Concerned Scientists.

Takahashi, K., T. Woolf, B. Havumaki, D. White, D. Goldberg, S. Kwok, A. Takasugi. 2021. *Missed Opportunities: The Impacts of Recent Policies on Energy Efficiency Programs in Midwestern States*. Synapse Energy Economics for the Midwest Energy Efficiency Alliance.

Liburd, S., E. Sinclair, T. Woolf, C. Roberto. 2021. *Hosting Capacity Analysis and Distribution Grid Data Security*. Synapse Energy Economics for the Northern Plains Resource Council.

Kallay, J., A. Napoleon, B. Havumaki, J. Hall, C. Odom, A. Hopkins, M. Whited, T. Woolf, M. Chang, R. Broderick, R. Jeffers, B. Garcia. 2021. *Performance Metrics to Evaluate Utility Resilience Investments*. Synapse Energy Economics for Sandia National Laboratories.

Kallay, J., S. Letendre, T. Woolf, B. Havumaki, S. Kwok, A. Hopkins, R. Broderick, R. Jeffers, K. Jones, M. DeMenno. 2021. *Application of a Standard Approach to Benefit-Cost Analysis for Electric Grid Resilience Investments*. Synapse Energy Economics for Sandia National Laboratories.

Woolf, T., B. Havumaki, S. Letendre, C. Odom, J. Hall. 2021. *Macroeconomic Impacts of the Rhode Island Community Remote Net Metering Program*. Synapse Energy Economics for the Rhode Island Division of Public Utilities and Carriers.

Woolf, T., D. Bhandari, C. Lane, J. Frost, B. Havumaki, S. Letendre, C. Odom. 2021. *Benefit-Cost Analysis of the Rhode Island Community Remote Net Metering Program*. Synapse Energy Economics for the Rhode Island Division of Public Utilities and Carriers.

Woolf, T., L. Schwartz, B. Havumaki, D. Bhandari, M. Whited. 2021. *Benefit-Cost Analysis for Utility-Facing Grid Modernization Investments: Trends, Challenges, and Considerations*. Prepared by Lawrence

Berkeley National Laboratory and Synapse Energy Economics for the Grid Modernization Laboratory Consortium of the U.S. Department of Energy.

National Energy Screening Project. 2020. *National Standard Practice Manual for Benefit-Cost Analysis of Distributed Energy Resources*. E4TheFuture, Synapse Energy Economics, Energy Futures Group, ICF, Pace Energy and Climate Center, Schiller Consulting, Smart Electric Power Alliance.

Glick, D., D. Bhandari, C. Roberto, T. Woolf. 2020. *Review of benefit-cost analysis for the EPA's proposed revisions to the 2015 Steam Electric Limitations Guidelines*. Synapse Energy Economics for Earthjustice and Environmental Integrity Project.

Knight, P., E. Camp, D. Bhandari, J. Hall, M. Whited, B. Havumaki, A. Allison, N. Peluso, T. Woolf. 2019. *Making Electric Vehicles Work for Utility Customers: A Policy Handbook for Consumer Advocates*. Synapse Energy Economics for the Energy Foundation.

Napoleon, A., B. Havumaki, D. Bhandari, T. Woolf. 2019. *Review of New Brunswick Power's Application for Approval of an Advanced Metering Infrastructure Capital Project: In the Matter of the New Brunswick Power Corporation and Section 107 of the Electricity Act; Matter No. 452*. Synapse Energy Economics for the New Brunswick Energy and Utilities Board Staff.

Malone, E., T. Woolf, S. Letendre. 2019. *New Hampshire Cost-Effectiveness Review: Application of the National Standard Practice Manual to New Hampshire*. Synapse Energy Economics for the New Hampshire Evaluation, Measurement, and Verification Working Group.

Havumaki, B., J. Kallay, K. Takahashi, T. Woolf. 2019. *All-Electric Solid Oxide Fuel Cells as an Energy Efficiency Measure*. Synapse Energy Economics for Bloom Energy.

Takahashi, K., B. Havumaki, J. Kallay, T. Woolf. 2019. *Bloom Fuel Cells: A Cost-Effectiveness Brief*. Synapse Energy Economics for Bloom Energy.

Napoleon, A., D. Goldberg, K. Takahashi, T. Woolf. 2019. *An Assessment of Prince Edward Island Energy Corporations' 2018 - 2021 Energy Efficiency and Conservation Plan*. Synapse Energy Economics for Carr, Stevenson and MacKay as Counsel to the Island Regulatory and Appeals Commission.

Camp, E., B. Fagan, J. Frost, D. Glick, A. Hopkins, A. Napoleon, N. Peluso, K. Takahashi, D. White, R. Wilson, T. Woolf. 2018. *Phase 1 Findings on Muskrat Falls Project Rate Mitigation*. Synapse Energy Economics for Board of Commissioners of Public Utilities, Province of Newfoundland and Labrador.

Malone, E., T. Woolf, D. Goldberg. 2018. *Updating the Energy Efficiency Cost-Effectiveness Framework in Minnesota: Application of the National Standard Practice Manual to Minnesota*. Conservation Applied Research and Development (CARD) Report. Synapse Energy Economics for Minnesota Department of Commerce, Division of Energy Resources.

White, D., K. Takahashi, A. Napoleon, T. Woolf. 2018. *Value of Energy Efficiency in New York: Assessment of the Range of Benefits of Energy Efficiency Programs*. Synapse Energy Economics for Natural Resources Defense Council.

Fisher, J., M. Whited, T. Woolf, D. Goldberg. 2018. *Utility Investments for Market Transformation: How Utilities Can Help Achieve Energy Policy Goals*. Synapse Energy Economics for Energy Foundation.

Woolf, T., A. Hopkins, M. Whited, K. Takahashi, A. Napoleon. 2018. *Review of New Brunswick Power's 2018/2019 Rate Case Application*. In the Matter of the New Brunswick Power Corporation and Section 103(1) of the Electricity Act Matter No. 375. Synapse Energy Economics for the New Brunswick Energy and Utilities Board Staff.

Woolf, T., C. Neme, M. Kushler, S. R. Schiller, T. Eckman. 2017. *National Standard Practice Manual for Assessing Cost-Effectiveness of Energy Efficiency Resources*. Edition 1, Spring 2017. Prepared by the National Efficiency Screening Project.

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.

Raab Associates and Synapse Energy Economics. 2017. *Grid Modernization in New Hampshire: Report to the New Hampshire Public Utilities Commission*. Prepared by the New Hampshire Grid Modernization Working Group. March 20, 2017.

Woolf, T. 2016. *Expert Report: Rate Mechanism, Reconciliation of Provisional Rates, Energy Efficiency Rider*. Prepared for Puerto Rico Energy Commission regarding Matter No. CEPR-AP-2015-0001, November 21, 2016.

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.

Fisher, J., A. Horowitz, J. Migden-Ostrander, T. Woolf. 2016. *Puerto Rico Electric Power Authority's 2015 Integrated Resource Plan*. Synapse Energy Economics for Puerto Rico Energy Commission.

Woolf, T., A. Napoleon, P. Luckow, W. Ong, K. Takahashi. 2016. *Aiming Higher: Realizing the Full Potential of Cost-Effective Energy Efficiency in New York*. Synapse Energy Economics for Natural Resources Defense Council, E4TheFuture, CLEAResult, Lime Energy, Association for Energy Affordability, and Alliance for Clean Energy New York.

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. Synapse Energy Economics on behalf of Natural Resources Defense Council and Pace Energy and Climate Center. August 21, 2015, September 10, 2015, October 26, 2015, November 23, 2015, December 7, 2015, and January 6, 2016.

Kallay, J., K. Takahashi, A. Napoleon, T. Woolf. 2015. *Fair, Abundant, and Low-Cost: A Handbook for Using Energy Efficiency in Clean Power Plan Compliance*. Synapse Energy Economics for the Energy Foundation.

Woolf, T., K. Takahashi, E. Malone, A. Napoleon, J. Kallay. 2015. *Ontario Gas Demand-Side Management 2016-2020 Plan Review*. Synapse Energy Economics for the Ontario Energy Board.

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

Woolf, T., E. Malone, F. Ackerman. 2014. *Cost-Effectiveness Screening Principles and Guidelines for Alignment with Policy Goals, Non-Energy Impacts, Discount Rates, and Environmental Compliance Costs*. Synapse Energy Economics for Northeast Energy Efficiency Partnerships (NEEP) Regional Evaluation, Measurement and Verification Forum.

Woolf, T., E. Malone, C. Neme. 2014. *Regulatory Policies to Support Energy Efficiency in Virginia*. Synapse Energy Economics and Energy Futures Group for the Virginia Energy Efficiency Council.

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.

Woolf, T., E. Malone, J. Kallay. 2014. *Rate and Bill Impacts of Vermont Energy Efficiency Programs*. Synapse Energy Economics for the Vermont Public Service Department.

Woolf, T., C. Neme, P. Stanton, R. LeBaron, K. Saul-Rinaldi, S. Cowell. 2014. *The Resource Value Framework: Reforming Energy Efficiency Cost-Effectiveness Screening*. The National Efficiency Screening Project for the National Home Performance Council.

Malone, E., T. Woolf, K. Takahashi, S. Fields. 2013. "Appendix D: Energy Efficiency Cost-Effectiveness Tests." *Readying Michigan to Make Good Energy Decisions: Energy Efficiency*. Synapse Energy Economics for the Council of Michigan Foundations.

Stanton, E. A., S. Jackson, G. Keith, E. Malone, D. White, T. Woolf. 2013. *A Clean Energy Standard for Massachusetts*. Synapse Energy Economics for the Massachusetts Clean Energy Center and the Massachusetts Departments of Energy Resources, Environmental Protection, and Public Utilities.

Woolf, T., K. Saul-Rinaldi, R. LeBaron, S. Cowell, P. Stanton. 2013. *Recommendations for Reforming Energy Efficiency Cost-Effectiveness Screening in the United States*. Energy Efficiency Screening Coalition for the National Home Performance Council.

Woolf, T., E. Malone, J. Kallay, K. Takahashi. 2013. *Energy Efficiency Cost-Effectiveness Screening in the Northeast and Mid-Atlantic States*. Synapse Energy Economics for Northeast Energy Efficiency Partnerships, Inc. (NEEP).

Raab Associates and Synapse Energy Economics. 2013. *Massachusetts Electric Grid Modernization Stakeholder Working Group Process: Report to the Department of Public Utilities from the Steering Committee*. Prepared for the Massachusetts Department of Public Utilities. DPU 12-76.

Jackson, S., P. Peterson, D. Hurley, T. Woolf. 2013. *Forecasting Distributed Generation Resources in New England: Distributed Generation Must Be Properly Accounted for in Regional System Planning*. Synapse Energy Economics for E4 Group.

Woolf, T., E. Malone, L. Schwartz, J. Shenot. 2013. *A Framework for Evaluating the Cost-Effectiveness of Demand Response*. Synapse Energy Economics and Regulatory Assistance Project for the National Forum on the National Action Plan on Demand Response: Cost-effectiveness Working Group.

Woolf, T., W. Steinhurst, E. Malone, K. Takahashi. 2012. *Energy Efficiency Cost-Effectiveness Screening: How to Properly Account for 'Other Program Impacts' and Environmental Compliance Costs*. Synapse Energy Economics for Regulatory Assistance Project and Vermont Housing Conservation Board.

Woolf, T., M. Whited, T. Vitolo, K. Takahashi, D. White. 2012. *Indian Point Replacement Analysis: A Clean Energy Roadmap. A Proposal for Replacing the Nuclear Plant with Clean, Sustainable Energy Resource*. Synapse Energy Economics for Natural Resources Defense Council (NRDC) and Riverkeeper.

Keith, G., T. Woolf, K. Takahashi. 2012. *A Clean Electricity Vision for Long Island: Supplying 100% of Long Island's Electricity Needs with Renewable Power*. Synapse Energy Economics for Renewable Energy Long Island.

Woolf, T. 2012. *Best Practices in Energy Efficiency Program Screening: How to Ensure that the Value of Energy Efficiency is Properly Accounted For*. Synapse Energy Economics for National Home Performance Council.

Woolf, T., J. Kallay, E. Malone, T. Comings, M. Schultz, J. Conyers. 2012. *Commercial & Industrial Customer Perspectives on Massachusetts Energy Efficiency Programs*. Synapse Energy Economics for the Massachusetts Energy Efficiency Advisory Council.

Woolf, T., M. Wittenstein, R. Fagan. 2011. *Indian Point Energy Center Nuclear Plant Retirement Analysis*. Synapse Energy Economics for Natural Resources Defense Council (NRDC) and Riverkeeper.

Woolf, T., V. Sabodash, B. Biewald. 2011. *Equipment Price Forecasting in Energy Conservation Standards Analysis*. Synapse Energy Economics for Appliance Standards Awareness Project and Natural Resources Defense Council (NRDC).

Johnston, L., E. Hausman, A. Sommer, B. Biewald, T. Woolf, D. Schlissel, A. Rochelle, D. White. 2007. *Climate Change and Power: Carbon Dioxide Emission Costs and Electricity Resource Planning*. Synapse Energy Economics for Tallahassee Electric Utility.

Woolf, T. 2007. *Cape Light Compact Energy Efficiency Plan 2007-2012: Providing Comprehensive Energy Efficiency Services to Communities on Cape Cod and Martha's Vineyard*. Synapse Energy Economics for the Cape Light Compact.

Woolf, T. 2007. *Review of the District of Columbia Reliable Energy Trust Fund and Natural Gas Trust Fund Working Group and Regulatory Processes*. Synapse Energy Economics for the District of Columbia Office of People's Counsel.

Woolf, T. 2006. *Cape Light Compact Annual Report on Energy Efficiency Activities in 2005*. Synapse Energy Economics for the Cape Light Compact, submitted to the Massachusetts Department of Telecommunications and Energy and the Massachusetts Division of Energy Resources.

Steinhurst, W., T. Woolf, A. Sommer, K. Takahashi, P. Chernick, J. Wallach. 2006. *Integrated Portfolio Management in a Restructured Supply Market*. Synapse Energy Economics and Resource Insight for the Ohio Office of Consumer Counsel.

Peterson, P., D. Hurley, T. Woolf, B. Biewald. 2006. *Incorporating Energy Efficiency into the ISO-New England Forward Capacity Market*. Synapse Energy Economics for Conservation Services Group.

Woolf, T., D. White, C. Chen, A. Sommer. 2005. *Potential Cost Impacts of a Renewable Portfolio Standard in New Brunswick*. Synapse Energy Economics for New Brunswick Department of Energy.

Woolf, T., K. Takahashi, G. Keith, A. Rochelle, P. Lyons. 2005. *Feasibility Study of Alternative Energy and Advanced Energy Efficiency Technologies for Low-Income Housing in Massachusetts*. Synapse Energy Economics and Zapotec Energy for the Low-Income Affordability Network, Action for Boston Community Development, and Action Inc.

Woolf, T. 2005. *The Cape Light Compact Energy Efficiency Plan: Phase III 2005-2007: Providing Comprehensive Energy Efficiency Services to Communities on Cape Cod and Martha's Vineyard*. Synapse Energy Economics for the Cape Light Compact.

Woolf, T. 2004. *Review of Avoided Costs Used in Minnesota Electric Utility Conservation Improvement Programs*. Synapse Energy Economics for the Minnesota Office of Legislative Auditor.

Woolf, T. 2004. *NEEP Strategic Initiative Review: Qualitative Assessment and Initiative Ranking for the Residential Sector*. Synapse Energy Economics for Northeast Energy Efficiency Partnerships, Inc.

Woolf, T. 2004. *A Balanced Energy Plan for the Interior West*. Synapse Energy Economics, West Resource Advocates, and Tellus Institute for the Hewlett Foundation Energy Series.

Steinhurst, W., P. Chernick, T. Woolf, J. Plunkett, C. Chen. 2003. *OCC Comments on Alternative Transitional Standard Offer*. Synapse Energy Economics for the Connecticut Office of Consumer Counsel.

Woolf, T. 2003. *Potential Cost Impacts of a Vermont Renewable Portfolio Standard*. Synapse Energy Economics for Vermont Public Service Board, presented to the Vermont RPS Collaborative.

Biewald, B., T. Woolf, A. Rochelle, W. Steinhurst. 2003. *Portfolio Management: How to Procure Electricity Resources to Provide Reliable, Low-Cost, and Efficient Electricity Services to All Retail Customers*. Synapse Energy Economics for Regulatory Assistance Project and Energy Foundation.

Woolf, T., G. Keith, D. White, M. Drunsić, M. Ramiro, J. Ramey, J. Levy, P. Kinney, S. Greco, K. Knowlton, B. Ketcham, C. Komanoff, D. Gutman. 2003. *Air Quality in Queens: Cleaning Up the Air in Queens County and Neighboring Regions*. Synapse Energy Economics, Konheim & Ketcham, and Komanoff Energy Associates for Natural Resources Defense Council (NRDC), Keyspan Energy, and the Coalition Helping to Organize a Kleaner Environment.

Chen, C., D. White, T. Woolf, L. Johnston. 2003. *The Maryland Renewable Portfolio Standard: An Assessment of Potential Cost Impacts*. Synapse Energy Economics for the Maryland Public Interest Research Group.

Woolf, T. 2003. *The Cape Light Compact Energy Efficiency Plan: Phase II 2003 – 2007: Providing Comprehensive Energy Efficiency Services to Communities on Cape Cod and Martha's Vineyard*. Synapse Energy Economics, Cort Richardson, Vermont Energy Investment Corporation, and Optimal Energy Incorporated for the Cape Light Compact.

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.

Woolf, T. 2002. *The Energy Efficiency Potential in Williamson County, Tennessee: Opportunities for Reducing the Need for Transmission Expansion*. Synapse Energy Economics for the Harpeth River Watershed Association and the Southern Alliance for Clean Energy.

Woolf, T. 2002. *Electricity Restructuring Activities in the US: A Survey of Selected States*. Synapse Energy Economics for Arizona Corporation Commission Utilities Division Staff.

Woolf, T. 2002. *Powering the South: A Clean and Affordable Energy Plan for the Southern United States*. Synapse Energy Economics with and for the Renewable Energy Policy Project and a coalition of Southern environmental advocates.

Johnston, L., G. Keith, T. Woolf, B. Biewald, E. Gonin. 2002. *Survey of Clean Power and Energy Efficiency Programs*. Synapse Energy Economics for the Ozone Transport Commission.

Woolf, T. 2001. *Proposal for a Renewable Portfolio Standard for New Brunswick*. Synapse Energy Economics for the Conservation Council of New Brunswick, presented to the New Brunswick Market Design Committee.

Woolf, T., G. Keith, D. White, F. Ackerman. 2001. *A Retrospective Review of FERC's Environmental Impact Statement on Open Transmission Access*. Synapse Energy Economics and the Global Development and Environmental Institute for the North American Commission for Environmental Cooperation, with the Global Development and Environment Institute.

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.

Woolf, T. 2000. *The Cape Light Compact Energy Efficiency Plan: Providing Comprehensive Energy Efficiency Services to Communities on Cape Cod and Martha's Vineyard*. Synapse Energy Economics for the Cape Light Compact.

Woolf, T., B. Biewald. 1999. *Market Distortions Associated With Inconsistent Air Quality Regulations*. Synapse Energy Economics for the Project for a Sustainable FERC Energy Policy.

Woolf, T., B. Biewald, D. Glover. 1998. *Competition and Market Power in the Northern Maine Electricity Market*. Synapse Energy Economics and Failure Exponent Analysis for the Maine Public Utilities Commission.

Woolf, T. 1998. *New England Tracking System*. Synapse Energy Economics for the New England Governors' Conference, with Environmental Futures and Tellus Institute.

Woolf, T., D. White, B. Biewald, W. Moomaw. 1998. *The Role of Ozone Transport in Reaching Attainment in the Northeast: Opportunities, Equity and Economics*. Synapse Energy Economics and the Global Development and Environment Institute for the Northeast States for Coordinated Air Use Management.

Biewald, B., D. White, T. Woolf, F. Ackerman, W. Moomaw. 1998. *Grandfathering and Environmental Comparability: An Economic Analysis of Air Emission Regulations and Electricity Market Distortions*. Synapse Energy Economics and the Global Development and Environment Institute for the National Association of Regulatory Utility Commissioners.

Biewald, B., T. Woolf, P. Bradford, P. Chernick, S. Geller, J. Oppenheim. 1997. *Performance-Based Regulation in a Restructured Electric Industry*. Synapse Energy Economics, Resource Insight, and the National Consumer Law Center for the National Association of Regulatory Utility Commissioners.

Biewald, B., T. Woolf, M. Breslow. 1997. *Massachusetts Electric Utility Stranded Costs: Potential Magnitude, Public Policy Options, and Impacts on the Massachusetts Economy*. Synapse Energy Economics for the Union of Concerned Scientists, MASSPIRG, and Public Citizen.

Woolf, T. 1997. *The Delaware Public Service Commission Staff's Report on Restructuring the Electricity Industry in Delaware*. Tellus Institute for The Delaware Public Service Commission Staff. Tellus Study No. 96-99.

Woolf, T. 1997. *Preserving Public Interest Obligations Through Customer Aggregation: A Summary of Options for Aggregating Customers in a Restructured Electricity Industry*. Tellus Institute for The Colorado Office of Energy Conservation. Tellus Study No. 96-130.

Woolf, T. 1997. *Zero Carbon Electricity: the Essential Role of Efficiency and Renewables in New England's Electricity Mix*. Tellus Institute for The Boston Edison Settlement Board. Tellus Study No. 94-273.

Woolf, T. 1997. *Regulatory and Legislative Policies to Promote Renewable Resources in a Competitive Electricity Industry*. Tellus Institute for The Colorado Governor's Office of Energy Conservation. Tellus Study No. 96-130-A5.

Woolf, T. 1996. *Can We Get There From Here? The Challenge of Restructuring the Electricity Industry So That All Can Benefit*. Tellus Institute for The California Utility Consumers' Action Network. Tellus Study No. 95-208.

Woolf, T. 1995. *Promoting Environmental Quality in a Restructured Electric Industry*. Tellus Institute for The National Association of Regulatory Utility Commissioners. Tellus Study No. 95-056.

Woolf, T. 1995. *Systems Benefits Funding Options*. Tellus Institute for Wisconsin Environmental Decade. Tellus Study No. 95-248.

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

Woolf, T., B. Biewald. 1995. *Electric Resource Planning for Sustainability*. Tellus Institute for the Texas Sustainable Energy Development Council. Tellus Study No. 94-114.

## TESTIMONY

**Public Utilities Commission of New Hampshire (Docket No. DE 20-161):** Direct Testimony of Tim Woolf and Ben Havumaki regarding Eversource's 2020 least-cost integrated resource plan. On behalf of the Office of the Consumer Advocate. August 19, 2022.

**Colorado Public Utilities Commission (Proceeding No. 19AL-0687E):** Cross-answer testimony and attachments of Tim Woolf regarding the need for a customer opt-out provision in Public Service Company of Colorado's proposed TOU rates plan. On behalf of Energy Outreach Colorado. May 21, 2020.

**Colorado Public Utilities Commission (Proceeding No. 19AL-0687E):** Answer testimony and attachments of Tim Woolf regarding Public Service Company of Colorado's proposal to establish mandatory Modified RE-TOU rates for residential customers. On behalf of Energy Outreach Colorado. April 24, 2020.

**New York Public Service Commission (Cases 19-E-0065 and 19-G-0066):** Direct testimony of Tim Woolf and Alice Napoleon regarding energy efficiency targets and incentives in Con Edison rate case. On behalf of the Natural Resources Defense Council. May 24, 2019.

**Virginia State Corporation Commission (Case No. PUR-2018-00168):** Direct testimony of Tim Woolf and Erin Malone regarding Virginia Electric and Power Company's application for approval to implement demand-side management programs and for approval of two updated rate adjustment clauses. On behalf of the Sierra Club. February 6, 2019.

**Rhode Island Public Utilities Commission (Docket No. 4780):** Direct testimony of Tim Woolf and Melissa Whited regarding National Grid's Power Sector Transformation proposals. On behalf of the Rhode Island Division of Public Utilities and Carriers. April 28, 2018.

**Rhode Island Public Utilities Commission (Docket No. 4770):** Direct testimony of Tim Woolf regarding National Grid's rate case. On behalf of the Rhode Island Division of Public Utilities and Carriers. April 6, 2018.

**Rhode Island Public Utilities Commission (Docket No. 4770):** Direct testimony of Tim Woolf and Melissa Whited regarding National Grid's proposed performance incentive mechanisms, benefit-cost analyses, and request for recovery of costs for its Advanced Metering Functionality study and distributed energy resources enablement investments. On behalf of the Rhode Island Division of Public Utilities and Carriers. April 6, 2018.

**Rhode Island Public Utilities Commission (Docket No. 4783):** Direct testimony of Tim Woolf and Melissa Whited regarding National Grid's Advanced Metering Functionality Pilot. On behalf of the Rhode Island Division of Public Utilities and Carriers. February 22, 2018.

**New York Public Service Commission (Case 17-E-0459):** Direct testimony of Tim Woolf regarding Energy Efficiency Earnings Adjustment Mechanisms proposed by Central Hudson Gas & Electric Company. On behalf of Natural Resources Defense Council. November 21, 2017.

**New York Public Service Commission (Case 17-E-0238):** Direct and rebuttal testimony of Tim Woolf and Melissa Whited regarding Earnings Adjustment Mechanisms proposed by National Grid. On behalf of Advanced Energy Economy Institute. August 25 and September 15, 2017.

**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 Regroupement 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 (31-098E):** 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

Malone, E., T. Woolf, D. Goldberg. 2019. "Assessing Resource Cost Effectiveness." *A.E.S.P. Magazine*, 2019 Edition, 8-10.

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. B Havumaki. 2022. "Economic Assessment of Grid Modernization Plans." Presentation at the NASUCA 2022 Mid-Year Meeting.
- Woolf, T. 2019. "Benefit-Cost Analysis for Utility-Facing Grid Modernization Investments." Distribution Systems and Planning Training for Mid-Atlantic Region and NARUC-NASEO Task Force on Comprehensive Electricity Planning. March 7-8, 2019.
- Woolf, T. 2018. Stakeholder presentation on "Updating the Energy Efficiency Cost-Effectiveness Framework in Minnesota: Application of the National Standard Practice Manual to Minnesota." Synapse Energy Economics project for Minnesota Department of Commerce, Division of Energy Resources, supported by the Conservation Applied Research and Development (CARD) Program. St. Paul, Minnesota. September 2018.
- Woolf, T. 2018. "Benefit-Cost Analysis for Investments in the Modern Grid: Recent trends in how to determine whether grid modernization investments will deliver value to customers." Smart Money Panel, NARUC Summer Policy Summit. Scottsdale, Arizona.
- Woolf, T. 2018. "Benefit-Cost Analysis for New York Energy Investments." Training Session for Earthjustice.

- Woolf, T. 2018. "National Standard Practice Manual for Energy Efficiency Cost-Effectiveness." Presentation at the NASUCA 2018 Mid-Year Meeting.
- Woolf, T. 2018. "The National Standard Practice Manual and the Value of Energy Efficiency in New York." Presentation on behalf of the Natural Resources Defense Council at the Stakeholder Forum, Case 18-M-0084.
- 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. "3<sup>rd</sup> Annual 21<sup>st</sup> 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.
- Woolf, 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 7<sup>th</sup> 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.

Woolf, 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.

*Resume updated July 2023*

## Danielle Goldberg, Senior Associate

---

Synapse Energy Economics | 485 Massachusetts Avenue, Suite 3 | Cambridge, MA 02139 | 617-453-7063  
dgoldberg@synapse-energy.com

### PROFESSIONAL EXPERIENCE

**Synapse Energy Economics Inc.**, Cambridge, MA. *Senior Associate*, April 2022 – Present, *Associate*, April 2019 – April 2022, *Research Associate*, February 2017 – March 2019

- Conducts research and provides consulting on energy sector issues, with a focus on data, programs, policies, and technologies related to energy efficiency, electrification, and electricity generation.
- Analyzes ratepayer-funded energy efficiency and other distribute energy resource programs across North America for best practices in cost-effectiveness testing and program design.
- Develops and evaluates cost-benefit analyses and other Excel-based models for energy efficiency programs and technologies.
- Manages client-facing projects to ensure valuable, complete, timely, and on-budget deliverables.
- Builds user-friendly benefit-cost models. Recent examples include models for Vermont Gas (VGS) for compliance with its most recent Public Utility Commission order and for the Maine Governor's Office to evaluate potential successor utility-scale distributed generation incentive programs.
- Serves as expert witness regarding ratepayer-funded energy efficiency plans on behalf of the consumer advocate offices in New Hampshire and Kansas.
- Leads the development of interactive tools such as Green Dash Northeast (funded by the Barr Foundation) and the Water Affordability Business Case Tool (by Roger Colton and the Natural Resources Defense Council).
- Leads internal Microsoft Excel trainings.
- Presented publication (New England Electrification Load Forecast) at American Council for an Energy Efficiency Economy (ACEEE) 2020 Summer Study.
- Provides extensive regulatory and data support to the Cape Light Compact.

**Helping Overcome Obstacles Peru**, Arequipa, Peru. *School Coordinator, English Teacher*, May 2016 – July 2016

- Managed daily operation of the school and organized school functions, including assemblies and field trips.
- Developed and led custom lesson plans to teach English to children ages 3-6.
- Acted as liaison between office staff, volunteers, and parents, communicating in both Spanish and English.

## EDUCATION

**Northeastern University**, Boston, MA

Bachelor of Science in Mechanical Engineering, 2016. *Cum Laude*.

Mechanical Engineering Co-ops: Allen Medical Systems (2015), Bose Corporation (2014), Amphenol Alden Products (2013)

## PUBLICATIONS

Goldberg, D., S. Chavin, J. Taberbero, P.Knight. 2023. *Green Dash Northeast: state-level data on emissions and energy in the Northeast*. Synapse Energy Economics for Barr Foundation.

Woolf, T., C. Lane, D. Goldberg, E. Camp, A. Takasugi, M. Chang, M. Whited, K. Parmenter, D. Violette. 2022. *Methods, Tools, and Resources: A Handbook for Quantifying Distributed Energy Resource Impacts for Benefit-Cost Analysis*. Synapse Energy Economics for the National Energy Screening Project.

Malone, E., D. Goldberg, S. Kwok, T. Woolf. 2022. *The Cape Light Compact's Low-Income Energy Efficiency Programs: Challenges and Opportunities*. Synapse Energy Economics for The Cape Light Compact.

Takahashi, K., T. Woolf, B. Havumaki, D. White, D. Goldberg, S. Kwok, A. Takasugi. 2021. *Missed Opportunities: The Impacts of Recent Policies on Energy Efficiency Programs in Midwestern States*. Synapse Energy Economics for the Midwest Energy Efficiency Alliance.

Takahashi, K., E. Sinclair, A. Napoleon, A.S. Hopkins, D. Goldberg. 2021. *Evaluation of EnergyWise Low-Income Energy Efficiency Program in Mississippi – Program Performance, Design, and Implications for Low-Income Efficiency Programs*. Synapse Energy Economics for Sierra Club and Gulf Coast Community Foundation.

Eash-Gates, P., K. Takahashi, D. Goldberg, A.S. Hopkins, S. Kwok. 2021. *Boston Building Emissions Performance Standard: Technical Methods Overview*. Synapse Energy Economics for the City of Boston.

Goldberg, D., J. Frost, D. Hurley, K. Takahashi. 2020. *New England Electrification Load Forecast*. Synapse Energy Economics for E4TheFuture.

Takahashi, K., J. Frost, D. Goldberg, A. S. Hopkins, K. Nishio, K. Nakano. 2020. *Survey of U.S. State and Local Building Decarbonization Policies and Programs*. Presented at the 2020 ACEEE Summer Study of Energy Efficiency in Buildings.

Malone, E., T. Woolf, D. Goldberg. 2019. "Assessing Resource Cost Effectiveness." *A.E.S.P. Magazine*, 2019 Edition, 8-10.

Napoleon, A., D. Goldberg, K. Takahashi, T. Woolf. 2019. *An Assessment of Prince Edward Island Energy Corporations' 2018 - 2021 Energy Efficiency and Conservation Plan*. Synapse Energy Economics for Carr, Stevenson and MacKay as Counsel to the Island Regulatory and Appeals Commission.

Malone, E., D. Goldberg, J. Frost. 2018. *Database of State Efficiency Screening Practices (DSESP): A Resource of the NESP*. Synapse Energy Economics for E4TheFuture.

Knight, P., D. Goldberg, E. Malone, A. S. Hopkins, D. Hurley. 2018. *Getting SMART: Making sense of the Solar Massachusetts Renewable Target (SMART) program*. Prepared for Cape Light Compact.

Malone, E., T. Woolf, D. Goldberg. 2018. *Updating the Energy Efficiency Cost-Effectiveness Framework in Minnesota: Application of the National Standard Practice Manual to Minnesota*. Conservation Applied Research and Development (CARD) Report. Synapse Energy Economics for Minnesota Department of Commerce, Division of Energy Resources.

Fisher, J., M. Whited, T. Woolf, D. Goldberg. 2018. *Utility Investments for Market Transformation: How Utilities Can Help Achieve Energy Policy Goals*. Synapse Energy Economics for Energy Foundation.

A. Hopkins, PhD, K. Takahashi, D. Goldberg. 2018. *Strategic Electrification Webinar*. Synapse Energy Economics.

D. Goldberg, E. Malone, J. Kallay, K. Takahashi. 2018. *Blog post: Switch on the Savings: A Heat Pump Cost-Effectiveness Study*. Synapse Energy Economics.

D. Goldberg, J. Kallay. 2017. *Blog post: Energy Efficiency Programs Plan for Post LED Success*. Synapse Energy Economics.

## TESTIMONY

**Corporation Commission of Kansas (Docket No. 22-EKME-254-TAR):** Direct Testimony of Danielle Goldberg regarding recommendations for future improvements to Evergy's Demand-Side Management Portfolios. June 17, 2022.

**New Hampshire Public Utilities Commission (Docket No. DE 20-092):** Direct Testimony of Courtney Lane and Danielle Goldberg regarding the NHSaves 2021-2023 Triennial Energy Efficiency Plan and the importance of ratepayer funded energy efficiency programs. On behalf of the Office of the Consumer Advocate. April 19, 2022.

## TESTIMONY ASSISTANCE

**Illinois Commerce Commission (Docket No. 18-0211):** Direct Testimony of Max Chang regarding Ameren Illinois Company's voltage optimization plan and the importance of prioritizing low-income communities. On behalf of the People of the State of Illinois, represented by the Office of the Illinois Attorney General. March 7, 2018.

**Commonwealth of Massachusetts Appellate Tax Board (Docket No. C331142):** Expert report by Max Chang on the process of steam generation and distribution under the Commonwealth of Massachusetts' definition for manufacturing. On behalf of the City of Boston. January 11, 2018.

*Resume updated July 2023*