David I. Poch Barrister tel. (613) 264-0055 fax (613) 264-2878

19 March 2018

BY EMAIL AND RESS

Ms. Kirsten Walli
Board Secretary
Ontario Energy Board
2300 Yonge Street, Suite 2700, P.O. Box 2319
Toronto, Ontario M4P 1E4

Dear Ms. Walli:

Re: EB-2017-0224 – Enbridge Gas Distribution Inc. ("Enbridge")
EB-2017-0255 – Union Gas Limited ("Union")
2018 Cap and Trade Compliance Plans

Attached please find the evidence of Chris Neme filed on behalf of the Green Energy Coalition and Environmental Defence pursuant to *Procedural Order #3*.

Sincerely,

David Poch

cc: Parties in this proceeding

1649 Old Brooke Road, Maberly, Ontario K0H 2B0 e-mail: dpoch@eelaw.ca

Exhibit L

Before the Ontario Energy Board

EB-2017-0224 and EB-2017-0255

Direct Testimony of:

CHRIS NEME
Energy Futures Group

For:

Green Energy Coalition
Environmental Defence

March 19, 2018

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I. Introduction, Qualifications and Purpose of Testimony

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

A: My name is Chris Neme. I am a co-founder and Principal of Energy Futures Group, a consulting firm that provides specialized expertise on energy efficiency and renewable energy markets, programs and policies. My business address is P.O. Box 587, Hinesburg, Vermont 05461.

Q: Please summarize your business and professional experience.

A: As a Principal of Energy Futures Group, I play lead roles in a variety of energy efficiency consulting projects. Recent examples include:

- Serving as an appointed expert representative on the Ontario Energy Board's (OEB's) Evaluation and Audit Committee for natural gas demand-side management, as well as on OEB advisory committees for the 2016 Ontario gas efficiency potential study and the 2017 Marginal Abatement Cost Curve study;
- Advising and appearing as an expert witness sponsored by the Green Energy Coalition in numerous Ontario gas DSM proceedings since the early 1990s, as well as serving (via election by a broad range of Ontario stakeholders) on various Enbridge and Union Gas evaluation and audit committees since 2000;
- Serving on a five-person national drafting committee for development of a new National Standard Practice Manual for cost-effectiveness screening of energy efficiency measures, programs and portfolios, which was published in May 2017, and subsequently presenting the Manual to and advising a range of parties (including regulators) on its application;

- Helping Green Mountain Power, Vermont's sole investor-owned electric utility, to develop its plan to meet recent state requirements to reduce customers direct consumption of fossil fuels, as well as in forecasting the long-term potential for strategic electrification;

- Representing the Natural Resource Defense Council (NRDC) in consultations with utilities and other parties in Michigan, Illinois and Ohio on efficiency program and portfolio design, cost-effectiveness screening, evaluation, and other related topics;

- Helping the National Association of Regulatory Utility Commissioners and the Michigan Public Service Commission staff assess the relative merits of alternative approaches to defining savings goals for utility efficiency programs (focusing on lifetime rather than just first year savings);

- Serving on the Management Committee and leading strategic planning and program design for a team of firms that was hired by the New Jersey Board of Public Utilities to deliver the electric and gas utility-funded New Jersey Clean Energy Programs;

- Leading a project for the Northeast Energy Efficiency Partnerships (NEEP) to document lessons learned from utility and other efforts across the United States over the past 25 years to use geographically targeted efficiency programs to cost-effectively defer capital investment in transmission and/or distribution system infrastructure; and

- Drafting policy reports for the Regulatory Assistance Project on a variety of energy efficiency and related regulatory issues, such as whether 30% electric savings is achievable in ten years, design considerations for possible European efficiency feed-in-tariffs, and the history of bidding of efficiency resources into the PJM and New England capacity markets.

Prior to co-founding Energy Futures Group in 2010, I worked for 17 years for the Vermont Energy Investment Corporation ("VEIC"), the last 10 as Director of its Consulting Division managing a group of 30 professionals with offices in three states. Most of our consulting work involved critically reviewing, developing and/or supporting the implementation of electric, gas, and multi-fuel energy efficiency programs for clients across North America and beyond.

During my more than 25 years in the in the energy efficiency industry, I have worked in numerous jurisdictions to develop or review energy efficiency potential studies; develop or review Technical Reference Manuals ("TRM") of deemed savings assumptions (including the Ontario (gas), Michigan, Ohio and Illinois TRMs); support utility-stakeholder "collaboratives" (including those in Michigan, Illinois and most recently Ohio); negotiate or support development of efficiency program performance incentive mechanisms (including Ontario and Michigan mechanisms, as well as the mechanism included in recently passed Illinois legislation); review or develop efficiency programs; and/or review or develop utility load forecasts. All told, I have worked on these and/or other policy and program issues for clients in half a dozen Canadian provinces, more than 30 U.S. states and several European countries. I have also led courses on efficiency program design, published widely on a range of efficiency topics and served on numerous national and regional efficiency committees, working groups and forums. A copy of my curriculum vitae is attached as Schedule A.

Q: Have you previously filed expert witness testimony in other proceedings before the Ontario Energy Board (OEB)?

A: Yes. I filed testimony in more than twenty OEB cases. The list is as follows: EBRO 487, EBRO 493/494, EBRO 497, EBRO 499, RP-1999-0001, RP-1999-0017, RP-2001-0029, RP-2001-0032, RP-2002-0133, RP-2003-0063, RP-2003-0203, EB-2005-0211, EB-2005-0001, EB-2005-0523, EB-2006-0021, EB-2008-0346, EB-2010-0279, EB-2012-0337, EB-2013-0451, EB-2015-0029, and EB-2015-0049

Q: Have you been an expert witness on energy efficiency matters before other energy regulators?

A: Yes, I have filed expert witness testimony on about 30 cases before similar regulatory bodies in nine other states and provinces, including the neighboring jurisdictions of Quebec, Ohio and Michigan.

II. Testimony Summary

Q: What is the purpose of your testimony in these proceedings?

A: My testimony addresses both Enbridge Gas Distribution's and Union Gas' consideration of increased investment in efficiency programs as a potential cost-effective carbon emission abatement option in their 2018 Cap and Trade Compliance Plans. It focuses particular attention on the following issues:

- The adequacy of the Companies' assessments of incremental efficiency as a carbon emission abatement option;
- The reasonableness of the Companies' conclusions that there is no cost-effective abatement potential possible from increased efficiency;
- The cost implications for the Companies' customers of failing to capture cost-effective abatement potential from increased efficiency;
- The risk implications for the Companies' customers of failing to capture abatement potential from increased efficiency.

Being mindful of the OEB's guidance, these issues are addressed at a relatively high level.

Q: Please summarize your conclusions on these issues.

A: My conclusions can be summarized as follows:

1. **The utilities analyses of incremental efficiency as a potential carbon abatement measure are extremely limited.** Even if those limited analyses had been conducted properly – and as noted in my next conclusion, they were not – they are of insufficient

breadth and depth to support any conclusion regarding the role additional efficiency should play in cap and trade plans.

2. **The limited analyses of incremental efficiency that the utilities did perform are fraught with errors and misleading omissions and therefore cannot be relied upon** for any conclusions regarding the merits of additional efficiency as a carbon emission abatement option.

3. **Part of the problem with the utilities analyses is that they "screen" the cost-effectiveness of additional efficiency through a very different test than the Board intended for the cap and trade plans, different than the utilities themselves have used for other abatement measures (e.g. renewable gas).** Moreover, the test they use for assessing cost-effectiveness of efficiency violates basic principles of cost-effectiveness by including all costs and ignoring key benefits of efficiency.

4. **Available data on efficiency potential suggests that 50% to 100% additional cost-effective savings potential is available** (probably closer to the lower end of that range for Union and the higher end for Enbridge). This includes data from the Board's own Conservation Potential Study, experience of other leading gas DSM jurisdictions and the very low market penetration rates for at least some of the utilities efficiency measures.

5. **A proper economic analysis of the cost-effectiveness of this additional efficiency potential reveals that these additional savings could be acquired at a lower cost than carbon emission allowances.** Indeed, some increments of additional efficiency could be acquired at a negative cost per tonne of carbon emission reduction because the value of

just the gas savings they would produce is greater than the additional program costs required to acquire them.

6. **The Companies' failure to pursue these additional cost-effective energy savings in 2018 likely means that each Company's customers will bear an additional $9 million in energy costs (about half of which is associated with otherwise unnecessary purchases of carbon emission allowances).** This is likely a conservatively low estimate.

7. **Failure to pursue additional cost-effective efficiency will increase risk, as well as cost, to gas ratepayers.** This is made clear by the fact that the Long-Term Carbon Price Forecast (LTCPF) suggests that the difference between the high end of potential carbon costs and the mid-range forecast (i.e. the potential downside for consumers) is much greater than the difference between the low end of potential carbon costs and the mid-range forecast (i.e. the potential upside for consumers).

8. **Waiting until the DSM Mid-Term review to consider whether additional efficiency resources should be acquired is far from ideal** because (A) it would mean delaying by at least a year the net benefits of additional efficiency; (B) cost-effectiveness of efficiency is evaluated using a more stringent test (TRC) under the DSM Framework than under the cap and trade plans, inappropriately creating a different standard for investment in different types of carbon abatement options; (C) the DSM mid-term review, at least as currently envisioned by the Board, allows for far less meaningful review of utility plans; and (D) the result of the three previous concerns will lead to more expensive cap and trade compliance plans than needed.

III. Concerns Regarding the Companies' "Abatement Construct"

Q: What options do Enbridge and Union have for meeting their carbon emission obligations?

A: At a high level, they have four options: (1) to purchase carbon emission allowances; (2) to purchase carbon emission offsets; (3) to reduce emissions at their own facilities – what the Companies call "facility-related abatement"; and (4) to reduce their customers carbon emissions associated with gas consumption – what the Companies call "customer-related abatement".

Q: How did both Enbridge and Union approach the question of which customer-related abatement options merited investment?

A: Enbridge and Union worked together to develop what they call their "abatement construct" to "guide abatement initiatives".[1] They state that the abatement construct "outlines the sustainment model by which low carbon initiatives are sought, vetted, categorized and advanced with the ultimate goal of broad based implementation."[2] The abatement construct has three key elements:

- Abatement program selection and screening criteria
- A four-phased "initiative funnel"
- A low carbon initiative fund (LCIF)

Five screening criteria are identified:

- The ability to draw on a variety of funding sources
- Advancement of new technology

[1] Enbridge Exh C, Tab 5, Sch. 1, pp. 4-12.
[2] Ibid.

- Contribution to GHG emission reduction targets and/or related policies
- Leveraging existing infrastructure ("particularly utility infrastructure") and not duplicating existing frameworks (e.g. DSM)
- Respect regulatory constructions regarding costs (e.g. cost allocations)

The utilities note that several additional considerations may also be used, including market size, technological maturity, market acceptance, cost-effectiveness and local content.

The four stages of the initiative funnel are:

- Conceptualization
- Formulation
- Proposal
- Implementation

The LCIF is a forward-looking proposal to support research, pilots and other developmental activities – presumably efforts in the first two or three stages of the funnel.

Q: Do you have any concerns regarding this "abatement construct"?

A: Yes. I have two specific concerns. First, while I agree that it is important to have criteria for deciding which abatement options merit investment, I have serious concerns about the specific criteria proposed by the Companies. Second, I am concerned that the structure of the abatement construct seems very heavily oriented towards research and development (R&D) and/or other approaches to developing options that may have abatement potential, but not the attainment of savings in the near term (at least not at any significant scale). It is reasonable to have some focus on and investment in R&D-type initiatives to explore potential long-term options. Such investments can be important and valuable. My concern is that such longer-term investments appears to be the principal focus – if not the sole focus – of the utilities. As I discuss further below, they have devoted much less effort to assessing well established efficiency program expansion options that could begin to provide substantial carbon emission abatement right away and at costs that actually lower customers' gas bills.

Q: What are your concerns regarding the abatement program selection criteria proposed by the utilities?

A: Most importantly, the criterion that I would suggest should be the most important – minimizing total costs to ratepayers – is not among the five primary criteria put forward by the Companies. Cost-effectiveness is listed only among additional considerations that "***<u>may</u>*** also be used." (emphasis added). Put another way cost-effectiveness (however measured) appears to have been relegated to an optional secondary consideration.

I also have concerns regarding the appropriateness of several of the proposed primary criteria. For example, it makes no sense to prioritize an abatement option simply because it is "able to draw on a variety of funding sources". Consider two abatement options, one of which costs $10 per ton of carbon emission reduction, all of which must be paid by gas ratepayers (i.e. no leveraging of other funding sources) and other that costs $40 per ton but for which gas ratepayers would only need to cover half the cost (perhaps with the other half being contributed by government or some other source). Even though it leverages other funding sources, the second option would still cost gas ratepayers twice as much as the first so it should not be given preference. Put simply, while efforts should always be made to leverage other funding sources, that should be treated more as a "standard practice" for all abatement options rather than a criterion for prioritization.

Similarly, I have concerns regarding the criterion of leveraging existing infrastructure, "particularly utility infrastructure". It would be inappropriate to give preference to an abatement option that leveraged existing infrastructure over one that did not, if the one that did not performed better and/or was less expensive. Again, while efforts should always be made to leverage existing infrastructure when such leveraging would improve performance and/or lower cost, such leveraging should be treated more as a standard practice than a criterion for prioritizing abatement options.

IV. The Companies' Inadequate and Flawed Assessments of Energy Efficiency Potential

1. Enbridge

Q: Please summarize your understanding of how Enbridge assessed the potential for additional energy efficiency – beyond what their current efficiency programs are designed to achieve – and what the result of that assessment was?

A: Enbridge did two things. First, the Company compared the level of savings the Marginal Abatement Cost Curve (MACC) study suggested was cost-effective to its own planned DSM savings levels for 2018 through 2020. The Company found that the energy savings it is forecasting for 2018 through 2020 was 87% higher than what the MACC study suggested were cost-effective.[3]

Second, Enbridge compared the increase in efficiency program costs to the increase in carbon emissions reduction between the "Constrained" and "Semi-Constrained" scenarios in the Conservation Potential Study. The Company then noted that its resulting $60/tonne estimate of the incremental cost of carbon emission reduction was higher than the values in the Long Term Carbon Price Forecast through 2028.[4]

Enbridge did not perform any other analyses to assess the potential for increased energy efficiency to serve as a cost-effective carbon abatement option.[5]

Q: What did Enbridge conclude from its analysis?

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[3] Exh. C, Tab 5, Sch. 2 p. 26.
[4] Enbridge response to Staff.24.
[5] Enbridge response to GEC.19a and Staff.24.

A: Enbridge concluded that "additional DSM programs would not be cost-effective" and that "in some cases the marginal costs of new programs may be higher than the cost of compliance instruments."[6]

Q: Is that a reasonable conclusion?

A: No.

Q: Why not?

A: For two reasons. First, the limited analysis that the Company performed has numerous errors and misleading omissions. Second, even if it had been accurate, the Company's analysis was far too cursory to rule out investment in additional energy savings.

Q: Can you elaborate on these concerns?

A: To begin with, there were two errors in the Company's comparison of its 2018-2020 planned savings to the MACC estimates of cost-effective savings. First, the company adjusted the MACC savings estimates down by assumed net-to-gross factors when the MACC savings estimates had already netted out free riders.[7] Second, Enbridge appears to have compared its total 2018 to 2020 planned savings from all customers to the MACC savings estimates, even though the MACC study excluded savings from customers that have their own carbon emission reduction obligations.[8] This is important because it is likely that at least 17% of the Company's commercial and industrial savings are from such customers.[9] As the following table shows, after

[6] Exh. C, Tab 5, Sch. 1 p. 15.
[7] Exh. C, Tab 5, Sch. 2, p. 26
[8] MACC Report, p. 24.
[9] According to Exh B., Tab 2, Sch. 1 p. 6, approximately 16% of forecast volumes before DSM and abatement for all rate classes other than Rate 1 are to customers whose carbon emissions are directly capped. That percentage

correcting for these errors Enbridge's planned savings are 23% higher than the MACC potential estimates instead of the 87% higher suggested by Enbridge.

Table 1: Corrected Comparison of MACC Savings Estimate to Enbridge Plan

<table>
<tr><th>Customer Segment</th><th>MACC Province-Wide Net Savings (millions m³)</th><th>% of Potential in EGD Territory</th><th>Net Potential in EGD Territory</th><th>EGD DSM Plan Savings Adjusted for Capped Customers</th><th>Difference between EDG Plan Savings and MACC Potential</th></tr>
<tr><td>Residential</td><td>97</td><td>62%</td><td>60</td><td>56</td><td></td></tr>
<tr><td>Commercial</td><td>99</td><td>58%</td><td>57</td><td rowspan="2">140</td><td rowspan="2"></td></tr>
<tr><td>Industrial</td><td>96</td><td>44%</td><td>42</td></tr>
<tr><td>Total</td><td>292</td><td></td><td>160</td><td>197</td><td>123%</td></tr>
<tr><td>Enbridge Estimates</td><td>214</td><td></td><td>121</td><td>226</td><td>187%</td></tr>
</table>

Of course, that might still raise questions if one were to believe that the MACC study had analyzed anything close to the maximum amount of efficiency program savings that could be achieved by the utilities. But it did not. In fact, the MACC report made clear that it analyzed only the savings potential possible with "Business as Usual" levels of financial incentives for all efficiency measures considered.[10] It should not be surprising that a study that examined Business as Usual program designs found savings potential to not be higher than current plans.

This leads to my second concern with Enbridge's analysis: the Company either cherry-picked the numbers to which it wanted to compare itself (i.e. just the MACC potential) or inexplicably failed to recognize that the Conservation Potential Study (CPS) suggests that there is

varies considerably from rate class to rate class. Assuming that the percentage of sales to capped customers for each rate class is equal to the percentage of DSM savings from each rate class, 17% of Enbridge DSM savings would be from such capped customers. And this is likely a conservatively low estimate because it doesn't differentiate between larger and smaller customers within each rate class. Enbridge, like most utilities, gets a disproportionate amount of its savings from larger customers who are also more likely to have their own emissions caps.

[10] See p. 7 of ICF, "Marginal Abatement Cost Curve for Assessment of Natural Gas Utilities' Cap and Trade Activities (EB-2016-0359)", Final Report, July 20, 2017.

significantly more savings that the Company could acquire. Indeed, the CPS suggests that even under the most constrained scenario (i.e. currently approved budget levels), Enbridge could acquire nearly 50% greater savings than it is planning to acquire under its current 2018 to 2020 DSM plan; without budget constraints it could acquire 132% more.[11] And that is despite the fact that the CPS estimates of cost-effective savings potential include only those efficiency measures that passed the TRC Plus test. Generally speaking, more efficiency measures will be able to pass the utility cost test (UCT) the Company appears to be using to assess abatement options in this proceeding.[12]

Third, the Company's conclusion that the incremental cost of carbon emission reductions between the CPS "constrained" and "semi-constrained" scenarios was $60/tonne is both incorrect and highly misleading. $60/tonne is just the incremental DSM cost divided by tonnes of carbon emission reduction. <u>*It does not account for the fact that the incremental gas savings also produce incremental gas bill savings for Enbridge's customers!*</u> Put simply, the gas cost savings of incremental efficiency investments need to be netted out of the incremental efficiency program costs when computing a cost per tonne of carbon emission reduction. As I show in the last section of my testimony, when one does that the cost per tonne of carbon emission reduction is actually *negative* for at least some increments of additional efficiency and below the mid-range LTCPF estimates of carbon prices for very large additional increments of efficiency.

[11] These estimates were developed by (1) subtracting the incremental annual savings potential estimated in the CPS for 2017 from those for 2020 (CPS report tables ES 7, ES 11 and ES 15); (2) multiplying those values, by sector, by the percent of provincial gas sales by sector estimated to be from Enbridge (using Enbridge's assumptions in Staff.24); and comparing the resulting sums to Enbridge's estimates of 2018 to 2020 savings (response to Staff.24).
[12] For example, see EGD, 2015 Demand Side Management Annual Report, December 18th, 2017, filed as Exh. B, Tab 1, Sch. 1 in EB-2017-0324, Table ES.0, p. 8 of 117.

Finally, the Company should have considered more than just the MACC and (in a very limited way) the CPS in assessing the extent to which additional cost-effective efficiency resources could be acquired for carbon emission abatement purposes. It is worth noting that the Board's guidance for Cap and Trade plans made clear that the MACC was "an input" (albeit an "essential" one) that the utilities should consider in developing their plans.[13] In addition, the Board said it "will want to see information from the Utilities that demonstrates they have undertaken a detailed analysis which supports their choice of compliance options…"[14] Enbridge's analysis of efficiency was anything but "detailed".

Q: With regard to that last point, what more could Enbridge have done (i.e. besides just comparing its forecast savings to the MACC study results and estimating the incremental cost per tonne of emission reduction from the Conservation Potential Study (CPS))?

A: At least two things. First, the Company could have benchmarked its current forecast savings levels against other leading gas utilities – ideally by sector, if not by program and/or key measures – to gain insight into whether others are capturing greater savings that may also be acquired in Ontario. More importantly, the Company could have reviewed its existing efficiency program offerings to identify measures and/or programs for which market penetration rates were modest and could be increased through increased financial incentives, increased marketing and/or other means. It should then have performed a quantitative analysis of the added DSM program cost, increased savings, increased carbon emission reductions, and other avoided costs to determine whether the additional savings could be acquired at a lower cost to its ratepayers than carbon emission allowances.

[13] Ontario Energy Board, "Regulatory Framework for the Assessment of Costs of Natural Gas Utilities' Cap and Trade Activities", Report of the Board, EB-2015-0363, September 26, 2016, p. 20.
[14] Ibid, p. 22.

2. Union

Q: Please summarize your understanding of how Union assessed the potential for additional energy efficiency – beyond what their current efficiency programs are designed to achieve – and what the results of that assessment was?

A: Like Enbridge, Union focused its analysis on the MACC study and, to a lesser degree, the Conservation Potential Study (CPS). First, it compared its currently planned savings to the MACC study estimates of cost-effective savings over the 2018-2020 period. The Company estimated that its C&I programs were capturing nearly three times as much savings as MACC found to be cost-effective.[15] The Company also states that it compared the C&I measures in the MACC study and concluded that the Company is already promoting most of them. On the other hand, Union concluded that it was planning to achieve only about 60% of the residential savings the MACC study suggested were cost-effective.[16] Second, like Enbridge, Union estimated that the incremental cost of moving from the Conservation Potential Study (CPS) constrained scenario to the semi-constrained scenario would be about $60/tonne of carbon emission reduction.[17]

Q: What did Union conclude from this analysis?

A: Union concluded that "there is no cost-effective, incremental DSM that is prudent to pursue in 2018."

Q: Is that a reasonable conclusion?

A: No.

[15] Exh. 3, Tab 4, Appendix A, p. 5.
[16] Exh. 3, Tab 4, Appendix A, p. 6.
[17] Exh. 3, Tab 4, Appendix A, p. 3.

Q: Why not?

A: For several reasons. First, as with Enbridge, Union's analysis is fraught with errors and misleading omissions. Second, also as was the case with Enbridge, even if it had been accurate, the Company's analysis was far too cursory to rule out investment in additional energy savings as part of its 2018 Cap and Trade Compliance Plan.

Q: Can you elaborate on these concerns?

A: To begin with, for the purpose of comparing its own planned savings levels to the MACC study Union adjusted the MACC results down by a set of net-to-gross (NTG) factors consistent with the average NTG factors it has historically used for its net savings estimates. That was inappropriate because the MACC study already accounted for naturally-occurring conservation.[18] Union argues that it made such NTG adjustments because the CPS only partially adjusted for free ridership, citing a statement in the CPS study that stated it did not account for any initiatives in the provincial Climate Change Action Plan.[19] However, the Company provided no analysis to suggest that the specific NTG adjustments it proposed – including a very large additional 54% free ridership adjustment for industrial savings – were appropriate for the effects, particularly in the early years, of the Climate Change Action Plan. Moreover, the Company failed to account for the fact that any change that the Climate Change Action Plan would have on total available net savings potential it would also likely have on the actual savings realized by the Company through its planned programs. In other words, the 54% free rider adjustment Union applied to

[18] ICF, "Natural Gas Conservation Potential Study", submitted to Ontario Energy Board, June 30, 2016, updated on July 7, 2016, p. 8.
[19] Union response to Staff.30.

the MACC's industrial savings estimates should arguably also apply to its own planned savings estimates for the same years (2018 to 2020).[20]

In addition, although Union excluded savings from its Large Volume program from the comparison, it appears to have included all other C&I savings, even though some of those savings will come from capped customers.[21] Again, this is a problem because the MACC study explicitly excluded savings from all capped customers based on information provided to the study authors by the utilities themselves.[22] Put simply, Union has made an "apples to oranges" comparison.

Second, Union did identify additional residential savings that were in the MACC study that it was not planning to capture. However, it chose not to include that savings potential in its 2018 Cap and Trade Compliance plan, suggesting that it will instead "assess the opportunity and pursue it through the DSM Framework where possible."

Third, as noted in the discussion of Enbridge's analysis above, the MACC study analyzed only savings potential under "Business as Usual" levels of financial incentives for all efficiency measures considered. The CPS looked at a more expansive set of options for financial incentives. Even the CPS "constrained scenario" included a number of measures for which "aggressive" incentive levels were modeled instead (rather than "BAU" incentive levels).[23] Thus, Union should also have compared its planned savings levels to the CPS savings levels.

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[20] The 54% free rider rate Union had planned for its industrial programs was developed well before the Climate Change Action Plan was developed.
[21] Even after excluding its Large Volume program, over 40% of Union's C&I program savings are from contract customers (Union attachment to response to GEC.2(c)), at least some of which may be capped. Furthermore, even some of the savings from General Service customers may be capped (Union response to GEC.2(b)).
[22] MACC study, p. 7
[23] Based on review of workpapers used to develop the CPS supply curves. Confirmed in personal communication with the MACC study project manager,

The results of such a comparison are telling: the CPS study suggests that even under the most constrained scenario Union could acquire 25% more savings from its non-Large Volume customers than it is currently planning for 2018 through 2020; without budget constraints it could acquire nearly 80% more savings than it is current planning for those years.[24]

Fourth, as is also the case with Enbridge, Union's conclusion that the incremental cost of carbon emission reductions between the CPS "constrained" and "semi-constrained" scenarios was \$60/tonne is both incorrect and highly misleading. \$60/tonne is just the incremental DSM cost divided by tonnes of carbon emission reduction. *It does not account for the fact that the incremental gas savings also produce incremental gas bill savings for Union's customers!* Union states that its calculation is "consistent with the OEB's Cap-and-Trade Framework" because the OEB concluded that "it was premature to apply the TRC or SCT to the Utilities' Compliance Plans at this time."[25] However, including avoided energy costs (and other avoided utility costs) in this analysis is not the same thing as applying the TRC or SCT. Rather, it is simply using what is commonly called the Utility Cost Test (UCT) – i.e. a test that only assesses impacts on the utility system.[26] That is the test used in the MACC report. Furthermore, as I discuss in more detail in the final section of my testimony, the UCT appears to be the very test Union and Enbridge have used to assess renewable gas.

[24] These estimates were developed by (1) subtracting the incremental annual savings potential estimated in the CPS for 2017 from those for 2020 (CPS report tables ES 7, ES 11 and ES 15); (2) adjusting the savings values down further to remove large volume savings per CPS report table ES 17 (assuming all large volume savings are industrial); (3) multiplying those values, by sector, by the percent of provincial gas sales by sector estimated to be from Union (using Union's assumptions in Staff.31); and comparing the resulting sums to Union's estimates of 2018 to 2020 savings (response to Staff.31).

[25] Response to GEC.7(d).

[26] The UCT is also sometimes call the Program Administrator Cost test (or PAC or PACT) to account for the fact that efficiency programs are managed in some jurisdictions by entities other than utilities.

Finally, Union should have considered more than just the MACC and (in a very limited way) the CPS in assessing the extent to which additional cost-effective efficiency resources could be acquired for carbon emission abatement purposes. Specifically, the Company could have benchmarked its forecast current forecast savings levels against other leading gas utilities – ideally by sector, if not by program and/or key measures – to gain insight into whether others are capturing greater savings that may also be acquired in Ontario. Finally, and most importantly, the Company could have reviewed its existing efficiency program offerings to identify measures and/or programs for which market penetration rates were modest and could be increased through increased financial incentives, increased marketing and/or other means. It should then have performed a quantitative analysis of the added DSM program cost, increased savings, increased carbon emission reductions, and other avoided costs to determine whether the additional savings could be acquired at a lower cost to its ratepayers than carbon emission allowances.

3. Cap and Trade Plans vs. DSM Mid-Term Review

Q: Both Enbridge and Union have suggested that it would be more appropriate to address the question of whether additional efficiency resources should be acquired in the DSM Mid-Term Review process instead of in this proceeding. What is your view of that suggestion?

A: That would be far from ideal for several reasons. First, the failure to target additional cost-effective efficiency resources in the Cap and Trade plan can lead to more expensive compliance options being adopted. The corollary to that point is that waiting until the DSM mid-term review probably means losing a year's worth of potential additional energy savings, many of which will be lost for decades.[27] Second, the DSM mid-term review process, at least as currently outlined by the Board, does not allow for meaningful review of utility plans. Third, the DSM framework utilizes a completely different test of cost-effectiveness (the TRC Plus test) than the cap and trade framework (effectively the Utility Cost Test). Because the TRC Plus test is generally more restrictive (fewer things pass), forcing efficiency resources to pass that test while allowing other resources to be considered under the UCT will likely result in cap and trade plans that are more expensive than they needed to be.

[27] For example, the failure to influence the decision of a customer to purchase a more expensive heating system at the time they are making their investment decisions will essential lock that customer – and the rest of ratepayers and the province – into providing gas, with its related carbon emissions, until that heating system is replaced because it is rarely cost-effective to replace such systems outside of their natural turnover cycle.

V. Additional Efficiency Is a Cost-Effective Abatement Option

Q: Have you performed your own assessment of additional cost-effective efficiency potential that the utilities could acquire?

A: I have not performed a detailed, bottoms-up up analysis of additional efficiency potential. That is beyond the scope of the task I was given for this testimony and my understanding of the Board's preferred approach in this proceeding. However, I have reviewed several appropriate reference points to inform a reasonable conclusion regarding the potential for both utilities to acquire additional cost-effective efficiency.

Q: Can you describe what those reference points are?

A: I have looked at three things:

1. The Conservation Potential Study;
2. Planned savings levels relative to those of leading gas utilities; and
3. My previous analyses of the planned market penetration rates for selected efficiency measures promoted by the two companies.

Q: Please summarize what each of those reference points tell you.

A: Consideration of efficiency potential from each of these three perspectives can be summarized as follows:

- **Conservation Potential Study (CPS)**: As discussed above, the CPS suggests that Enbridge could acquire nearly 50% more savings under the constrained scenario (i.e. with budgets similar to those currently planned) and 132% more if it had no budget constraints; Union could acquire 25% more savings under the constrained scenario and more than 75% more without budget constraints. It should be emphasized that those savings are all cost-effective under the "TRC Plus" cost-effectiveness test. Generally speaking, the TRC Plus test is more constraining than the Utility Cost Test (UCT) that the Board appears to be supporting for use in carbon cap and trade planning and that the utilities have used to assess and support other abatement initiatives such as renewable gas. Indeed, Enbridge's own analysis of its 2015 DSM portfolio results concluded that its TRC Plus benefit-cost ratio was 2.95 while its UCT benefit-cost ratio was 4.47.[28] The difference was even more pronounced for commercial programs (TRC Plus ratio of 3.39 vs. UCT ratio of 10.78) and industrial programs (TRC Plus ratio of 6.15 vs. UCT ratio of 15.45).[29] Put simply, the CPS estimates of the additional cost-effective potential that the utilities could acquire is very conservative relative to the additional potential that would be considered cost-effective under the cost-effectiveness framework applicable to this proceeding.

- **Savings levels of leading gas utilities**. Enbridge is currently planning to achieve annual savings from non-capped customers equal to about 0.6% of sales from those customers from 2018 to 2020.[30] Union did not provide data in its cap and trade plan that would enable a comparable estimate. However, they did provide data to suggest that their planned annual savings from General Service customers are the order of 0.9% of annual

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[28] EGD, 2015 Demand Side Management Annual Report, December 18th, 2017, filed as Exh. B, Tab 1, Sch. 1 in EB-2017-0324, Table ES.0, p. 8 of 117.
[29] Ibid.
[30] Enbridge's forecast average annual savings is 75.2 million m^3 (Exh C, Tab 5, Sch. 2, p. 26), of which I estimate approximately 65 million m^3 to be from non-capped customers; its forecast sales are to non-capped customers are 10.59 billion m^3 (Exh B, Tab 2, Sch 1., p 6).

sales to such customers.[31] In contrast, the actual average savings in 2016 of gas utilities in the four cold weather U.S. states of Minnesota, Rhode Island, Massachusetts and Michigan was about 1.2%).[32] In other words, they were achieving savings on the order of twice the level forecast by Enbridge and one-third higher than that forecast by Union for its general service customers.

- **Planned participation rates for selected efficiency measures**. In my testimony in the EB-2015-0029 and EB-2015-0049 dockets, the cases governing Union's and Enbridge's 2015-2020 DSM plans, I noted that another indicator of the relative aggressiveness of the utilities' efficiency program plans was the level of market penetration they were forecasting to achieve for each efficiency measure in the plans. I then estimated the market penetration of rates for each utility of four different kinds of C&I efficiency measures: a water heating measure, a ventilation measure, and building envelop measure and a bundle of commercial cooking equipment measures. In all four cases, for both utilities, the planned market penetration rates were less than 15%; in half of the cases they were less than 5%. That is well below what one might consider achievable under aggressive programs designed to maximize cost-effective participation.

Put simply, consideration of each of these perspectives leads me to conclude that both utilities could substantially increase their planned efficiency program savings, and do so cost-effectively.

[31] Union savings from general service customers (Rates 01, 10, M1 and M2) are forecast to be approximately 49.6 million m^3 in 2018 (Union Attachment to response to GEC.2); its forecast sales to general service customers, before DSM effects, are 5.563 billion m^3 in 2018 (Exh 2, Sch. 1). Note that the ratio of these two values is an imperfect proxy for savings as a percent of sales to non-capped customers, both because there are savings and sales to contract customers who are not capped and because some of the general service customers may be capped.

[32] This is a straight average across the four states (Michigan at 1.05%, Massachusetts at 1.13%, Rhode Island at 1.26% and Minnesota at 1.40%) rather than a weighted average. See Berg, Weston et al., "The 2017 State Energy Efficiency Scorecard", American Council for an Energy Efficient Economy Report U1710, September 2017. (http://aceee.org/research-report/u1710).

Indeed, in ballpark terms, it appears reasonable to conclude that they could increase savings by 50% to 100% (perhaps at the higher end of that range for Enbridge and closer to the lower end of the range for Union).

Q: Could the utilities have achieved that level of increased savings in 2018?

A: Probably not. In my experience it would be reasonable to plan for that kind of increase to be achieved over a 2-year or 3-year ramp up period. If they had planned for such an increase in late 2017, an increase in savings on the order of 25% would likely have been reasonable for 2018.[33] In Enbridge's case, that would have meant about an extra 16 million m^3 in annual savings from non-capped customers. For Union, it would have meant about an extra 12 million m^3 in annual savings from general service customers.

Q: Do you consider those estimates to be precise?

A: They are what I would call "ballpark" estimates. To provide a more definitive estimate would require a multi-month analysis and planning exercise which is not possible within my resource and time constraints for this case.

[33] By way of comparison, Consumers Energy in Michigan filed an update to its 2017 plan in March of 2017 – i.e. a couple of months into the year – in which it proposed to increase its gas savings by about 27% (Case U-17771 (Amended), Exh. A-11 (TAY-2), p. 2).

VI. Not Including More Efficiency in Cap and Trade Plans Increases Costs and Risk

1. Costs

Q: What is your understanding of how the Board expected the utilities to assess the cost-effectiveness of different carbon emission compliance options?

A: The Board made clear in its Cap and Trade framework that it felt it was premature to adopt the TRC or SCT cost-effectiveness tests. Instead, it appears to have adopted what is often called in the energy efficiency industry the Utility Cost Test (UCT). That test compares the total costs incurred by just the utility system for an investment to the total benefit realized by the utility system (i.e. all utility avoided costs).

Q: What is the basis for your conclusion that the Board adopted the UCT as the primary test of cost-effectiveness in the Cap and Trade framework?

A: To begin with, the Board clearly articulated that the utilities should use the MACC study as one of several inputs to considerations of cost-effectiveness. The cost-curves in the MACC study – which was commissioned by the Board – were developed using the UCT. The Board also noted that it expected the utilities to develop plans that function "in an integrated manner that extracts maximum value from commitments that integrate *multiple benefits*."[34] (emphasis added)

Q: Have the utilities used the UCT in their analyses of cost-effectiveness of abatement measures?

[34] Ontario Energy Board, "Regulatory Framework for the Assessment of Costs of Natural Gas Utilities' Cap and Trade Activities", Report of the Board, EB-2015-0363, September 26, 2016, p. 21.

A: Yes and no. The Companies did implicitly use the UCT when assessing the cost-effectiveness of their renewable gas proposals. That is, they assumed that they would pay a price for renewable gas that is equal to (1) the cost of conventional gas that would be displaced by the renewable gas plus (2) the cost of carbon emission allowances that would otherwise be required for consumption of conventional gas; they further assumed that provincial subsidies would cover substantial price premium for renewable gas. This would result in a break-even scenario for their customers – or the equivalent of a UCT benefit-cost ratio of 1.00 – under the UCT.

However, when it came to analyzing the cost-effectiveness of efficiency measures, the utilities essentially created a different test. As discussed above, they simply compared the additional efficiency program cost to the value of carbon emission allowances, ignoring the benefit of avoided gas costs their customers would receive. Again, that is highly problematic. As the following graphic demonstrates, using the same approach to assessing their renewable gas proposal would have rendered it extremely cost-ineffective, with a benefit-cost ratio for 2018 of less than 0.20. Note that for illustrative purposes – to help underscore the importance of decisions regarding which cost-effectiveness test to use – I have included in the graphic the results of the renewable gas proposal cost-effectiveness under the TRC or Societal Test as well.

Figure 1: Comparison of Renewable Gas Proposal Cost-Effectiveness Test Results

Utility Cost Test

Benefits		Costs		Net Benefits	Benefit-Cost Ratio
Avoided Cost of Traditional Gas	$3.69	Utility payment for RNG	$4.54		
Avoided Cost of CO2 Allowances	$0.85	Provincial Subsidy for RNG	n.a.		
Total	$4.54	Total	$4.54	$0.00	1.00

TRC or Societal Test

Benefits		Costs		Net Benefits	Benefit-Cost Ratio
Avoided Cost of Traditional Gas	$3.69	Utility payment for RNG	$4.54		
Avoided Cost of CO2 Allowances	$0.85	Provincial Subsidy for RNG	$11.46		
Total	$4.54	Total	$16.00	($11.46)	0.28

Utility Cost vs. Carbon Benefits Only
(i.e. approach utilities used to evaluate incremental efficiency)

Benefits		Costs		Net Benefits	Benefit-Cost Ratio
Avoided Cost of Traditional Gas	n.a.	Utility payment for RNG	$4.54		
Avoided Cost of CO2 Allowances	$0.85	Provincial Subsidy for RNG	n.a.		
Total	$0.85	Total	$4.54	($3.69)	0.19

Q: Have you assessed the cost-effectiveness of incremental efficiency from the UCT cost-effectiveness perspective?

A: I have performed a high-level assessment of the cost-effectiveness of incremental efficiency from the UCT cost-effectiveness perspective. I essentially used the same data that Union used in computing the cost per tonne of carbon emission reduction.[35] That is, I focused on the incremental utility costs and incremental savings of going from the CPS' constrained scenario to its semi-constrained scenario. However, I did two things in my analysis that Union and Enbridge

[35] Exh. 3, Tab 4, Sch. 1.

did not do. First, I estimated the economic value of the incremental avoided gas cost associated with the incremental savings. That was done using the same avoided costs as were used in the CPS[36] and the average measure life for the incremental savings between the constrained to semi-constrained scenario (21 years) and between the constrained to unconstrained scenario (19 years). Second, rather than just compare the net cost per tonne of the carbon emission reduction to the LTCPF, I actually computed the economic value (NPV) of the avoided carbon emission allowance purchases. Finally, it should be noted that I did this for just one year, to serve as a proxy for 2018, by taking the 2015-2020 totals from the CPS (and as used by Union in its estimate of the cost per tonne of carbon emission avoided) and dividing by 6.

Q: What are the results of that analysis?

A: As shown in Table 1 below, for the incremental efficiency between the CPS constrained and semi-constrained scenarios, the value of the incremental avoided gas costs ($56 million) are greater, by themselves, than the entire incremental program cost ($37 million). In other words, the net cost per tonne of carbon emission reduction is negative (-$31/tonne) rather than the $60 Union and Enbridge estimated. When one adds the value of the avoided carbon emissions ($17 million) to the value of the avoided gas costs, the total economic benefit of the incremental efficiency is $73, or nearly twice as great as the $37 million incremental program costs. In other words, it is highly cost-effective under the UCT.

The larger amount of incremental efficiency between the constrained and unconstrained CPS scenarios is also cost-effective. While the incremental avoided gas costs ($285 million) are not enough, by themselves, to offset the incremental program costs ($369 million), the combination

[36] CPS Exh 11 (p. 26). Note that I used the average of the weather-sensitive and baseload avoided costs to account for the diversity of efficiency measures included in the CPS analysis.

of avoided gas costs ($285 million) plus avoided carbon emission allowance purchases ($85 million) is greater than the incremental program costs. This leads to a net program cost per tonne of avoided carbon emissions of $27 – again well below the $119/tonne estimated by Union.

Moreover, I believe that these results are conservative.

Table 1: UCT Cost-Effectiveness of Incremental CPS Efficiency

	Incremental Impact between Constrained & Unconstrained	Incremental Impact between Constrained & Semi-Constrained
Savings		
Annual m3 Savings (millions)	86	16
lifetime m3 Savings (millions)	1,653	328
Average measure life (years)	19.3	21.2
Annual CO2 emissions (tonnes)	160,938	29,063
Costs		
Program cost (millions $)	$369	$37
Benefits		
Avoided gas cost	$285	$56
Value of avoided carbon emissions	$85	$17
Total gas utility benefit	$370	$73
Net Benefits		
Total benefit minus prog cost	$1	$36
Benefit-Cost Ratio		
Total benefits divided by prog cost	1.00	1.98
Net Cost per Tonne of CO2 avoided		
(Program cost - Avoided gas Cost) / Tonnes	$27	-$31

Q: Why do you believe that these results are conservative?

A: There are several major reasons. First, and probably most importantly, this analysis implicitly assumes that the CPS constrained scenario is a proxy for the utilities currently planned level of savings because it assumed essentially the same budget levels as currently planned.

However, as I noted earlier, the utilities are not achieving savings as great as estimated in the CPS for the constrained scenario. Thus, the incremental savings that could be acquired by the utilities per additional budget dollar are likely higher than implied in my analysis (and Union's and Enbridge's). Greater savings per additional program dollar will improve the cost-effectiveness results shown in Table 1.

Second, the CPS study only captured savings potential that was cost-effective under the TRC Plus test. As I demonstrated earlier in my testimony, more efficiency potential is likely to be cost-effective under the UCT cost-effectiveness test used in this proceeding than under the TRC Plus.

Finally, for both simplicity and to be conservative, I assumed that the mid-range LTCPF values for carbon allowances in 2029 through 2038 would remain the same (in real dollars) as forecast for 2028 – the last year for which the LTCPF forecast was developed. If they were instead to continue to grow over time (i.e. continuing the trend implicit in the LTCPF), the value of additional efficiency would grow as well.

Q: Given the results of your cost-effectiveness analysis, how much could the utilities have saved their customers by including additional efficiency in their 2018 Cap and Trade compliance plans?

A: It is difficult to say definitively without a more granular analysis that examined exactly which measures and programs would produce the extra savings, as well as the nature of the program design changes that would be necessary to produce them. However, it would seem reasonable to assume that they could have, between the two of them, increased savings by at least one year's worth of the magnitude of the difference between the CPS' constrained and semi-constrained scenarios – i.e. 16 million m^3 of additional annual savings.[37] As my analysis above shows, that level of increase in energy savings would produce cost savings to customers on the order of $36 million to the two utilities' customers (combined). About half of those net benefits (i.e. cost savings) coming from avoided gas and related gas infrastructure investment cost and the other half from avoided purchases of carbon emission allowances. In ballpark terms, I think that about half of those extra savings (8 million m^3) – and therefore about half of the cost savings ($9 million) – could have been realized by each utility.[38] Again, I believe that those are conservatively low estimates of additional savings potential and economic net benefits.

2. Risk

Q: Are there risk implications of the Companies' failure to include increases in efficiency program savings?

A: Yes. Efficiency investments are generally considered less risky than supply investments and expenditures for several reasons, including reduced risk of exposure to future fuel price volatility and the cost of compliance with future environmental regulations. The latter risk is made clear in OEB's long-term carbon price forecast (LTCPF). For example, the mid-range LTCPF estimate was $57/tonne in 2028, with the minimum LTCPF in the same year being $27 and the maximum being $108. In other words, the downside risk to consumers of higher prices than the best estimate (i.e. an increase of $51/tonne) is greater than the upside potential of lower prices (i.e. a decrease of $30/tonne). Thus, every tonne of carbon emission reduction that is foregone because of decisions to not increase efficiency investment in cost-effective efficiency exposes

[37] Note that this is only the average annual difference for non-large volume customers.
[38] Using Union's assumptions regarding the share of CPS savings from each sector, excluding large volume customers, that would attributable to each utility – i.e. 38% residential, 42% commercial and 66% industrial being Union's and the balance being Enbridge's (Union response to Staff.31) – the magnitude of the increased savings potential between the CPS constrained and semi-constrained potentials is roughly the same for each utility.

gas ratepayers not only to higher gas bills given our bests estimates of future carbon allowance costs, but also to a significant risk of higher than expected costs.

Q: Does this conclude your testimony?

A: Yes.

CHRISTOPHER NEME, PRINCIPAL

EDUCATION

M.P.P., University of Michigan, 1986
B.A.., Political Science, University of Michigan, 1985

EXPERIENCE

2010-present: Principal (and Co-Founder), Energy Futures Group, Hinesburg, VT
1999-2010: Director of Planning & Evaluation, Vermont Energy Investment Corp., Burlington, VT
1993-1999: Senior Analyst, Vermont Energy Investment Corp., Burlington, VT
1992-1993: Energy Consultant, Lawrence Berkeley National Laboratory, Gaborone, Botswana
1986-1991: Senior Policy Analyst, Center for Clean Air Policy, Washington, DC

PROFESSIONAL SUMMARY

Chris specializes in analysis of markets for energy efficiency, renewable energy and strategic electrification measures and the design and evaluation of programs and policies to promote them. During his 25+ years in the clean energy industry, Mr. Neme has worked for energy regulators, utilities, government agencies and advocacy organizations in nearly 30 states, 5 Canadian provinces and several European countries. He has defended expert witness testimony before regulatory commissions in ten different jurisdictions; he has also testified before several state legislatures.

SELECTED PROJECTS

- ***Green Mountain Power (Vermont).*** Support development and implementation of GMP's plan for reducing customers' direct consumption of fossil fuels. Also developed 10-year forecast different levels of promotion of residential heat pumps and electric vehicles. (2016 to present)
- ***Ontario Energy Board:*** Serve on gas DSM Evaluation Committee, advisory committee on gas efficiency potential study and advisory committee on carbon price forecast. (2015-present)
- ***Alberta Energy Efficiency Alliance.*** Drafting white paper on key ways in which consideration of "efficiency as a resource" could be institutionalized. Paper followed presentations to government agencies and others on behalf of the Pembina Institute. (2017 to present)
- ***Green Energy Coalition (Ontario).*** Assisting a coalition of environmental groups in regulatory proceedings, utility negotiations and stakeholder meetings on DSM policies (including integrated resource planning on pipeline expansions) and utility proposed DSM Plans. (1993 to present)
- ***New Jersey Board of Public Utilities.*** Serve on management team responsible for statewide delivery of New Jersey Clean Energy Programs. Lead strategic planning; support regulatory filings, cost-effectiveness analysis & evaluation work. (2015 to present)
- ***Natural Resources Defense Council (Illinois, Michigan and Ohio).*** Critically review multi-year DSM plans and IRPs of Illinois, Michigan and Ohio utilities. Draft and defend regulatory testimony. Represent NRDC in stakeholder-utility processes governing development of efficiency policy manuals, annual TRM updates, annual NTG updates, etc. (2010 to present)

- **Toronto Atmospheric Fund.** Helped draft an assessment of efficiency potential from retrofitting of cold climate heat pumps into electrically heated multi-family buildings (2017).
- ***E4TheFuture.*** One of five authors of a new 2017 National Standard Practice Manual for cost-effectiveness analysis of energy efficiency and other distributed resources. (2016-present)
- ***Regulatory Assistance Project - U.S.*** Provide guidance on efficiency policy and programs. Lead author on strategic reports on achieving 30% electricity savings in 10 years, using efficiency to defer T&D system investments, & bidding efficiency into capacity markets. (2010 to present)
- ***Regulatory Assistance Project - Europe.*** Provide support on efficiency policies in the UK, Germany, and other countries. Reviewed EU policies on Energy Savings Obligations, EM&V protocols, and related issues. Drafted policy brief on efficiency feed-in-tariffs. (2009 to present)
- ***Northeast Energy Efficiency Partnerships.*** Helped manage Regional EM&V forum project estimating savings for emerging technologies, including field study of cold climate heat pumps. Led assessment of best practices on use of efficiency to defer T&D investment. (2009 to 2015)
- ***Ontario Power Authority.*** Managed jurisdictional scans on leveraging building efficiency labeling requirements and non-energy benefits. Led staff workshop on efficiency as an alternative to T&D investment. (2012-2015)
- ***Vermont Public Interest Research Group***. Conducted comparative analysis of the economic and environmental impacts of fuel-switching from oil/propane heating to either natural gas or efficient, cold climate electric heat pumps. Filed regulatory testimony on findings. (2014-2015)
- ***National Association of Regulatory Utility Commissioners (NARUC).*** Assessed alternatives to first year savings goals to better promote longer-lived savings. (2013)
- ***California Investor-Owned Utility***. Senior advisor on EFG project to compare the cost of saved energy across ~10 leading U.S. utility portfolios. The research sought to determine if there are discernable differences in the cost of saved energy related to utility spending in specific non-incentive categories, including administration, marketing, and EM&V. (2013)
- ***New York State Energy Research and Development Authority (NYSERDA).*** Led residential & renewables portions of several statewide efficiency potential studies. (2001 to 2010)
- ***DC Department of the Environment (Washington DC).*** Part of VEIC team administering the DC Sustainable Energy Utility (SEU). Helped characterize the DC efficiency market and supported the design of efficiency programs that the SEU will be implementing. (2011 to 2012)
- ***Ohio Public Utilities Commission.*** Senior Advisor to a project to develop a web-based Technical Reference Manual (TRM). The TRM includes deemed savings assumptions, deemed calculated savings algorithms and custom savings protocols. It was designed to serve as the basis for all electric and gas efficiency program savings claims in the state. (2009 to 2010)
- ***Vermont Electric Power Company.*** Led residential portion of efficiency potential study to assess alternatives to new transmission line. Testified before Public Service Board. (2001-2003)
- ***Efficiency Vermont.*** Served on Sr. Management team. Supported initial project start-up. Oversaw residential planning, input to regulators on evaluation, input to regional EM&V forum,

development of M&V plan and other aspects of bidding efficiency into New England's Forward Capacity Market (FCM), and development and updating of nation's first TRM. (2000 to 2010)