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11 March 2011

Ontario Energy Board
2300 Yonge St., 27th Floor
Toronto, ON
M4P 1E4

Attn: Ms Kirsten Walli
Board Secretary

By electronic filing and e-mail

Dear Ms Walli:

Re: EB-2010-0279 – OPA 2011 Revenue – GEC Evidence

Attached please find the evidence of Mr. Chris Neme filed by the GEC in this matter.

Sincerely,

David Poch
Cc: all parties

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

Exhibit K-2-1

Before the Ontario Energy Board

EB-2010-0279

Issues Pertaining to CDM-Related Spending in Ontario Power Authority's 2011 Revenue Requirements Submission

Prepared by:

Chris Neme
Energy Futures Group

For:
The Green Energy Coalition
David Suzuki Foundation
Greenpeace Canada
Sierra Club of Canada
WWF-Canada

March 10, 2011

I. INTRODUCTION

The Board has identified a number of issues to be addressed in this proceeding, most of which relate to the five strategic objectives put forward by the OPA. This report principally addresses issues associated with Strategic Objective #2 (Conservation), with greatest emphasis placed on issue 2.3:

> *"Does Strategic Objective #2 adequately reflect the tasks that the OPA is charged with by statute and directives in 2011, and do the initiatives capture the range of activity required to achieve that end?"*

Through examination of that issue a variety of other issues are touched on as well. They include whether OPA has provided adequate information regarding achievement and efficiency on the performance of Strategic Objective #2 (Issue 2.1), the reasonableness of OPA's proposed operating budget (Issue 2.2), and whether OPA is adequately building organization capacity (Issues 4.2 and 4.3).

Note that though OPA's strategic objectives and the government policies that underlie them address the need to acquire both peak demand (i.e. capacity) savings and energy savings through conservation and demand management (CDM), the principal focus of this evidence is on energy savings. Energy savings is an important part of the CDM agenda for the province, particularly after 2014 when new baseload generation will be needed to ensure a coal-free supply mix and existing nuclear generators will be retired or out of service for refurbishment.[1]

Mr. Neme, the author of this report, has previously filed testimony on DSM/CDM issues before the Ontario Energy Board on numerous occasions over the past decade (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), as well as before similar regulatory bodies in Quebec, Connecticut, Illinois, Maine, Maryland, New Jersey, Ohio and Vermont. A copy of his curriculum vitae is provided as Appendix B to this document.

II. Consistency of OPA Plans with Government Policies

1. Ontario Policy

We begin with a review of Ontario's Long-Term Energy Plan (LTEP), as that document summarizes the medium and longer-term goals that the various Ministerial Directives are designed to help the province to address. Though many goals are presented in the LTEP, we focus on the nearest term targets for conservation:

[1] Ontario's Long-Term Energy Plan (LTEP).

- 4550 MW of peak capacity savings, and
- 13 TWh of annual energy savings by 2015.

It is important to emphasize that both the capacity and energy savings numbers are ***annual*** savings targets – i.e. the amount of savings ***persisting*** in the year 2015. [2]

These targets were recently reinforced in the Supply Mix Directive (MC-2011-625). The Minister made clear that OPA "shall plan to achieve interim CDM targets", including the 2015 targets noted above. Importantly, the Minister also stated that the OPA's Plan:

> *"shall seek to exceed and accelerate the achievement of these CDM targets if this can be done in a manner that is feasible and cost-effective."*

These targets can be met through a combination of (1) demand-side management programs; and (2) codes, standards, regulations and other initiatives that are reasonable based on OPA analysis.

In addition, the Minister has instructed the OEB to establish 2011-2014 CDM targets for each LDC that, in aggregate, are "equal to 1330 megawatts (MW) of provincial peak demand persisting at the end of the four year period and 6000 gigawatt hours (GWh) of reduced electricity consumption accumulated over the four-year period."

2. OPA's Plan

As Table 1 illustrates, OPA has put forward a plan with CDM programs expected to achieve incremental annual savings ranging from about 0.6 TWh in 2011 to about 1.5 TWh in 2014. The overwhelming majority of the 2011 savings are projected to come from LDC delivered initiatives, including their participation in OPA's province-wide programs. By 2014, nearly half of the savings will come from the Transmission-Connected Industrial Accelerator Program.

[2] The LTEP also suggests that the target for 2030 is 28 TWh of energy savings (p. 41). That 28 TWh is presented as 14% of the 198 TWh of generation otherwise projected to be needed in 2030 (see pie chart on p. 20). The LTEP also describes the 2030 level of savings "as equivalent to taking 2.4 million homes off the grid" and reducing Ontario's greenhouse gas emissions by "up to 11 megatonnes *annually*" (p. 40, emphasis added). Both of those statements demonstrate that the energy savings target is a cumulative persisting annual target, not a lifetime savings-to-date target. The savings are measured from a 2005 base year.

Table 1: OPA-Estimated Incremental Annual GWh Savings (2011-2014)[3]

Initiative		2011	2012	2013	2014
LDC Obligations					
OPA Province-Wide Programs	91%	519	649	708	729
Supplemental LDC programs	9%	51	64	70	72
Total	100%	570	713	778	801
Other Programs					
Transmission-Connected Industrial Accelerator Program		12	163	407	698
OPA-Delivered Demand Response Programs		4	5	5	5
Total		16	168	412	703
Grand Total		586	881	1,190	1,504

As Table 2 shows, OPA is forecasting that the amount of energy savings from these and other past programs that will be persisting in 2014 is about 5.6 TWh. Roughly half of that amount will come from new LDC obligations, roughly 20% will come from the Transmission-Connected Industrial Accelerator Program and roughly 30% will come from savings persisting from 2006-2010 OPA programs.

Table 2: OPA-Estimated Cumulative Persisting Annual GWh Savings (2011-2014)[4]

Initiative		2011	2012	2013	2014
2011-2014 LDC Obligations					
OPA Province-Wide Programs	91%	519	1,136	1,766	2,419
Supplemental LDC programs	9%	51	112	175	239
Total	100%	570	1,248	1,941	2,658
2011-2014 Other Programs					
Transmission-Connected Industrial Accelerator Program		12	174	581	1,279
OPA-Delivered Demand Response Programs		4	5	5	5
Total		16	179	586	1,284
Savings Persisting from 2006-2010 OPA Programs		2108	1,775	1,762	1,647
Grand Total		2,694	3,202	4,289	5,589

[3] Savings for OPA Province-wide programs from OPA response to GEC Interrogatories 11 (for 2011) and 14 (for 2012 through 2014). Savings from Supplemental LDC programs estimated based on OPA assumption that LDCs will achieve approximately 91% of their targets through participation in OPA-Contracted Province Wide programs (response to GEC Interrogatory 15). 2011 savings from other programs from Ex I, Tab 4, Attachment 1. 2012-2014 savings from other programs from OPA response to GEC Interrogatory 15.

[4] Ibid. Savings persisting from 2006-2010 OPA programs based on OPA responses to GEC Interrogatories 11 and 14. Analysis assumes the rate of persistence of the Supplemental LDC programs will be the same as for the OPA Province-Wide programs.

It is worth noting that OPA is not interpreting the Minister's Directive to mean that system sales in 2014 will be 6000 GWh lower as a result of the LDC efforts. Indeed, as noted in Table 2 above, OPA is expecting LDC initiatives, including their participation in OPA's province-wide programs, to reduce system sales in 2014 by only about 2700 GWh. Rather, OPA appears to be interpreting the Minister's Directive to acquire 6000 GWh over the 2011-2014 period to mean 6000 GWh of lifetime savings through 2014. Put another way, savings from measures installed in 2011 would be counted four times (once each for 2011, 2012, 2013 and 2014); savings from measures installed in 2012 would be counted three times (once each for 2012, 2013 and 2014); and so on.[5] Under this interpretation, OPA appears to be expecting the LDCs to slightly exceed the province-wide target by producing approximately 6400 GWh (i.e. the sum of 570, 1248, 1941 and 2658 GWh savings persisting in 2011, 2012, 2013 and 2014, respectively).

OPA has not conducted any analysis or done any planning to determine whether it could cost-effectively acquire more than the minimum level of savings required by the Minister's Directives.

3. Critique of OPA's Plan

As discussed above, OPA has three planning obligations related to energy (GWh) savings:

1. To put the province on the path to achieve 13 TWh of persisting annual savings in 2015;
2. To assess whether the 2015 target can be cost-effectively exceeded and/or accelerated and put in place plans to do so if possible; and
3. To assist the province in achieving 6 TWh of new savings delivered by LDCs over the 2011-2014 period.

My review of the evidence suggests that the Company has failed on at least the first two of these obligations and arguably has failed with respect to the third as well.

A. Achieving 13 TWh of Persisting Savings in 2015

As the discussion above shows, OPA data suggests that it will achieve approximately 5.6 TWh of persisting cumulative annual savings in 2014 (2.7 TWh from 2011-2014 LDC obligations, 1.3 TWh from the Transmission-Connected Industrial Accelerator Program and 1.6 TWh still persisting from 2006-2010 programs). Based on the rate of growth of its persisting savings, it would be reasonable to assume that value would grow to roughly 7 TWh in 2015. That would represent only a little more than half of the 2015 target of 13 TWh.

[5] This is a simplified explanation that works for measures that have a life of 4 years or more. Measures installed in 2011 that have a life of only three years, two years or one year would be counted only three times, two times or one time, not four times.

As noted above, government policy allows OPA to count savings from new codes and standards as well as savings from CDM programs towards the 13 TWh target. Ontario adopted new building codes in 2007 and another round of updates is expected next year. The province is also currently in the process of considering adoption of new appliance and equipment efficiency standards for 30 different products, roughly half of which are electricity consuming devices. However, there are at least two important reasons to doubt whether these new standards will be enough to achieve the additional 6 TWh of persisting annual savings needed by 2015.

To begin with, though codes and standards can sometimes produce substantial savings, those savings are not instantaneous. They occur only as new buildings are constructed or new equipment is purchased, the latter being largely a function of the rate of turnover of existing equipment. In most cases, the proposed compliance dates for the new Ontario product efficiency standards would be in 2012. That would leave only three to four years of impacts to contribute to meeting the 2015 LTEP energy savings target. Thus, for long-lived equipment like refrigerators (e.g. with lives of 15 years or more), only a small portion of the existing stock will have turned over and been affected by the new standards by 2015. Second, some of the products that would be governed by the proposed new Ontario standards – e.g., those affecting the efficiency of incandescent light bulbs – are already or soon to be covered by standards promulgated in the United States and/or at the Canadian federal level. In such cases, even without an Ontario standard no inefficient products could be imported into or exported out of Ontario. Thus, for such products, the only situation in which savings would not occur anyway would be when manufacturers determine that it is worth it to produce a product in Ontario that is different from the product it produces and sells in the rest of North America (and often much of the rest of the world) and sell it only to Ontario customers. In a global market place in which manufacturers are increasingly consolidating their product lines and often reticent to produce several different variations on the same product for different regions, that may mean that the incremental impact of many of *Ontario's* efforts would be modest.

Needless to say, it is critical that analysis be conducted and carefully reviewed before any definitive determination is made that new efficiency codes, standards and/or other regulatory initiatives are sufficient to bridge the large gap to the 2015 LTEP energy savings targets. OPA bears the responsibility for doing this analysis. However, OPA has provided no estimates of the magnitude of savings expected from codes and standards in its revenue requirements submission. Moreover, in concurrent proceedings before the Board, OPA has declined a request to produce such estimates.[6] As a result, it is impossible to assess whether OPA's proposed CDM strategy – including its associated 2011 staffing and budget – is adequate to achieve perhaps its most basic conservation obligation. That represents a fundamental accountability failure.

B. Planning to Exceed and/or Accelerate 13 TWh Target

In response to GEC Interrogatory 6, OPA has bluntly stated that it has not conducted any research or planning to determine whether additional CDM was cost-effective and

[6] EB-2010-0332 TCJ1.7.

feasible. That represents a fundamental planning failure. It is also of concern because it means that the Province's electric rate-payers may end up paying higher than necessary electric bills.

C. Achieving 6 TWh of New LDC Savings over 2011-2014

The determination of whether OPA has put forward a plan that can be reasonably expected to achieve the 6 TWh of savings from LDC efforts hinges on how one interprets the Minister's Directive. Specifically, was the Minister expecting 6 TWh of lifetime savings through 2014 (e.g. counting savings from measures installed in 2011 four times, savings from measures installed in 2012 three times, etc.), or was it expecting the LDCs to collectively reduce system load by 6 TWh in 2014? As noted above, if the first interpretation is accurate, then OPA's plan appears consistent with the Directive; if the second interpretation is more appropriate, then OPA's plan falls well short – i.e. not even reaching 50% – of the requirements.

The language in the Minister's Directive is admittedly not as clear as would be ideal. However, several factors suggest that interpreting the directive as 6 TWh in cumulative persisting savings in 2014 would be most appropriate.

1. **Consistency with industry terminology**. In the North American energy efficiency industry, energy savings goals are almost always expressed as either incremental new annual savings (i.e. the new annual savings that will be produced from one year of CDM efforts) or cumulative persisting annual savings (i.e. the cumulative effects of several years of CDM efforts on demand in a particular year). Though much less common, savings goals are occasionally expressed as the total lifetime savings from one or more years of CDM efforts (i.e. the annual savings multiplied by the expected average measure life, summed over as many years of program implementation as desired). However, I am unaware of a jurisdiction in which goals have been articulated as lifetime savings up to a particular cut-off date (i.e. OPA's interpretation of the Minister's Directive).
2. **Value of the metric**. Both incremental annual savings and cumulative persisting annual savings are useful in comparing what demand-side initiatives are producing relative to supply. Total lifetime savings are useful as measures of the lifetime benefits of CDM. However, lifetime savings up to a particular cut-off date has little value as a planning metric.
3. **Consistency with the *form* of the LTEP goals**. The Minister's Directive is designed to support achievement of LTEP savings targets. The LTEP energy savings targets are clearly expressed as cumulative persisting annual energy savings targets. Thus, it would make most sense for the LDC goals to be expressed in the same terms.
4. **Consistency with the *substance* of the LTEP goals.** If the LDC delivered programs were indeed being designed to achieve 6000 GWh of cumulative persisting annual energy savings in 2014, the likelihood of the LTEP 2015 target being achieved (after consideration of the impact of codes and standards) would be enhanced, again suggesting that such an interpretation is more consistent with government policy.

5. **Consistency with goal of being a North American leader**. The Ontario government has made clear that it sees the province as a North American leader in energy efficiency. If the Minister's Directive is interpreted as OPA has interpreted it – to be lifetime savings up to 2014 – then the province would be producing incremental average annual savings equal to about 0.7% of annual electric sales over the 2011-2014 period.[7] That is well below what North American leaders are currently planning and in some cases already producing. Indeed, as a recent ACEEE review shows (see Appendix A), at least half a dozen states are planning to achieve average annual incremental electric energy savings equal to roughly 2% or more of sales between now and 2015. Many others are planning to achieve between 1% and 1.5% per year. Put simply, the OPA's interpretation of the Minister's Directive is inconsistent with the notion that Ontario is a North American leader. If the Minister's Directive was instead interpreted to mean 6 TWh of cumulative persisting annual savings in 2014 from LDCs, then the province's CDM efforts would be producing average annual incremental savings of about 1.3% per year over the 2011 to 2014 period.[8] While well below the levels of the six most aggressive states, that amount of incremental annual savings would be much more consistent with a broader definition of "a North American leader".

4. Implications of OPA's Inadequate Plan

In the context of this proceeding, OPA's planning failures make it impossible for the Board or any other party to assess the adequacy and appropriateness of OPA's proposed 2011 revenue requirement.

It is possible, for example, that OPA is under-investing in staff, consultants and/or other resource costs relative to what would be necessary to meet the LTEP goals and the Minister's Directives. Indeed, the very fact that OPA has neither done the analysis necessary to determine whether it is on track to meet those goals nor assessed whether additional cost-effective savings could be pursued (as required by the Minister's Directive) raises questions about whether its conservation division is adequately staffed.

Beyond these critical procedural needs, OPA's inadequate planning leaves open the possibility that the Province's electric rate-payers will end up paying higher than necessary electric bills.

[7] As shown in Table 1 above, the OPA plan will produce incremental annual savings of about 0.6 TWh in 2011, 0.9 TWh in 2012, 1.2 TWh in 2013 and 1.5 TWh in 2014 – an average of about 1.05 TWh over the four years. That represents about 0.7% of forecasted provincial sales of just under 150 TWh per year over the same period (LTEP p. 15).

[8] Achieving 6 TWh of cumulative persisting savings from LDCs in 2014 would mean averaging roughly 1.6 TWh of incremental annual savings each year. It would be a little more than 1.5 TWh because some of the savings in 2011, 2012 and 2013 would be from measures with short enough lives that the savings would not persist in 2014 (in response to GEC Interrogatory 11, OPA indicated that 4% of incremental annual savings generated in 2011 would have a life of only 1 year and 14% would have a life of only 2 years). In addition, as the data in Table 1 above suggest, savings from the transmission connected industrial accelerator program would provide an additional 0.3 TWh of savings per year.

III. Verification of Savings Claims

One other issue that is critically important to the determination of whether 2015 LTEP and/or other savings targets are reached is the method by which savings are initially estimated, reviewed, and ultimately verified, all matters that we understand are funded by OEB approved rates rather than by the procurement budget. OPA does not have an annual savings auditing process akin to those used by the gas utilities. OPA says that this is because:

> *"EM&V for electricity CDM activities is performed by independent third-party contracted evaluation managers selected by a competitive Request for Proposals process. EM&V conclusions are inherently independent."*[9]

While it is certainly better than doing all EM&V work internally, hiring external evaluation firms does not guarantee independence. OPA decides what evaluation activities to undertake. It decides what the scope of work will be. It decides which independent contractors to hire. It presumably reviews and provides comments on draft work products that are never made public. In other words, OPA can have great influence over estimates of the savings it is producing.

This is the very reason that a growing number of jurisdictions have been moving responsibility for EM&V to organizations other than those charged with delivering efficiency programs – so the proverbial "fox" is not guarding the proverbial "henhouse". Years ago, the Board decided not to go that far, but instead elected to require the gas utilities to (1) hire independent auditors to review savings claims and all underlying evaluation work supporting those claims; and (2) create Evaluation and Audit Committees comprised of several stakeholders charged with providing input on evaluation plans, draft evaluation work products and the hiring and management of the annual auditor.

Absent a similar modification to the existing Ontario electric EM&V framework, it is likely that there will be significant questions and/or controversy about what has actually been accomplished. This will be arguably more important on the electric side of things because roughly 80 different LDCs are reliant on the performance of the OPA programs.

IV. Recommendations

There remains uncertainty as to the extent to which OPA's CDM efforts will be scrutinized in the forthcoming IPSP process. CDM, by its nature tends to be a continually evolving matter, better suited to ongoing accountability and improvement rather than intermittent review. However, it is also apparent that the Board is not charged with regulating OPA's CDM procurement budget as part the annual revenue requirements process. Rather, the Board has made clear that reviews such as the current

[9] Response to GEC Interrogatory 7e.

one are focused on the efficiency of the administration of the larger effort and on ensuring that such spending is in support of the fulfillment of the tasks that OPA is charged with pursuing. Accordingly, this evidence has not attempted to review the particulars of CDM programs. Rather, it is intended to assist the Board in obtaining assurance that OPA is being efficient and applying appropriate resources to meet its obligations.

With that context, the discussion above suggests the following recommendations regarding the disposition of the OPA's revenue requirements submission:

1. The Board should require OPA to re-file its 2011 revenue requirements plan with sufficient evidence to demonstrate *prima facie* that:

    a. It has a plan to meet the 2015 LTEP persisting annual energy savings target;
    b. It has identified all cost-effective opportunities to exceed and/or accelerate achievement of the 2015 LTEP savings targets, and has a plan to acquire the additional savings and/or accelerate achievement of the 2015 LTEP savings targets;
    c. Its staffing, consulting and other resources proposed in its 2011 revenue requirements are consistent with the plans to meet or exceed the 2015 LTEP savings targets (i.e. consistent with points "a" and "b" above).

2. The Board should put in place an interim order authorizing OPA to pursue CDM activities consistent with its current plan until such time as its revised plan (per my first recommendation) is approved. This will ensure that time is not wasted and much needed CDM initiatives are launched as soon as possible.

3. The Board should make clear that in all future revenue requirements proceedings that OPA will be expected to include in its submission an analysis which documents how it plans to meet each Ministry Directive and the savings targets of the LTEP, including

        i. how much of the savings will come from each DSM/CDM initiative;
        ii. how much of the savings will come from each efficiency code and standard;
        iii. high level analyses supporting estimates that are projected to come from each CDM initiative, each code, each standard and other contributing policies; and
        iv. a report on the potential for and planned efforts to accelerate and exceed the LTEP targets in accord with the Supply Mix Directive.

4. The Board should require OPA to annually hire an independent auditor of its annual savings claim (and budget for doing so).

5. The Board should require OPA to create an Evaluation and Audit Committee, comprised of stakeholder representatives, to provide input on evaluation planning, evaluation scopes of work, draft evaluation work products, the selection of the annual auditor and the management of the work of the annual auditor. This would be akin to the EAC Committees currently working with Enbridge and Union Gas.

6. The Board should require OPA to file annual reports, following completion of the annual auditing process, regarding progress towards LDC CDM Directive goals and the LTEP goals.

ACEEE
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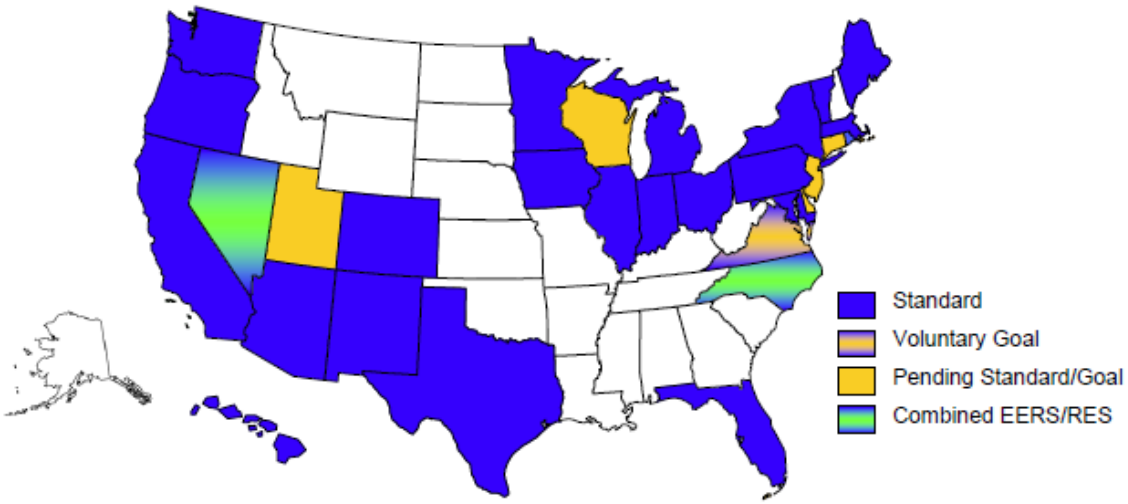
State Energy Efficiency Resource Standard (EERS) Activity

November 2010



Twenty-four states have enacted energy savings goals, or Energy Efficiency Resource Standards (EERS), through legislation and several states have a pending EERS

State EERS descriptions are listed below chronologically from when the state adopted an EERS.

State	EERS Policy	Reference
Texas 1999 and 2007 Electric	Texas became the first state to establish an EERS in 1999, requiring electric utilities to offset 10% of load growth through end-use energy efficiency. In 2007 the legislature doubled the standard to 20% of load growth by 2010 and directed that higher targets be investigated. In 2010, the Public Utilities Commission approved an increase in the energy efficiency goal to 25% of electric demand growth by 2012 and 30% in 2013 and beyond.	Texas Statutes 39.905; PUCT Substantive Rule Sec. 25.181
Vermont 2000 Electric	Efficiency Vermont (EV), an independent "efficiency utility" that delivers efficiency programs for the state, is contractually required to achieve energy and demand goals. EV cumulatively met over 9% of Vermont's electricity requirements by the end of 2008. EV has energy savings goals for 2009-2011 of 360,000 total annual MWh, 51.2 total summer peak MW, and 54 total winter peak MW. The projected MWh savings amount to 6% of 2008 sales for these three years combined.	30 V.S.A. Sec. 209(d)(e); VT PSB Docket 5980; Draft 2009-2011 Annual Plan, 2009-2011 Energy Efficiency Utility Contract

State	EERS Policy	Reference
California 2004 and 2009 Electric and Natural Gas	California's long-term targets for its investor-owned utilities (IOUs) plan to save over 16,000 GWh and over 4,500 MW between 2012 and 2020. The most recent 2010-2012 program plan sets interim targets of 1,500 MW and 7,000 GWh, which is equivalent to 3.9% of total retail electric sales for California's 3 major utilities. The plan also establishes natural gas savings targets of 150 million metric therms.	Rulemaking 06-04-010; Application 08-07-021
Hawaii 2004 and 2009 Electric	The state's new EEPS sets a goal of 4,300 GWh savings by 2030, approximately 40% of 2007 electricity sales. The PUC must set interim goals and may change the 2030 goal if proven unattainable. It also calls for penalties for non-compliance. Formerly, under the state's RPS requirements, energy efficiency was allowed to qualify as an eligible resource. As of January 1, 2015, energy efficiency may no longer count towards the state's renewable goals.	HB 1464
Pennsylvania 2004 and 2008 Electric	Energy efficiency is an eligible resource in Tier II of Pennsylvania's Alternative Energy Portfolio standard, which was established in 2004 as a two-tiered renewable energy standard; however, there was no minimum efficiency target. In 2008, legislation was passed requiring electric distribution companies to meet 1% electricity savings in 2011 and a total of 3% by 2013, as a percent of 2009-2010 electricity sales.	Act 129; Alternative Energy Portfolio Standards (AEPS) Act (Act 213)
Connecticut 2005 (Pending) Electric	In compliance with its renewable portfolio standard, Connecticut's utilities had to procure a minimum 1% of electricity sales from energy efficiency and/or CHP, a class III resource, each year from 2007 through 2010. The Department of Public Utility Control (DPUC) did not adopt higher savings goals proposed by the utility program administrators and the Energy Efficiency Board in the last two Integrated Resource Plans, which were equivalent to about 20% energy savings over ten years. In its latest decision, the DPUC did not approve additional funding for energy efficiency programs that would be necessary to comply with the state's statute to acquire all cost-effective energy efficiency.	The 2007 Electricity and Energy Efficiency Act (H.B. 7432); Conn. Gen. Stat. §16a-3a (2007). Docket 09-10-03; Docket 10-02-07
Nevada 2005 and 2009 Electric	Nevada's Renewable Portfolio Standard was revised in 2005 to increase the portfolio requirement to 20% by 2015 and allow the utilities to use energy efficiency to help meet the requirements. The state's RPS was expanded in 2009 to 25% of electricity sales. Energy efficiency can meet up to 25% of the total portfolio standard.	2009 Senate Bill 358
Rhode Island 2006 Electric and Natural Gas	The Comprehensive Energy Conservation, Efficiency, and Affordability Act of 2006 requires utilities to submit energy efficiency procurement plans. The Commission has approved the plan of the state's major utility, National Grid, which aims to save 1% in 2009, ramping up to 1.5% in 2011 based on 2008 retail sales. The goals also include natural gas targets of 0.5% for programs in 2009.	2006 SB 2903; Docket No. 3931

State	EERS Policy	Reference
Washington 2006 Electric	In 2006, ballot initiative I-937 was approved requiring utilities to acquire all cost-effective energy efficiency. The Northwest Power and Conservation Plan sets the basis for efficiency targets. The 6th and most recent NWPC plan identifies 5,900 average MW of cost-effective and achievable conservation savings in the Northwest by 2030. In January 2010, Washington's three IOUs submitted biennial conservation goals and identified achievable efficiency potential through 2019. Avista, has had its goals approved, which aim for over 1% savings a year. Pacificorp has proposed similar goals. Puget Sound Energy submitted lower goals based on the 5th Power Plan, which have been challenged by the utility commission.	Ballot initiative 937; Sixth Northwest Power Plan
Colorado 2007 Electric and Natural Gas	In April 2007, the Colorado legislature adopted a bill that called on the Colorado Public Utilities Commission (CPUC) to establish energy savings goals and provide financial incentives for electric and natural gas utilities. The CPUC established an energy savings goal of about 11.5% by 2020 for Xcel Energy and sets the same targets for Black Hills Energy to 2011. Natural gas utilities have individual targets in place as well	HB-07-1037; CPUC Docket No. 07A-420E; Docket No. 08A-518E
Minnesota 2007 Electric and Natural Gas	Minnesota utilities must achieve 1.5% annual energy savings of electric and natural gas sales, at least 1% of which must come from energy efficiency. This plan was enacted in legislation in 2007 and requires utilities to meet the annual targets by 2010.	MN Statutes 2008 § 216B.241
Virginia 2007 Electric	Governor Kaine inserted an enactment clause into the March 2007 electricity restructuring legislation stating that the Commonwealth shall have a goal of reducing electricity consumption by 10% (of 2006 consumption) by 2022. Dominion is currently on track to achieve about 3% energy savings by 2022. As it is a voluntary goal, it is not counted among the twenty-five states with an EERS.	VA 2007 Acts of Assembly, Chapter 933; Case No. PUE-2007-00049
Illinois 2007 Electric and Natural Gas	In July 2007, the Illinois legislature set energy efficiency and demand response program requirements for utilities. With help from the state of Illinois Utilities must achieve annual savings goals of: 0.2% of energy delivered in 2008, 0.4% in 2009, and so on, rising to 2.0% annually for 2015 and subsequent years. Program implementation began in 2008. The state also passed natural gas savings targets in 2009 providing cumulative savings of 8.6% in 2020. For all programs, there is a rate impact cap of 2% of overall rates over the 3-year reporting period.	220 ILCS 5/12-103; SB 1918
North Carolina 2007 Electric	In August 2007, the North Carolina legislature enacted a law requiring public electric utilities in the state to obtain renewable energy power and energy efficiency savings of 3% of prior-year electricity sales in 2012, 6% in 2015, 10% in 2018, and 12.5% in 2021 and thereafter. Energy efficiency is capped at 25% of the 2012-2018 targets, and at 40% of the 2021 target.	N.C. Gen. Stat. § 62-133.8

State	EERS Policy	Reference
New York 2008 Electric and Natural Gas	In June 2008, the New York State Public Service Commission approved a goal to reduce electricity usage 15% by 2015. The Commission currently has an open proceeding working with utilities and NYSERDA to expand existing programs and develop new ones. New York also has natural gas targets that aim for 1.3% annual savings and are not binding.	NYSERDA Order 07-M-0548
New Mexico 2008 Electric	Electric and gas utilities must acquire all cost-effective and achievable energy efficiency resources. Investor-owned electric utilities must achieve 5% energy savings from 2005 sales by 2014 and 10% by 2020.	NMSA §§ 62-17-1 – 62-17-11
Maryland 2008 Electric	In 2008, legislation was enacted that requires the state's electric utilities to reduce per-capita electricity consumption 15% by 2015, relative to 2007 per capita consumption. Utilities must meet 2/3rds of the goal and the state must administer programs to reach 1/3rd of the goal.	MD Public Utility Companies Code, Title 7-211
Ohio 2008 Electric	In 2008, legislation was enacted that requires a gradual ramp-up to a 22% reduction in electricity use by 2025. Starting in 2009, electric distribution utilities must achieve 0.3% savings, which amps up to 1% per year by 2014, then jumps to 2%/year in 2019 through 2025.	Ohio Revised Code 4928.66
Michigan 2008 Electric	Michigan's goals start at 0.3% of electricity sales in 2009 and ramp up to an annual electricity savings requirement of 1% of total sales by 2012, and continue at that level each year thereafter (0.75% for natural gas utilities).	SB 213
Iowa 2009 Electric	In 2008, the Iowa Utilities Board (IUB) issued an order asking investor-owned utilities (IOUs) to submit plans including a scenario to achieve a 1.5% annual electricity and natural gas savings goal. Most recently, in March 2009, the IUB approved MidAmerican Energy Company's Energy Efficiency Plan which calls for 1.5% electricity savings by 2010 and 0.85% natural gas savings by 2013. Although not required by legislation, once the board approves the utility plan, the goals are binding. Also in 2008, the legislature passed a new framework for municipal and cooperative utility efficiency programs requiring these utilities to set energy savings goals, create plans to achieve those goals, and report to the IUB on progress.	Docket No. 199 IAC 35.4(1) (EEP-02-38, EEP-03-1, EEP-03-4); 2009 Iowa Code Title XI, Subtitle 5, Ch. 476
Indiana 2009 Electric	Indiana's Commission ordered all jurisdictional electric utilities to begin submitting three-year DSM plans in 2010 indicating their proposals and projected progress in meeting annual savings goals outlined by the Commission. The goals begin at 0.3% annual savings in 2010, increasing to 1.1% in 2014, and leveling at 2% in 2019.	Cause No. 42693
Arizona 2009 Electric	On December 18th, the ACC ordered that all investor-owned utilities and rural electric cooperatives achieve 2% annual savings beginning in 2014. By 2020, the state should reach 20% cumulative savings, relative to 2005 sales, plus 2% from peak demand reductions from demand response programs. Electric distribution cooperatives are required to meet 75% of the standard in any year.	Docket Nos. RE-00000C-09-0427, Decision No. 71436

State	EERS Policy	Reference
Massachusetts 2009 Electric and Natural Gas	Massachusetts has a legislative requirement enacted in 2008 for electric and gas utilities to acquire all cost-effective energy efficiency that costs less than new energy supply as the first priority resource. The Department of Public Utilities also recently approved an annual electricity savings target of 2.4% and natural gas target of 1.15% by 2012.	D.P.U. 09-116 through D.P.U. 09-128
Florida 2009 Electric	In December 2009, the Florida Public Utility Commission set goals for its electric utilities at 3.5% energy savings over 10 years. The goal is less than half of the goal recommended by the Commission staff's own expert.	Docket Nos. 080407-EG – 080413-EG; Order No. PSC-09-0855-FOF-EG
Maine 2010 Electric and Natural Gas	The Maine Public Utilities Commission approved the triennial plan of the Efficiency Maine Trust, which develops, plans, coordinates, and implements energy efficiency programs in the state. In the plan, the Trust commits to annual energy savings goals in FY2011 of around 1%, ramping up to 1.4% in FY2013. The plan also includes savings targets for other fuels.	Docket No. 2010-116
Oregon 2010 Electric and Natural Gas	In its first ever long-range strategic plan, the Energy Trust of Oregon laid out energy savings goals between 2010 and 2014 of 256 average megawatts (2,242.6 GWh) of electricity and 22.5 million annual therms of natural gas. These goals include savings from Northwest Energy Efficiency Alliance programs. The electric targets are equivalent to 0.8 percent of 2009 electric sales in 2010, ramping up to 1% in 2013 and 2014. The natural gas targets ramp up from 0.2 percent of 2007 natural gas sales to 0.4 percent in 2014.	Energy Trust of Oregon 2009 Strategic Plan
Delaware Pending Electric and Natural Gas	On July 29, 2009, Governor Markell signed SB 106, which sets goals for consumption and peak demand for electricity and natural gas utilities. The goals are 15% electricity consumption and peak demand savings and 10% natural gas consumption savings by 2015. A binding EERS is currently pending, however, as regulations outlining compliance standards and procedures have yet to be approved.	SB 106
Wisconsin Pending Electric and Natural Gas	In November 2010, the Wisconsin Public Service Commission approved electric energy and demand goals as a percent of peak load and electric sales of 0.75% in 2011, ramping up to 1.5% in 2014. The PSC also approved natural gas goals of 0.5% in 2011, ramping up to 1% in 2013. The goals must be approved by the State Senate Finance Committee before they are binding and may be revised by the PSC.	Docket 5-GF-191
Utah Pending Electric and Natural Gas	Utah passed an EERS bill in 2009 that urges the UT PUC to set energy savings goals of at least 1% per year for regulated electric utilities and at least 0.5% per year for gas utilities. The bill does not penalize utilities that do not meet the savings goals, as long as they make good faith efforts. A docket is open that is reviewing a wide range of DSM policies including (but not limited to) the issues addressed in the resolution.	Docket No. 09-035-T08, House Joint Resolution 9

State	EERS Policy	Reference
New Jersey Pending Electric and Natural Gas	New Jersey's utility efficiency goals, which are still under development, contain two main elements: (1) setting energy and demand goals for the administrators of the Clean Energy Program, and (2) requiring each electricity supplier/provider to meet efficiency goals. As of June 2007, the BPU has been authorized to adopt an electric and a gas energy efficiency portfolio standard, with goals as high as 20% savings by 2020 relative to predicted consumption in 2020. It has yet to implement any targets for utilities.	Executive Order 54; New Jersey Energy Master Plan

For further information, please visit http://www.aceee.org/energy/state/
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CHRISTOPHER NEME, PRINCIPAL

EDUCATION

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

EXPERIENCE

2010-present: Principal, 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 Neme leads a variety of consulting projects for clients across the United States, Canada, and Europe. He specializes in analysis of markets for energy efficiency measures and the design of programs and policies to promote them. Prior to co-founding Energy Futures Group, he served as Director of the Vermont Energy Investment Corporation's 30-person consulting division. During his more than 20 years in the energy efficiency industry, Mr. Neme has conducted analyses of efficiency potential in five states; reviewed or developed efficiency programs in more than 20 different states and provinces and the United Kingdom; led utility-stakeholder "collaboratives" in six states, and defended expert witness testimony before regulatory commissions in nine different states and provinces. Mr. Neme has led several different training courses on the elements of good efficiency program design, including one sponsored by Affordable Comfort for its annual national conference. He has also published papers and/or presented assessments of efficiency markets, programs and policies through a wide variety of publications, conferences, Consortium for Energy Efficiency Technical Committees, ENERGY STAR working groups and other international forums. Mr. Neme currently serves as Co-Chair of NEEP's EM&V Research and Evaluation Committee.

SELECTED PROJECTS

- ***Regulatory Assistance Project.*** Drafting "white papers" on (1) policies and program strategies to achieve whole house retrofits of half of all homes within 15 years; and (2) the role efficiency programs can play in cost-effectively deferring transmission and distribution system investments. Also helping to administer initiative to provide technical support on efficiency program planning and evaluation to Energy Foundation grantees and regulatory staff. (2010 to present)
- ***Efficiency Vermont.*** Oversaw residential program planning, input to the VT Department of Public Service on evaluation planning, and development of M&V plan and other aspects of bids of efficiency resources into New England's Forward Capacity Market (FCM) from March 2000 through Spring 2010. Currently providing strategic support on bidding of efficiency resources into the FCM. (2000 to present)
- ***Northeast Energy Efficiency Partnerships.*** Senior Advisor to a project to develop a Technical Reference Manual for three Mid-Atlantic States. The manual will cover measures accounting for more than 90 percent of non-custom savings for the region. (2009 to present)

CHRISTOPHER NEME, PRINCIPAL

- ***Natural Resources Defense Council (Illinois).*** Critically reviewed 3-year DSM plans filed by Commonwealth Edison and Ameren. Drafted and defended regulatory testimony on critiques. Represent NRDC in Stakeholder Advisory Group (SAG) which meets monthly with utilities to provide discuss program designs, evaluation priorities and input on draft evaluation reports that are presented simultaneously to the utilities and the SAG. (2010 to present)

- ***Green Energy Coalition (Ontario).*** Representing a coalition of environmental groups in various regulatory proceedings. Present recommendations on DSM policies, critically review and negotiate with utilities on proposed DSM Plans, serve (elected by non-utility stakeholders) on utility Evaluation/Audit Committees which oversee an annual savings verification process and evaluation planning, and defend expert witness testimony. (1993 to present)

- ***Iowa Consumer Advocate.*** Critically reviewed several electric and gas utilities' DSM plans and savings claims. Assisted with the development of regulatory testimony. Currently serve as technical advisor to statewide collaborative process, occasionally providing input on utility evaluation plans and other topics.

- ***Tennessee Valley Authority.*** Assisted a team providing input to TVA on the redesign of its residential efficiency program portfolio to meet aggressive new five-year savings goals. (2010)

- ***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 will serve as the basis for all electric and gas efficiency program savings claims in the state. (2009 to 2010)

- ***New Jersey Clean Energy Program.*** Oversaw support of Honeywell-led team delivering all statewide residential efficiency and renewable energy programs. Led work on program design, regulatory filings, savings algorithms, and evaluation planning. (2006 to 2010)

- ***New York State Energy Research and Development Authority (NYSERDA).*** Led several analyses of residential electric and gas efficiency potential (over 20 years) for New York State. Scenarios included continuation of existing initiatives, new budget constraints and a least-cost approach to meeting greenhouse gas emission reduction targets. (2001 to 2010)

- ***British Department of Energy and Climate Change.*** Supported the British government's development of aggressive national efficiency initiatives, particularly strategies for rapid and massive-scale retrofits of the thermal envelops of existing homes. (2009)

- ***Oregon Energy Trust***. Part of a team that developed case studies of successful community-based efficiency or renewable energy efforts across North America, synthesized lessons learned from those examples, and developed recommendations for how the trust might more effectively advance its mission through community-based approaches to promoting efficiency. (2004-2005)

- ***NSTAR Collaborative***. Oversaw all technical assistance on the design of and implementation planning for six major residential DSM programs. Personally led work on two of the programs (high use retrofit & low income). This involved negotiations with NSTAR on goals, budgets and program designs, and technical assistance on selection of delivery contractors, development of field protocols to guide measure installation decisions, and review of program results. All work was conducted on behalf of the Massachusetts Non-Utility Parties. (1999 to 2005)

CHRISTOPHER NEME, PRINCIPAL

- ***Natural Resource Defense Council – New Jersey Utilities Collaborative.*** Oversaw all technical assistance on the design of and implementation planning for eight statewide residential DSM programs and one statewide renewable energy program. Personally led work on two of the programs (Electric HVAC and Gas HVAC). This involved facilitation of monthly meetings with all seven electric and gas utilities in the state; negotiations with the utilities on budgets, goals, and program designs; and extensive technical assistance on a variety of programmatic issues, including the development of marketing plans and evaluation plans. (1994 to 2003)
- ***Long Island Power Authority Clean Energy Plan.*** Led team that designed the four major residential programs (three efficiency, one PV) incorporated into the plan in 1999. Oversaw extensive technical support to the implementation of those programs. This involved assistance with the development of goals and budgets, development of savings algorithms, cost-effectiveness screening, and on-going program design refinements. (1998 to 2009)
- ***Northeast Energy Efficiency Partnerships Residential HVAC Initiative.*** Served as NEEP's Residential HVAC Program Manager. Responsible for promoting NEEP's program design concept to utilities in the Northeast, providing technical support to efforts to implement the design, and promoting the adoption of improved federal efficiency standards (and ENERGY STAR standards) for central air conditioners. (1997 to 2005)
- ***Southern Maryland Electric Cooperative.*** Led review and feedback on residential efficiency program portfolio. Also led impact evaluation of residential new construction and home retrofit programs. (1994 to 1998)
- ***Lawrence Berkeley Laboratory/Botswana.*** Conducted both economic and institutional analyses of the potential for cost-effective end-use energy efficiency improvements in southern Africa. Principal focus was on the electricity sector in Botswana. Initiated discussions between the Botswana government and LBL on the benefits of energy efficient building codes and the possibility of LBL developing such a code for Botswana. (1992)

SELECTED PUBLICATIONS

- "Is it Time to Ditch the TRC?" Proceedings of ACEEE 2010 Summer Study on Energy Efficiency in Buildings, Volume 5 (with Marty Kushler).
- "A Comparison of Energy Efficiency Programmes for Existing Homes in Eleven Countries", prepared for the United Kingdom Department of Energy and Climate Change on behalf of the Regulatory Assistance Project, 19 February 2010 (with Blair Hamilton et al.).
- "Energy Efficiency as a Resource in the ISO New England Forward Capacity Market", in *Energy Efficiency*, published on line 06 June 2010 (with Cheryl Jenkins and Shawn Enterline).
- "Energy Efficiency as a Resource in the ISO New England Forward Capacity Market", Proceedings of the 2009 European Council on an Energy Efficient Economy Summer Study, pp. 175-183 (with Cheryl Jenkins and Shawn Enterline).
- "Playing with the Big Boys: Energy Efficiency as a Resource in the ISO New England Forward Capacity Market", Proceedings of ACEEE 2008 Summer Study Conference on Energy Efficiency in Buildings, Volume 5 (with Cheryl Jenkins and Blair Hamilton)

- "Recommendations for Community-Based Energy Program Strategies", Final Report, developed for the Energy Trust of Oregon, June 1, 2005 (with Dave Hewitt et al.)
- "Shareholder Incentives for Gas DSM: Experience with One Canadian Utility", Proceedings of ACEEE 2004 Summer Study Conference on Energy Efficiency in Buildings, Volume 5 (with Kai Millyard).
- "Shareholder Incentives for Gas DSM: Experience with One Canadian Utility", Proceedings of ACEEE 2004 Summer Study Conference on Energy Efficiency in Buildings, Volume 5 (with Kai Millyard).
- "Cost Effective Contributions to New York's Greenhouse Gas Emission Reduction Targets from Energy Efficiency and Renewable Energy Resources", ACEEE 2004 Summer Study Proceedings, Volume 8 (with David Hill et al.).
- "Opportunities for Accelerated Electric Energy Efficiency Potential in Quebec: 2005-2012", prepared for Regroupement national des conseils regionaux de l'environnement du Quebec, Regroupement des organisms environnementaux energie and Regroupement pour la responsabilite sociale des enterprises, May 16, 2004 (with Eric Belliveau, John Plunkett and Phil Dunsky).
- "Review of Connecticut's Conservation and Load Management Administrator Performance, Plans and Incentives", for Connecticut Office of Consumer Counsel, October 31, 2003 (with John Plunkett, Phil Mosenthal, Stuart Slote, Francis Wyatt, Bill Kallock and Paul Horowitz)
- "Energy Efficiency and Renewable Energy Resource Development Potential in New York State", for New York Energy Research and Development Authority, August 2003 (with John Plunkett, Phil Mosenthal, Stave Nadel, Neal Elliott, David Hill and Christine Donovan).
- "Assessment of Economically Deliverable Transmission Capacity from Targeted Energy Efficiency Investments in the Inner and Metro-Area and Northwest and Northwest/Central Load Zones", for Vermont Electric Power Company, Final Report: April 2003 (with John Plunkett et al.).
- "Residential HVAC Quality Installation: New Partnership Opportunities and Approaches", Proceedings of ACEEE 2002 Summer Study Conference on Energy Efficiency in Buildings, Volume 6 (with Rebecca Foster, Mia South, George Edgar and Put Murphy).
- "Using Targeted Energy Efficiency Programs to Reduce Peak Electrical Demand and Address Electric System Reliability Problems", published by the American Council for an Energy Efficient Economy, November 2000 (with Steve Nadel and Fred Gordon).
- "Energy Savings Potential from Addressing Residential Air Conditioner and Heat Pump Installation Problems", American Council for an Energy Efficient Economy, February 1999 (with John Proctor and Steve Nadel).
- "Promoting High Efficiency Residential HVAC Equipment: Lessons Learned from Leading Utility Programs", Proceedings of ACEEE 1998 Summer Study Conference on Energy Efficiency in Buildings, Volume 2 (with Jane Peters and Denise Rouleau).

- PowerSaver Home Program Impact Evaluation, report to Potomac Edison, February 1998 (with Andy Shapiro, Ken Tohinaka and Karl Goetze).
- "PowerSaver Home Program Impact Evaluation", prepared for Southern Maryland Electric Cooperative, December 9, 1997 (with Andy Shapiro, Ken Tohinaka and Karl Goetze).
- "A Tale of Two States: Detailed Characterization of Residential New Construction Practices in Vermont and Iowa", Proceedings of ACEEE 1996 Summery Study Conference on Energy Efficiency in Buildings, Volume 2 (with Blair Hamilton, Paul Erickson, Peter Lind and Todd Presson).
- "New Smart Protocols to Avoid Lost Opportunities and Maximize Impact of Residential Retrofit Programs", in Proceedings of ACEEE 1994 Summer Study on Energy Efficiency in Buildings, pp. 9.147-9.157 (with Blair Hamilton and Ken Tohinaka.
- "Economic Analysis of Woodchip Systems" and "Finding Capital to Pay for a Woodchip Heating System", Chapters 6 and 8 in *Woodchip Heating Systems: A Guide for Institutional and Commercial Biomass Installations*, published by the Council of Northeastern Governors, July 1994.
- "PSE&G Lost Opportunities Study: Current Residential Programs and Relationship to Lost Opportunities", prepared for the PSE&G DSM Collaborative, June 1994 (with Blair Hamilton, Paul Berkowitz and Wayne DeForest).
- "Long-Range Evaluation Plan for the Vermont Weatherization Assistance Program", prepared for the Vermont Office of Economic Opportunity, February 1994 (with Blair Hamilton and Ken Tohinaka).
- "Impact Evaluation of the 1992-1993 Vermont Weatherization Assistance Program", prepared for the Vermont Office of Economic Opportunity, December 1993 (with Blair Hamilton and Ken Tohinaka).
- "Electric Utilities and Long-Range Transport of Mercury and Other Toxic Air Pollutants", published by the Center for Clean Air Policy, 1991.
- "Coal and Emerging Energy and Environmental Policy", in *Natural Resources and Environment*, 1991 (with Don Crane).
- "Acid Rain: The Problem", in EPA Journal, January/February 1991 (with Ned Helme)
- "An Efficient Approach to Reducing Acid Rain: The Environmental Benefits of Energy Conservation", published by the Center for Clean Air Policy, 1989.
- "The Untold Story: The Silver Lining for West Virginia in Acid Rain Control", published by the Center for Clean Air Policy, 1988.
- "Midwest Coal by Wire: Addressing Regional Energy and Acid Rain Problems", published by the Center for Clean Air Policy, 1987.
- "Acid rain: Road to a Middleground Solution", published by the Center for Clean Air Policy, 1987 (with Ned Helme).