BRITISH COLUMBIA UTILITIES COMMISSION

FortisBC Inc.

2016 Long Term Electric Resource Plan and

Long Term Demand Side Management Plan

BCUC Project No. 3698896

Testimony of James Grevatt, Energy Futures Group, Inc.

for

B.C. Sustainable Energy Association and Sierra Club B.C.

May 25, 2017

I. Introduction and Summary

BCSEA-SCBC retained Jim Grevatt, Energy Futures Group, Inc. (EFG), to review and analyze FortisBC Inc.'s 2016 Long Term Electric Resource Plan (LTERP) and 2016 Long Term Demand Side Management Plan (LT DSM Plan) in order to determine if there are opportunities for FortisBC Inc. (Fortis) to increase the benefits it provides to ratepayers and to the Province through its DSM initiatives.

Mr. Grevatt has provided expert review of programs in Maryland, Pennsylvania, Mississippi, New Hampshire, and Maine and currently leads strategic planning for the New Jersey Clean Energy Program for EFG. He brings 25 years' leadership experience in energy efficiency program operations to his consulting practice. As Director of Residential Energy Services for Efficiency Vermont for over five years, and then in the same role for the District of Columbia Sustainable Energy Utility for its startup operation, Mr. Grevatt has hands-on experience with industry-leading markets-based approaches to managing energy efficiency programs, including multi-family, low income, residential retrofit, new construction, HVAC, and efficient products programs. Mr. Grevatt's CV is attached as Appendix A.

Based on its review and analysis, EFG has identified opportunities for Fortis to improve its approach to DSM planning in the following areas:

1. **Fortis shows reluctance to consider higher levels of DSM than are proposed in the application in part on the grounds that DSM is too risky. This determination on Fortis' part is not well-founded in evidence. The cost effectiveness of increasing the size of the DSM portfolio may remain a limiting factor, but Fortis should not arbitrarily limit the size of its DSM portfolio, either now or in the future, based on suppositions about risk that are not strongly supported by evidence.**
2. **Fortis asserts that DSM is not sufficiently reliable to warrant analyzing the potential use of DSM to defer capital investments. EFG finds that both energy efficiency and demand response can, in some cases, be used to defer such investments, and recommends that Fortis review the available research on leading practices in this area. Then, Fortis should conduct analyses specific to**

the FBC system to determine whether DSM would be a feasible and cost-effective alternative to defer future distribution improvements, transmission improvements or supply-side capacity acquisition.

3. **Fortis should be prepared to adjust its LT DSM Plan based upon analyses from the next phase of the Conservation Potential Review that are not now available. These would include whether fuel-switching in support of low carbon electrification would be cost effective.**
4. **Fortis should improve its approach to assessing DSM program cost-effectiveness in two ways:**
    a. **The analysis should reflect environmental values based on the Modified TRC test as a standard practice, and not only when measures or programs do not pass screening using the standard TRC test.**
    b. **The analysis should use marginal, rather than average, line losses in screening the cost-effectiveness of DSM initiatives, given that DSM saves energy and demand at the margin.**

II. Detail

A detailed explanation of EFG's findings follows.

1. **Fortis shows reluctance to consider higher levels of DSM than are proposed in the application in part on the grounds that DSM is too risky. This determination on Fortis' part is not well-founded in evidence. The cost effectiveness of increasing the size of the DSM portfolio may remain a limiting factor, but Fortis should not arbitrarily limit the size of its DSM portfolio, either now or in the future, based on suppositions about risk that are not strongly supported by evidence.**

In its 2016 LTERP Fortis states:

> "…DSM levels higher than the High scenario create risks in terms of managing the LRB. DSM is neither available on demand nor as reliable as a supply side resource option because DSM programs require voluntary participation by customers. Therefore, there is no guarantee that actual DMS program uptake will materialize as planned and an over-reliance on

> DSM could leave unexpected gaps in the LRB that still need to be filled to meet customer load requirements."[1]

Fortis does not provide evidence to substantiate its claim that high DSM savings targets are too risky. Actually, many jurisdictions in North America routinely achieve high savings goals through DSM programs, and are often required by regulators to do so. These savings goals are often considerably larger than those contemplated by Fortis. In its response to Staff IR, Fortis provides estimates of savings as a percent of total load for 2018-2022 from the 2016 LT DSM Plan. These estimates range from 0.5% in the low scenario to 0.8% in the max scenario.[2] Even accounting for any mitigating factors in the comparisons, these are substantially lower savings than have been achieved in other jurisdictions in North America. For example, according to the 2016 ACEEE State Scorecard, three U.S. states achieved net savings greater than 2.0% of sales in 2015, and an additional thirteen states achieved savings between 1.0% and 2.0% of sales. In all, nineteen states achieved greater than the 0.8% savings that Fortis contemplates in its Max scenario, and many of these states have been achieving high levels of savings year after year.[3]

While it may be true that "there is no guarantee that actual DSM program uptake will materialize," it is also true that participation is not random. Fortis seems to underestimate its ability to influence customer participation. In its LT DSM Plan, Fortis states:

> "The Max scenario was not chosen for a number of reasons including the voluntary nature of DSM participation….The Max scenario presents…Higher risks of… Insufficient customer participation…." [4]

Achieving a specific level of savings, especially when the bar is high, requires implementing thoughtful strategies to ensure that enough customers participate in the programs. Fortis has many tools at its disposal to ensure that enough customers will

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[1] Exhibit B-1, Fortis BC Inc. 2016 LTERP, p.104, pdf p.125.
[2] Exhibit B-2, Table 4 from Fortis response to BCUC IR 1.38.2, pdf p.140.
[3] Berg, Weston, et al. The 2016 State Energy Efficiency Scorecard, p.28. ACEEE, September, 2016, http://aceee.org/node/3078?id=5254.
[4] Exhibit B-1, Volume 2, Fortis BC Inc. 2016 Long-Term DSM Plan, p.15, pdf p.501.

participate for it to meet its proposed goals or goals that are higher, including marketing and outreach, technical assistance, and incentives. It is Fortis' work to determine how to best use these tools to overcome the barriers that limit "voluntary" participation in DSM programs. When goals are higher, greater effort will certainly be required. However, there is ample evidence that even Fortis' proposed Max scenario is well below the level that effective programs can be expected to achieve.

In summary, Fortis does not present evidence to support its speculation that high DSM savings targets are too risky. EFG recommends that savings goals in this and future LT DSM Plans should be supported by evidence.

2. **Fortis asserts that DSM is not sufficiently reliable to warrant analyzing the potential use of DSM to defer capital investments. EFG finds that both energy efficiency and demand response can, in some cases, be used to defer such investments, and recommends that Fortis review the available research on leading practices in this area. Then, Fortis should conduct analyses specific to the FBC system to determine whether DSM would be a feasible and cost-effective alternative to defer future distribution improvements, transmission improvements or supply-side capacity acquisition.**

Fortis states that it "…considers DSM savings to be reliable but non-firm resources, and thus cannot be counted on to defer network system reinforcements that are predicated on peak load requirements."[5] However, EFG finds this statement to be over-generalized.

For instance, in its response to BCSEA IR 25.2, Fortis cites air source heat pumps as an example of "…the non-dependability of DSM measures with respect to system operations and planning."[6] Fortis says that "…at temperatures below approximately -10° C to -20° C, an air source heat pump (ASHP) relies almost entirely on backup heating (typically electric resistance heating)."[7] However, the study cited by Fortis in its IR

[5] Exhibit B-2, Fortis response to BCUC IR 23.2.1, pdf p.79.
[6] Exhibit B-13, Fortis response to BCSEA IR 25.2, pdf p.6.
[7] Exhibit B-13, Fortis response to BCSEA IR 25.2, pdf p.6.

response was published in 2010, and heat pump technology has advanced since that time, particularly for inverter-driven ductless mini-split heat pumps.

The Northeast Energy Efficiency Partnerships (NEEP) facilitated a collaborative process that included manufacturers, efficiency program sponsors, and consultants to develop its "Cold Climate Air-Source Heat Pump Specification." For equipment to qualify to be listed as meeting the specification it must, among other things, have a COP @ 5° F (-15° C) >1.75 (at maximum capacity operation).[8] Much of the equipment included in this specification is designed to perform in heat pump mode without electric resistance backup at temperatures as low as -25° C. The equipment that meets this specification will perform much differently, and much more efficiently, than the equipment that was tested in the 2010 study cited by Fortis as evidence that heat pumps are not reliable in terms of system planning.

In support of not analyzing the potential use of DSM to defer capital investments, Fortis also asserts that "Targeted regional offers introduce disparate incentive offers, which are inequitable to customers outside of the target region."[9] EFG does not share Fortis' assumption that disparate incentive offers are necessarily required for targeted DSM, or that disparate incentive offers are necessarily unduly discriminatory. In some cases, it may be possible to generate significantly increased DSM savings in specific geographical locations through increased marketing and outreach, without increasing incentive offers. However, even if increased incentive offers are required to generate the needed participation, it is relevant that Fortis acknowledges that "providing DSM measures on a regional basis would not violate any known policy or regulation."[10] Further, in EFG's view, different incentives in different areas are not inequitable where they contribute to all ratepayers benefiting from deferred infrastructure investments.

Fortis notes that part of its rationale for not pursuing the Max DSM scenario is that DSM is a non-dispatchable resource, and presumably this argument extends to the

[8] http://www.neep.org/file/5066/download?token=Uav-ZGyM
[9] Exhibit B-2, Fortis response to BCUC IR 23.2.1, pdf p.79.
[10] Exhibit B-13, Fortis response to BCSEA IR 25.1, pdf p.5.

potential use of DSM to defer infrastructure investments. However, demand response arguably is dispatchable and should be considered in analyses of Fortis' ability to mitigate capacity constraints in its system. In response to BCSEA-SCBC IR 18.5, Fortis provided a table outlining "…the capacity-focused DSM measures that will be explored as part of the Demand-Response potential review"[11] in the next module of the CPR. These include Direct Load Control, Interruptible Rate/Curtailable Load, and a Pricing Program. EFG looks forward to reviewing this study once it has been completed, and recommends that Fortis consider how the findings can be incorporated into analyses of opportunities to use DSM to defer system upgrades.

In particular, direct load control and interruptible rate/curtailable load programs in other jurisdictions have been used as alternatives for managing peak demand that are less costly than the construction of transmission/distribution projects and/or new peaking generation. For example, BGE in Maryland reports that "The PeakRewards Air Conditioner Program ended the second half of the year with demand response devices in 33% of eligible homes (i.e. those with central air conditioning) and 409 MW of peak load reduction capability." [12] Also, Hydro-Quebec offers interruptible contracts to its Large-Power customers, saying "These options were developed to help balance electricity supply and demand in Québec."[13]

Fortis states that because it "…considers itself to be long on capacity over the planning horizon…there is no requirement for capacity-focused DSM measures."[14] However, Fortis has not done the analysis[15] that would be needed to determine if capacity-focused DSM could be used to defer localized capacity-related infrastructure investments if any are anticipated. Fortis states:

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[11] Exhibit B-4, Fortis response to BCSEA IR 18.5, pdf p.41.
[12] BGE's Semi-Annual Report for Third and Fourth Quarters – July 1 through December 31, 2016 in Case No. 9154. P.43. http://webapp.psc.state.md.us/intranet/Casenum/NewIndex3_VOpenFile.cfm?ServerFilePath=C:\Casenum\9100-9199\9154\\792.pdf .
[13] http://www.hydroquebec.com/majorcustomers/rates/large-power-rates/interruptible-electricity-rate/.
[14] Exhibit B-4, Fortis response to BCSEA IR 18.9, pdf p.43.
[15] Exhibit B-11, Fortis response to BCUC IR 2.82.2, pdf 110.

> "The FBC transmission planning group conducts system studies to ensure that the system will continue to reliably meet capacity demand in the presence of growing customer load during the planning horizon used for these studies, typically 20 years. These studies are performed annually and result in the identification of transmission system upgrades required in the short term and medium term."[16]

EFG recommends that Fortis modify its transmission planning process to consider 'non-wires alternatives' to construction, including aggressive energy efficiency and demand response initiatives, on an equal footing with traditional poles and wires solutions.

In addition, Fortis should assess its expected distribution upgrade projects to determine if there is potential for deferment through the use of targeted DSM. In response to BCSEA IR 26.1, Fortis describes the Unplanned Growth and Small Growth programs,[17] but does not provide information about its forward-looking distribution planning.

Fortis should perform a thorough analysis of both system-wide and geographically targeted DSM alternatives to future proposals for transmission and generation investments. Fortis should determine how much and what kinds of DSM (including demand response) would be needed to defer any future investments driven by growing demand. This should be done well in advance of an application for approval of any infrastructure development, such as the hypothetical SCGT referenced in Fortis' LTERP.[18]

EFG notes Fortis' claim that "…the inclusion of a SCGT plant in the preferred portfolio does not materially contribute to B.C.'s GHG emissions as it would be required for limited, peak demand periods beginning in 2033."[19] However, EFG's opinion is that any contribution to B.C.'s GHG emissions that can be cost-effectively avoided, should be. Absent timely analyses, informed decisions on such matters cannot be made.

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[16] Exhibit B-1, Section 6.2.3, pdf. p.107.
[17] Exhibit B-13, Fortis response to BCSEA IR 26.1, pdf p.8.
[18] e.g. Exhibit B-1, Section 9.3.6.2, pp. 128-129, pdf pp.149-150.
[19] Exhibit B-4, Fortis response to BCSEA IR 2.1, pdf p.3.

Early identification of opportunities for DSM to defer infrastructure upgrades is crucial, because the measures need to be implemented in time to achieve adequate participation before construction would otherwise be needed.[20] The analyses must be completed well in advance of the expected time by which decisions regarding construction would need to be made. Experience in other jurisdictions demonstrates that DSM can reliably defer infrastructure upgrades. However, it may take longer to achieve the necessary participation levels for the amount of DSM needed than it would take to construct, for example, a hypothetical SCGT.

The importance of early identification of DSM alternatives was highlighted by the Vermont Public Service Board in its decision on a transmission project known as the "Northwest Reliability Project." The Board reluctantly approved construction of the project. However, the Board admonished the parties involved for their failure to analyze DSM alternatives early enough so that these alternatives could be fairly considered.[21] The Board's frustration regarding the companies' failure to adequately consider non-wires alternatives in this project ultimately led to the creation of the Vermont System Planning Committee, which is charged with ensuring full and fair consideration of non-wires alternatives to distribution and transmission infrastructure projects.[22]

3. Fortis should be prepared to adjust its LT DSM Plan based upon analyses from the next phase of the Conservation Potential Review that are not now available. These would include whether fuel-switching in support of low carbon electrification would be cost effective.

In its LT DSM Plan, Fortis included analysis of one residential and one commercial fuel switching scenario.[23] In response to IR from BCSEA regarding whether

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[20] Neme, Chris and Grevatt, Jim: Energy Efficiency as a T&D Resource: Lessons from Recent U.S. Efforts to Use Geographically Targeted Efficiency Programs to Defer T&D Investments. Northeast Energy Efficiency Partnerships. 2015. P. 63. http://www.neep.org/sites/default/files/products/EMV-Forum-Geo-Targeting_Final_2015-01-20.pdf.

[21] Neme, Chris, and Grevatt, Jim. P.47.

[22] Id., pp 50-54.

[23] Exhibit B-1, Appendix C, pdf pp. 681-687.

this limited analysis is sufficient to conclude that fuel switching from natural gas to electricity for heating is not cost-effective, Fortis responded:

> "The space heating fuel switching measures reviewed in Section 5.1 of the LT DSM Plan were in response to the referenced Commission Directive. FBC believes those measures to be indicative since the fundamental driver, i.e. "the higher commodity cost of electricity relative to gas", is likely true for other fuel switching measures."[24]

EFG finds this to be an insufficient analysis, and believes that it is premature to conclude that low-carbon electrification is not cost effective on this basis. In its response to BCSEA-SCBC IR 20.6 regarding analysis of early retirement fuel switching, Fortis states that "No early retirement measures were explored because they are more costly than replace on burnout measures."[25] However, costs are only one part of the cost effectiveness analysis. It cannot be concluded that early retirement would not be cost effective without having considered the benefits of the greater savings that would occur from an early retirement measure. Fortis implicitly acknowledges this in response to BCSEA IR 27.2, in stating that "FBC will consider this replacement type as part of the BC CPR additional scope services work to estimate electrification (fuel switching) potential."[26]

In response to BCSEA's question regarding including cooling unit costs in the fuel switching scenario that it has explored, Fortis states that "The ASHP unit provides both heating and cooling for the same cost, and the cost of the ASHP unit has been included."[27] However, Fortis did not indicate whether the baseline scenario used for comparison included the cost of replacing the cooling equipment in addition to the heating equipment. An accurate analysis would require that both heating and cooling costs for both the baseline and alternative scenarios be included.

Fortis states that "Industrial process heating was considered as a fuel switching measure but not pursued because it is too specific and must be evaluated on a case by

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[24] Exhibit B-4, Fortis response to BCSEA-SCBC IR 21.1, pdf p.51.
[25] Exhibit B-4, Fortis response to BCSEA IR 20.5, pdf p.48.
[26] Exhibit B-13, Fortis response to BCSEA IR 27.2, pdf p.9.
[27] Exhibit B-13, Fortis response to BCSEA IR 28.3, pdf p.10.

case basis."[28] EFG suggests that it would be useful for Fortis to include in the DSM Expenditure Schedule that it anticipates filing this year a discussion of how it proposes to address industrial low-carbon fuel switching opportunities.

EFG looks forward to reviewing the next component of the CPR, including the more complete fuel switching analyses. The final phase of the CPR could suggest that revisions to the LT DSM Plan, such as low carbon electrification, are appropriate. The LTERP and LT DSM Plan, if approved, should be subject to modification and further review, based on the final CPR analysis and Fortis's proposed response to that analysis.

4. Fortis should improve its approach to assessing DSM program cost-effectiveness in two ways:

a. The analysis should reflect environmental values based on the Modified TRC test as a standard practice, and not only when measures or programs do not pass screening using the standard TRC test.

b. The analysis should use marginal, rather than average, line losses in screening the cost-effectiveness of DSM initiatives, given that DSM saves energy and demand at the margin.

Because environmental values are central to B.C. policy, EFG suggests that the "Modified TRC" (MTRC) that includes monetization of the environmental benefits associated with DSM should be used as standard practice in DSM cost effectiveness testing. Fortis says that "…FBC has used the modified TRC on both a plan and reporting basis to incorporate non-energy benefits for measures that otherwise fail the TRC." [29] While appreciative of the fact that dispositive decisions about programs and measures are not made without considering environmental benefits, in EFG's view it would be better to consistently represent the full value of DSM in the analysis. This would provide a fuller

[28] Exhibit B-4, Fortis response to BCSEA IR 20.1, pdf p.46.
[29] Exhibit B-4, Fortis response to BCSEA-SCBC IR 12.1, pdf p.33.

picture of the benefits associated with DSM, even when not used dispositively in program screening.

Line loss values used in cost effectiveness analyses should reflect the full value of the benefits that DSM provides. Fortis recognizes and reports on the capacity benefits that derive from energy efficiency measures. Line losses are greater at times of greater load, and logically the line loss reductions associated with energy efficiency that occurs during times of peak demand also occur at times of greater load. The Regulatory Assistance Project[30] (RAP) states:

> "First, energy efficiency measures typically provide significant savings at the time of the system peak demand, and that time occurs when the line losses are highest. The avoided line losses can add as much as 20% to the capacity value measured at the customer meter.
>
> Second, because they are reducing loads, including marginal line losses, energy efficiency measures also reduce the level of required generating reserves.
>
> Each of these benefits increases the economic savings provided by energy efficiency investments. The compounding of a 20% marginal line loss savings and a 15% reserves savings can produce a 44% total generating capacity benefit, over and above the peak load reduction measured at the customer's meter."[31]

Energy efficiency provides significant peak demand benefits whose value should be reflected in cost effectiveness screening. Therefore, the line loss values used in cost effectiveness screening should reflect marginal, rather than average values.

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[30] http://www.raponline.org/. "The Regulatory Assistance Project (RAP) is an independent, non-partisan, non-governmental organization dedicated to accelerating the transition to a clean, reliable, and efficient energy future. We are former utility and environmental regulators, industry executives, system operators, and other policymakers and officials with extensive experience in the power sector."

[31] Lazar, Jim and Baldwin, Xavier: *Valuing the Contribution of Energy Efficiency to Avoided Marginal Line Losses and Reserve Requirements*. Regulatory Assistance Project, August, 2011., p.8. http://www.raponline.org/wp-content/uploads/2016/05/rap-lazar-eeandlinelosses-2011-08-17.pdf

III. Conclusion

EFG concludes that Fortis should significantly improve its DSM planning and analysis by:

- Relying on evidence and industry best practices to evaluate the merits of high DSM savings targets and the use of DSM measures to defer infrastructure investments;
- Using the findings of the final module of the Conservation Potential Review, together with utility experiences in other jurisdictions, to identify the opportunities for capacity-focused DSM, including demand response and interruptible contracts/curtailable loads, to defer capacity additions;
- Modifying the transmission planning process to consider 'non-wires alternatives' to construction, including energy efficiency and demand response initiatives, on an equal footing with traditional poles and wires solutions;
- Being prepared to adjust the LTERP and LT DSM Plan to reflect final outcomes of the CPR should it indicate that low-carbon fuel switching is cost effective;
- Utilizing and reporting on the results of the modified TRC test that incorporates values for the environmental benefits that result from energy efficiency;
- Developing and using marginal line losses in DSM cost-effectiveness assessments rather than the average line loss values that are currently employed.

Appendix A

JIM GREVATT, MANAGING CONSULTANT

EDUCATION

B.F.A., University Honors, University of Illinois, 1982

EXPERIENCE

2013-present: Managing Consultant, Energy Futures Group, Hinesburg, VT
2012-2013: Director, Targeted Implementation, Vermont Energy Investment Corp., Burlington, VT
2011-2012: Director, Residential Energy Services, District of Columbia Sustainable Energy Utility for Vermont Energy Investment Corp., Washington, D.C. and Burlington, VT
2010-2012: Managing Consultant, Vermont Energy Investment Corporation, Burlington, VT
2005-2010: Director, Residential Services, Vermont Energy Investment Corp., Burlington, VT
2001-2005: Manager, Energy Services, Vermont Gas Systems, S. Burlington, VT
1998-2001: Manager, Residential Energy Services, Vermont Gas Systems, S. Burlington, VT
1996-1998: Manager, HomeBase Retrofit Program, Vermont Gas Systems, S. Burlington, VT
1994-1996: Technical Specialist, Vermont Gas Systems, S. Burlington, VT
1991-1994: Technical Specialist, Champlain Valley Weatherization Program, Burlington, VT

PROFESSIONAL SUMMARY

Jim Grevatt brings over 20 years' experience as a leadership professional in energy efficiency program operations to his consulting practice. Jim focuses on both the forest and the trees, using an in-depth knowledge of the nuts and bolts of running programs and a clear understanding of strategic thinking and planning to ensure that programs achieve their desired market impacts. Throughout his career, Jim has focused on building strong relationships with staff, peers, trade allies, and clients as the best way to understand the needs and challenges that each sector faces.

SELECTED PROJECTS

- ***Targeted Implementation, VEIC-*** Responsible for market analysis and strategic planning for a new division expanding VEIC's energy efficiency program implementation projects (2012-2013)
- ***DC Sustainable Energy Utility-*** Led the planning and startup implementation of Residential programs for the DC SEU, including single and multi-family and retail market programs. Led the development of the initial portfolio-level Annual Plan. Led client and partner interactions around planning and policy development. Member of DC SEU Senior Management Team (2011-2012)
- ***EmPOWER Maryland Critical Program Review-*** Expert consultant to the Maryland Office of Peoples' Counsel in EmPOWER Maryland hearings regarding utility energy efficiency planning and reporting. Represented the OPC in stakeholder meetings that informed the current 2012-2014 EmPOWER plans. Multiple appearances before the Maryland Public Service Commission. (2010-2012)
- ***Efficiency Vermont 20 year Forecast of Efficiency Potential-*** Senior Advisor in developing the forecast scenarios that led to significantly increased efficiency investment in Vermont (2010-2011)

JIM GREVATT, MANAGING CONSULTANT

- ***Efficiency Vermont Residential Programs-*** Directed 100% growth in program budgets to nearly $10M annually. Responsible for strategic direction, leadership, and results for Efficiency Vermont's award-winning residential retrofit, new construction, retail, and low income programs. Supported excellence in a staff of 30 (2005-2010).
- ***Vermont Gas Systems Efficiency Program Leader-*** Directed strategic planning and program operations that led to six programs and portfolio as a whole being recognized as exemplary in *Responding to the Natural Gas Crisis: America's Best Natural Gas Energy Efficiency Programs* (ACEEE, 2003). Built contractor infrastructure and internal support to consistently meet program objectives. Led development of Annual Reports, planning and budgeting. Collaborated with Efficiency Vermont staff to develop a fuel-blind, state-wide, jointly offered residential new construction program (2001-2005)
- ***Residential Retrofit Program Development-*** Enhanced design and performance of VGS' residential retrofit offerings by streamlining delivery and building strong relationships with contractors, homeowners, and property managers (1994-2005)
- ***Demonstrated Technical Excellence in Approaches to Residential Retrofits*** Conducted hundreds of residential energy audits and quality assurance inspections for natural gas and alternative-fueled homes. Trained and coached installers to obtain desired quality. Worked to satisfy homeowners through explanation, education, sound listening to concerns, and ultimately assuring that concerns were addressed. Trained new staff in auditing techniques. (1991-1998)

SELECTED PUBLICATIONS AND PRESENTATIONS

Residential Retrofit Programs: What's Working? Perspectives from National Program Leaders- Panelist at AESP National Conference 2012

Elements of Retrofit Program Incentive Design- DOE Technical Assistance Program Publication, April, 2011

Designing Effective Incentives to Drive Residential Retrofit Participation- DOE Technical Assistance Program Webinar, October, 2010

Quality Assurance for Residential Retrofit Programs- DOE Technical Assistance Program Webinar, October, 2010

Home Performance with ENERGY STAR, Quality Assurance in Vermont- Panelist at the ACI Home Energy Retrofit Summit, April 2010

Delivering on the Promise-Engaging Communities and the Public- Panelist at 2010 NEEP Summit, March, 2010

Home Performance with Energy Star in Vermont - Presentation at CEE Member meeting, June 2009

Leading by Example: Exemplary Low Income Energy Efficiency Programs –Presented on Efficiency Vermont's Residential low income services at California's Low Income Energy Efficiency Symposium, June 2006

"Natural Gas Efficiency Policies, Responding to the Natural Gas Crisis One Therm at a Time" - Co-presented with Dan York and Anna Monis Shipley of American Council for an Energy-Efficient Economy (ACEEE) -ACEEE/CEE Market Transformation Symposium, 2004