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February 10, 2014

Susan M. Hudson, Clerk
Vermont Public Service Board
112 State Street
Montpelier, VT 05620-2701

Re: EEU 2013-01 Department of Public Service Comments on Vermont Energy
Investment Corporation Scenario Modeling Results

Dear Mrs. Hudson:

Pursuant to the January 29, 2014 Vermont Public Service Board (“Board”) memo adjusting the schedule for the Demand Resource Plan (“DRP”) proceeding, the Vermont Public Service Department (“Department” or “DPS”) submits the following comments related to Vermont Energy Investment Corporation (“VEIC”) modeling results for three and twenty year electric budgets and expected savings based on Scenarios ordered by the Board. The Department’s comments are based on VEIC modeling results filed in this proceeding on December 6, 2013; the subsequent Board workshop in this proceeding on January 16, 2014; as well as additional information filed by VEIC on January 31, 2014.

Summary

For the reasons explained herein, the Department recommends the Board order VEIC to re-run the DRP model with no savings or costs attributed to non-hard-wired initiatives in the resource acquisition estimated budgets and estimated savings for three and twenty years (with savings and costs appropriately re-attributed to installed hardware measures).

¹ We believe that this effort will provide the Board and all interested parties with vital additional information that is necessary for the Board to make budget and savings decisions in this proceeding that are in the best interests of the State of Vermont and its’ ratepayers. The Department further recommends costs for non-hard-wired initiatives such as innovative education and marketing be included in VEIC’s non-incentive costs for resource acquisition and suggests that costs supporting internal research, development, pilots, and evaluation may be included in the non-resource acquisition budget. The Department also requests greater information regarding VEIC’s heat pump penetration assumptions and the potential impacts of changes in penetration on VEIC’s modeling results.

¹ Hard-wired measures are those that involve the use, upgrade, or installation of efficient equipment, appliances, or control systems; these are also referred to as “hardware” measures. Non-hard-wired measures are conservation measures that involve changing the behavior of the user of a piece of equipment, appliance, or control system; these are also referred to as “behavioral” or “conservation” measures.



Background

The Department distinguishes the measure and program mixes used to create the various scenario model results for this process from implementation plans for the future. We consider the forecasted scenario model results to be a set of data to inform the resource acquisition portion of stakeholder budget and expected electric savings recommendations due to be filed in this proceeding on March 14, 2014. To that end, the modeling of DRP scenarios by VEIC and BED is useful because it has obligated the Energy Efficiency Utilities (“EEUs”) to analyze, on a twenty-year time scale, a range of possible future costs and expected savings that may be possible with continued investments in energy efficiency. However, for a variety of reasons as described below, the Department does not support VEIC’s inclusion of non-hard-wired initiatives with savings directly attributed as a resource in the resource acquisition forecast.

Numerous factors make this both an interesting and challenging time to forecast the procurement of electric energy efficiency as a least-cost resource. For example, certain emerging new technologies like cold-climate air source heat pumps (ASHPs) add complexity to the forecast because, for example, in retrofit situations this technology may reduce thermal energy consumption and also increase electric consumption at the same time. In addition, VEIC forecasts a ramp-up of non-lighting measures and miscellaneous non-hard-wired initiatives in the residential sector to make up for reduced savings available from compact fluorescent lighting associated with federal policy changes that will take effect in 2020. Further, VEIC conceptualizes the benefits of emerging tools and programs that increase the effectiveness of existing efficiency efforts, like the availability of more granular digital meter data enabled by ratepayer investment in advanced metering infrastructure. Finally, VEIC conceptualizes the beginning of a potentially fundamental shift in efficiency resource acquisition strategy by estimating the savings impact from non-hard-wired initiatives and conservation efforts, whereas resource acquisition strategies to date have overwhelmingly relied on hard-wired measures². VEIC and BED employed fundamentally different approaches when modeling the effect of non-hardwired measures. The 2013-14 DRP modeling process has stimulated a host of valuable discussions with the EEUs about future procurement of energy efficiency as a resource.

The Department and its contractors have reviewed the back-up files used to create the modeling results for VEIC, and find the models to be fully functional and technically sound. VEIC conceptualized non-hard-wired initiatives as having the direct effect of producing quantifiable energy savings; conversely, BED assumed no direct savings from non-hard-wired initiatives. BED modeled non-hard-wired measures as increasing the effectiveness of hardware programs, which results in additional customer participation and savings in traditional programs. Because VEIC’s modeling included direct energy savings from non-hard-wired initiatives the DPS requested VEIC’s modeling results with these costs and benefits isolated and removed in order to study and better understand the value and impact of these initiatives. VEIC’s results for that case do not re-allocate the funds that would be spent on non-hard-wired measures; they simply remove such programs and their costs from the analysis. Some of the DPS analysis provided in the

² Hard wired measures are traditional energy efficiency measures such as lighting, appliances or equipment.

comments below was made possible by having VEIC's back-up files and model results with the non-hard-wired cost and benefits removed. The Department notes that other stakeholders may also find this information useful.

Many, but not all, of the Department's questions and concerns about the scenario modeling were resolved with VEIC during the modeling process. VEIC has clearly devoted significant resources to the modeling effort; however, the results do not provide sufficient information and basis with which to estimate budgets and resulting expected savings levels for a portfolio constructed without attributing direct savings for non-hard-wired measures. Despite significant coordination and collaboration in development of the models, the Department has some significant concerns related to VEIC's estimate of the number of heat pumps installed in Vermont over the DRP planning period, and more significantly, VEIC's modeling and characterization of non-hardware efficiency measures as a resource that produces direct savings.

Heat pumps

VEIC's model assumes that by 2034, 40% of residential homes will be heated by air source heat pumps. VEIC provides little documentation and rationale for the 40% penetration assumption. However, this is a rapidly changing market and it is not certain what a reasonable estimate of this technology's penetration is currently or should be in the forecast. Adding to the uncertainty, the pace of adoption of this technology could be significantly impacted by public policy choices outside of the DRP process and we do not know if EEUs will need to intervene to direct or accelerate the market. The appropriate scale of modeled heat pump adoption, and forecast heat pump-related measures, may be informed by the following points:

- The Department's 2012 residential and commercial market assessments were used to inform VELCO forecast used in the DRP. The penetration of all energy efficient technologies was incorporated into the forecast. However, while ground source heat pumps are minimally present, there were no air source heat pumps observed in the sample of approximately 200 residential existing buildings and new construction.
- The Department contacted one contractor that frequently installs this type of equipment for customers and estimated their company installing about one air source heat pump per week. This is an indicator of the technology's increasing popularity, the scale of current adoption, and the market working without the use of EEU incentives to motivate customer investments.
- Another indicator of this technology's apparent appeal to customers is the air source heat pump pilot program of Green Mountain Power ("GMP"), which provides financing for this technology through a rental plan. The pilot is limited with a target of 200 units and has generated interest without offering an incentive. In less than a year, through this initiative, approximately 159 ASHP units have either been installed or are in the queue (in 134 households).

The VELCO forecast of energy and demand, which underlies the DRP modeling, did not include estimates of this technology. This likely has the greatest impact on Scenario 3, which is based on an investment in energy efficiency to procure 3% of VELCO-modeled

utility electric sales by 2020. If all other factors were held constant and a significant penetration of air source heat pumps had been input to the VELCO forecast then projected electric sales would have been greater and the efficiency resource investment to reach 3% of sales would also need to be greater.

The Department expects this technology and associated policy to be a prominent focus of future discussions with the EEU's and the Board. Continued market observation will inform parties regarding the pace of installation, as well as the likely effectiveness (or lack thereof) of purchase incentives to drive adoption of this technology. The Department expects the discussion to continue within the context of the DRP as well as VEIC's proposed scenario in this proceeding to analyze the benefits and costs of associated with VEIC's "Strategic Electrification" concept. A necessary component of this discussion is the evaluation of this technology's performance in various building types with different heating fuels and under different control strategies. As a starting point, the Department, in coordination with VEIC and GMP, plans to evaluate and report on the performance of air source heat pumps installed in 2013 and 2014 through GMP's Community Energy and Efficiency Development (CEED) fund. In order to better formulate its recommendations for filing on March 14, the Department would benefit from both 1) a derivation of the 40% penetration assumption (including any scenario-specific changes to that assumption) and 2) an explanation of the impact on VEIC's model results if heat pump penetrations were to be significantly lower (e.g. 10% of households by 2034) or higher (e.g. 60% of households).

Behavior

Based on the results of the modeling, the Board workshop that focused on the issue, numerous conversations with VEIC and OPower, internal staff discussions as well as independent research, the Department continues to have serious concerns about a fundamental shift in energy efficiency program delivery strategy to include programs that claim savings from measures that are not hard-wired. (These are often characterized as "conservation" or "behavior" measures.) Such initiatives attribute energy savings to various methods used to educate, encourage, and stimulate customers to use less energy, not by installing energy efficient hardware, but rather by turning down or switching off equipment, lighting, appliances and equipment at a greater frequency. Modeling of these initiatives, referred to on the residential side as "Home Energy Reports" and on the commercial side as "Continuous Energy Improvement" ("CEI"), has been beneficial because it has stimulated additional understanding about the challenges of including savings from non-hard-wired measures in an EEU's portfolio.

VEIC's model assumes that the best and most cost-effective way to take advantage of meter data, particularly AMI meter data, over the long term, while engaging a greater number of individuals and firms in saving energy, involves designing programs for, and claiming savings from, non-hard-wired measures, such as the CEI proposal for the commercial and industrial sector and Opower-like Home Energy Reports for the residential sector.

The Department disagrees. Instead, we believe that greater potential benefit over the long

term lies in using data proactively to identify new opportunities and to market hardware measures. Therefore, the Department does not support using savings claimed from non-hard-wired measures as the basis for budgeting and planning, either for the 2015-17 performance period or for the 20-year planning horizon. VEIC has contracted with OPower to develop a data storage and analytics platform for the state's meter data that may be used to assist in securing additional ratepayer value from our state's significant investment in advanced metering infrastructure. This more granular data is likely to facilitate the possibility to better engage with customers on a regular basis. Data-driven efforts may increase the effectiveness of VEIC's existing or new marketing programs, and innovative marketing programs using AMI data could require a change in VEIC's marketing budgets, while still allowing VEIC to redirect funds identified in this modeling exercise as "behavioral" to instead be used for programs that lead to installed hardware measures.

We recommend therefore that VEIC re-run the model with no savings attributed to non-hard-wired initiatives in the resource acquisition estimated budgets and estimated savings and file those results in this proceeding. In contrast to the results already filed, this scenario would reallocate the funds identified for behavioral programs to other measures. The Department recommends that costs for initiatives such as innovative education and marketing (such as those enabled by advanced meter data) could reasonably be included in VEIC's non-incentive costs for resource acquisition. Costs for evaluating the success of these new efforts, both to increase participation in hard-wired measures as well as to determine potential savings from non-hard-wired measures, would be included in the non-resource acquisition budget, as would any research and development regarding non-hard-wired energy savings measures. Once rigorously evaluated, if savings from new kinds of measures appear to provide value, then planning for some level of direct savings from these initiatives may be deemed reasonable for the future.

The Department's recommendation rests on the following argument. Given current knowledge and information, short-lived non-hard-wired measures such as those modeled by VEIC are not the optimal resource to best advance the public interest. Other modeled programs targeting hardware measures create more net benefit. Furthermore, we are confident that using AMI data and other continuing advances in VEIC's capabilities will enable better marketing and uptake of these measures. The success of Home Energy Reports rests on non-hardware savings, which we believe is the wrong emphasis when seeking to deliver long-term value. In addition, what we do know about the modeled programs is highly uncertain. CEI, as modeled, is based on a set of hypotheses that have not been tested at the program scale. The actual savings in Vermont from Home Energy Report-type measures is also open to question. To base projections of annual and cumulative savings over 3, much less 20, years on such indefinite information exposes the state to a significant risk of over- or under- budgeting for efficiency. The Department's recommendation for VEIC to re-tune the models without directly attributing savings to behavioral initiatives will reduce that risk and provide the Board and the DRP stakeholders with a more accurate and complete set of data upon which to base budget and expected savings recommendations.

Portfolio optimization

When developing modeled scenarios, which are indicative of the methods that an EEU would use to develop program portfolios under different budgets, the EEU faces many potentially-conflicting objectives, with one overarching goal: to deliver the greatest benefit to the public good that can be achieved within certain constraints. Those constraints include rate class and income equity, the need for market transformation, baseline cost-effectiveness, and the desire for broad participation in EEU programs. Within these constraints, each of which itself advances the final portfolio toward the public good; portfolio choices remain for the EEU. While it is an imperfect measure, one way to identify the greatest public good is via the net societal benefit. Historically, with hardware measures lives of at least four years (and averaging ten years or more), advancing the greatest first-year MWh energy savings would result in quite similar portfolios to optimizing for net societal benefit, while being easier to conceptualize and calculate. However, with the introduction of one-year measures, such as the behavioral measures under discussion here, the potential for conflict between the greatest net societal benefit and the most first-year MWh has become real. The Department favors emphasizing net societal benefit as a better proxy, for modeling purposes, to the public good.

Further, upon review of the VEIC model, the Department believes VEIC has incorrectly analyzed and forecasted societal benefit from residential Home Energy Report programs in the three and twenty-year scenarios by including forecast reduction in non-electric consumption, despite the Department's encouragement to remove these savings from the modeling. At the workshop Mr. Wickenden stated that such savings were not being presented; however, VEIC's subsequent clarifications indicate that they did indeed include non-electric consumption reductions in its modeling of societal benefit, thus the concern remains.

The Department's recommendation to exclude reductions in non-electric consumption is based on the following important conclusions. First, there is no evidence that informing residential customers about their electric energy use through Home Energy Reports will result in conservation behaviors that will save non-electric energy. The evidence cited in VEIC's supplemental finding supporting a 1% conservation effect is strictly from natural gas utilities informing their customers about comparative natural gas use. Second, the statistical methods used to identify and verify savings from such non-hard-wired measures depend on regular and accurate billing data. As the Department and VEIC learned from the recent evaluation of the Home Performance with Energy Star program; acquiring and utilizing deliverable fuel billing data for this purpose would be practically impossible given the relative seasonality and "bulk" nature of unregulated fuel deliveries. Further, it is premature to assume that this problem would be resolved if Vermont Gas Systems ("VGS") participated in the Home Energy Report initiative because it has not indicated any such plans and even if VGS did participate, given its relatively small customer base, verifying savings with statistical accuracy would be difficult³.

³ VGS participation would also incur costs, borne by VGS ratepayers, and savings would be attributed to VGS for those investments.

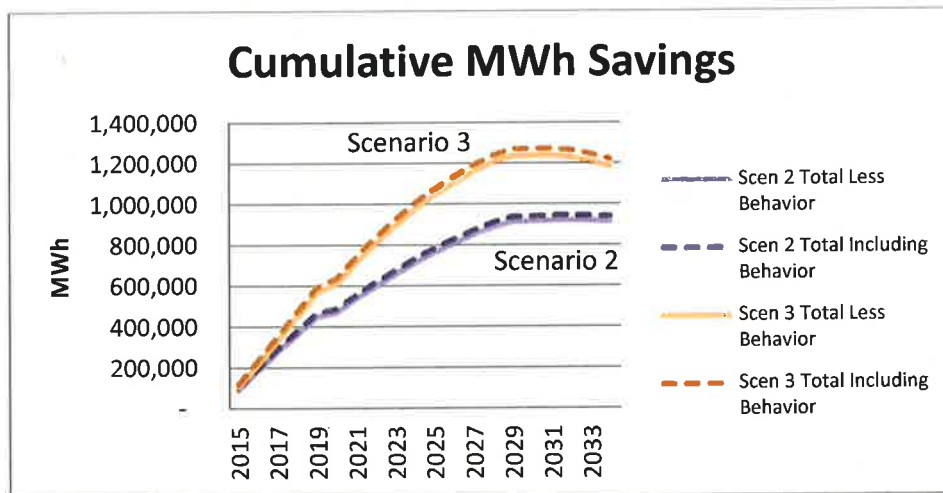
Correcting this analytical error results in the cost-effectiveness data that VEIC presented in their supplemental filing, which clearly shows that such measures, while cost effective, are quite poorly-performing relative to the rest of the modeled residential portfolio. Further, the cost-effectiveness analysis includes benefits associated with avoided transmission and distribution infrastructure and non-energy benefits. Yet it is not clear that a utility would be able to avoid a distribution system investment based on a measure with only one year of measure life. Further, some of the categories of non-energy benefits included in the “adder” utilized in the state screening tool, such as comfort and health, could be compromised because they are based on an assumption that the same or greater level of energy service will be provided, rather than a potential reduction (conservation rather than efficiency). It should also be noted that these costs do not account for what would likely be a relatively expensive evaluation and monitoring program to verify savings. While other programs also don’t account for EM&V costs, the Department believes that for the non-hard-wired measures under consideration here, such costs might be much more costly than for other programs. Also, as discussed below, the very marginal cost-effectiveness of this program suggests that there may be better investments in better-established measures.

VEIC's reliance on the analytical error identified above has unfortunate downstream effects on the construction of the portfolios for the three modeled scenarios. In particular, the inclusion of non-electric conservation savings makes the performance of the modeled behavioral measures look much better than it actually is, and thus calling into question the basis for deeming such measures worthy of inclusion in a portfolio aimed at delivering maximum net societal benefit per dollar invested over the course of a strategic program to acquire all reasonably available cost effective efficiency. A simple (and admittedly imperfect) calculation that reallocates the \$18 million in present value measure cost from the Home Energy Report programs into the average of the rest of the modeled Scenario 2 residential retrofit portfolio would indicate a more than doubling of the net societal benefit delivered from these funds, while increasing the net societal benefit of residential retrofit programs as a whole by 5%. The Department admits that it does not have the expertise to accurately reallocate these resources, which leads to our request for such analysis from VEIC. As previously mentioned, the Department assumes that some resources in such a case would be directed toward using advanced meter data to develop new and innovative marketing tools, with some of the costs for those tools displacing the traditional education/marketing costs typically allocated for hard-wired measures, thereby freeing up money to be invested in additional hard-wired measures.

Scenario 3 is also impacted, although differently. Given that scenario's definition in terms of first-year MWh savings, it may make sense that the most cost-effective way to achieve the 3% target is with one-year measures. However, when the modeling results are considered in terms of the ability of an aggressive energy efficiency acquisition strategy to “bend the curve” on energy consumption, the cumulative effects of the investments are critical for making room in our electric system for new technologies like air source heat pumps and electric vehicles without requiring significant investments in the grid and generation facilities. The Department’s updated potential study indicates an achievable potential significantly in excess of the cumulative savings projected even in Scenario 3,

and the DRP process is weaker for not having a scenario under analysis that more closely approaches the costs and benefits of achieving that potential. The Department’s recommendation for VEIC to re-run the three scenario models will provide additional information and strengthen the DRP process.

The figure below titled “Cumulative MWh Savings” illustrates the cumulative effect of behavioral initiatives with savings relative to Scenarios 2 and 3 (without resource reallocation). Including behavioral savings adds minimal cumulative savings over 20 years due to the one year measure life and the need to reinvest annually in order to realize the benefits. A disproportionate focus on first year savings would leave significant cumulative benefits unclaimed from installed measures.



Among the many potentially conflicting constraints that the EEU’s portfolios must address is the desire for rate class and income equity. When one class or set of customers receives benefits with a significantly shorter measure life than other customers, the long-term result is that that group achieves less cumulative savings, leaving that group fewer net benefits in the long-term than might be achieved with a different portfolio.

The table below titled “Weighted Average Measure Life Over 20 Years by Market” illustrates how various markets are impacted by including non-hard-wired measures with energy savings directly attributed to them in the portfolio. Scenario 1 and 3 include proportionately nearly the same amount of non-hard-wired initiatives relative to the total budgets as does Scenario 2, therefore only analysis of Scenario 2 is provided. The Low-income and Existing Homes markets are affected most with a 59% and 54% decrease in weighted average measure life when non-hard-wired measures with savings are included. Further, non-hard-wired initiatives with savings decrease the total portfolio weighted average measure life by more than 20%. Because of greater investment longevity, more cumulative benefits, and superior durability the Department supports focusing on how to best deliver the mix of measures with greater rather than lesser weighted average measure life (as represented in the column titled “Without Behavior”).

Weighted Average Measure Life Over 20 Years by Market			
Program	Without Behavior (years)	With Behavior (years)	% Decrease in Measure Life with Behavior
Low-Income	9.43	3.86	59.1%
Existing Homes	14.05	6.47	53.9%
Multi-Family Low Income	18.52	11.54	37.7%
Multi-Family Market Rate	16.66	12.15	27.0%
Commercial Retrofit	12.05	9.37	22.3%
Retail Products	10.79	10.79	0.0%
Residential New Construction	23.00	23.00	0.0%
Commercial New Construction	13.51	13.51	0.0%
Commercial Efficient Equipment	13.07	13.07	0.0%
Total Programs	12.66	10.10	20.2%

Measure performance in the context of budgeting and planning

Not enough is known about the performance of behavioral measures in Vermont to allow for accurate budgets and reasonable planning. If the Board were to set budgets and QPIs based on the current admittedly incomplete information, there is a very real risk being very far off, while skewing the appropriate QPIs for hardware measures.

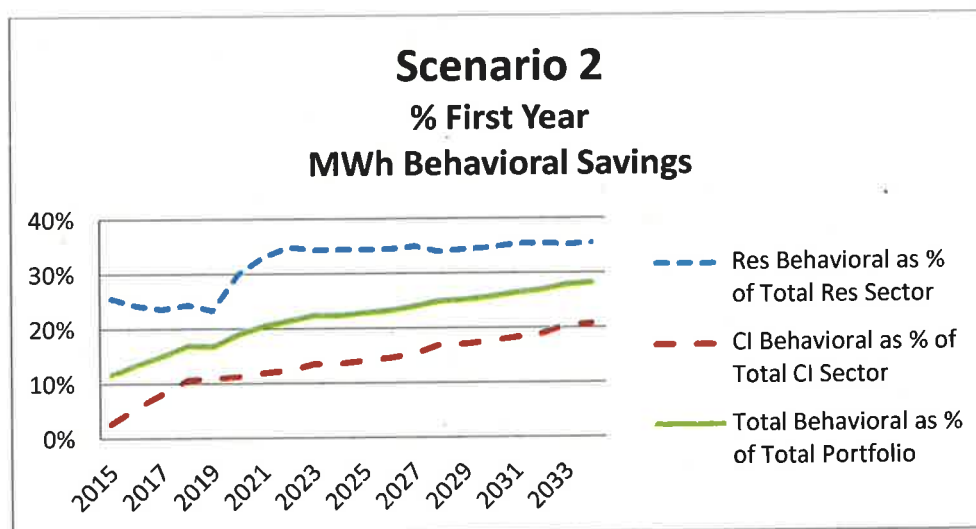
VEIC's modeled savings includes Home Energy Reports for four different residential sub-markets including low-income, single family, multi-family low-income and multi-family market rate. However, the evaluations cited by VEIC appear to largely reflect only results from single family homes. VEIC characterizes its 1.5% annual savings per home as conservative, however, in informal discussions with VEIC and OPower it has been noted the forecasted savings for the Vermont based program in 2014 has a lower weighted average savings per participant of 1.3% and is based on Massachusetts households that have higher average household consumption than Vermont as well as a higher penetration of air conditioning use. These considerations indicate to the Department that VEIC's estimate of a 1.5% average reduction in consumption per home may be overstated.

The uncertainty in the long-term value of these measures is also reflected in their current exclusion from the Forward Capacity Market. The Department recently inquired of staff at ISO-NE as to the eligibility of non-hard-wired savings for bidding into the Forward Capacity Market ("FCM"). The response was that savings from these measures are currently not accepted into the ISO-NE Forward Capacity Market. It is also debatable whether distribution utilities should plan for year-over-year persistence in these measures – potentially reducing the value of avoiding transmission and distribution infrastructure investment. Disproportionate investment in non-hard-wired initiatives has potential to undermine the value of energy efficiency as a resource.

The Department understands the basic premise for not allowing the savings in the FCM is due to the absence of quantifiable data to correlate the identifiable behavior changes

customers are taking to reduce load with the resulting changes in load shapes. At this time the Department has no indication how many years it may take for savings from non-hard-wired measures to be accepted as a resource eligible for bidding into the FCM.⁴ While some evaluative efforts to this end appear to be underway (and further would likely be necessary in Vermont), at this point such measures are not treated as certain by the FCM process.

Without results of pilot projects in Vermont (such as the residential pilot underway in 2014), establishing 3 or 20-year budgets and resource acquisition strategies that incorporate behavioral measures to the degree forecast by VEIC in the face of this uncertainty would expose the state and ratepayers to real risks of over or under-budgeting for efficiency. The figure below titled “Scenario 2 - % First Year MWh Behavioral Savings” illustrates the relative magnitude of first year savings for non-hard-wired resource acquisition. The graphical representation for Scenario 1 is nearly the same as Scenario 2. For Scenario 3, the totals for the commercial sector relative to Scenario 2 in 2034 increase from approximately 20% to 30% and the total share increases from near 28% to 32%. While the proportion of cumulative savings is much smaller, a determination at this time to plan to achieve more than one quarter of annual first-year Mwh from a one-year measure whose performance is not yet measured in Vermont would be premature.



⁴ The Department is also concerned that some FCM revenue generating opportunity may be lost if a disproportionate amount of resource acquisition funding is placed on generating “ineligible” savings from non-hard-wired initiatives. Based on FCM revenue projections and the resource acquisition costs modeled by VEIC for non-hard-wired initiatives, the Department estimates lost FCM revenue opportunities could exceed \$300,000 per year on average for the next five years. This assumption is based on a conservative estimate of FCM clearing prices for the next five years. Lost revenue could be significantly more if the FCM clearing price increases in the coming years. While reduced revenue from the FCM in and of itself is not a societal cost or benefit (it is a transfer from ratepayers), the reinvestment of those funds into thermal efficiency programs does create a societal benefit that could be lost.

Recommendations

The Department recommends the Board order VEIC to re-run and file the DRP model results with no savings or costs attributed to non-hard-wired initiatives in the resource acquisition estimated budgets and estimated savings for three and twenty years (with savings and costs appropriately re-attributed to installed hardware measures). The Department further recommends costs for non-hard-wired initiatives such as innovative education and marketing be included in VEIC's non-incentive costs for resource acquisition and suggests that costs supporting internal research, development, pilots, and evaluation may be included in the non-resource acquisition budget.

The Department also requests greater information regarding VEIC's heat pump penetration assumptions and the potential impacts of changes in penetration on VEIC's modeling results.

Thank you for your consideration, and please do not hesitate to contact us with any questions.

For the Department of Public Service

/s/

Brian Cotterill
Energy Program Specialist

/s/

Jeanne Elias
Special Counsel

cc: EEU 2013-01 Service List (electronic service only)