Régie de l'énergie
R-3473-01

Joint Testimony of
Timothy Woolf and Philip Raphals

On Behalf of
Regroupment national des Conseils régionaux
de l'environnement du Québec

On the Topic of
Hydro-Québec's Energy Efficiency Plan: 2003-2006

February 5, 2003

Table of Contents

1. INTRODUCTION AND QUALIFICATIONS OF TIM WOOLF

Q. What is your name, position and business address?

A. My name is Timothy Woolf. I am the Vice-President of Synapse Energy Economics, Inc, 22 Pearl Street, Cambridge, MA 02139.

Q. Please describe Synapse Energy Economics.

A. Synapse Energy Economics is a research and consulting firm specializing in electricity industry regulation, planning and analysis. Synapse works for a variety of clients, with an emphasis on consumer advocates, regulatory commissions, and environmental advocates.

Q. Please describe your experience in the area of electric utility restructuring, regulation and planning.

A. My experience is summarized in my resume, which is attached as Exhibit TW-1. Electric power system planning and regulation have been a major focus of my professional activities for over twenty years. In my current position at Synapse, I investigate a variety of issues related to the electric industry, with a focus on energy efficiency, renewable resources, air quality, environmental policies, performance-based ratemaking, market structure, customer aggregation and many aspects of consumer protection.

Q. Please describe your professional experience before beginning your current position at Synapse Energy Economics.

A. Before joining Synapse Energy Economics, I was the Manager of the Electricity Program at Tellus Institute, a consulting firm in Boston, Massachusetts. In that capacity I managed a staff that provided research, testimony, reports and regulatory support to state energy offices, regulatory commissions, consumer advocates and environmental organizations in the US. Prior to working for Tellus Institute, I was employed as the Research Director of the Association for the Conservation of Energy in London, England. I have also worked as a Staff Economist at the Massachusetts Department of Public Utilities, and as a Policy Analyst at the Massachusetts Executive Office of Energy Resources. I hold a

Masters in Business Administration from Boston University, a Diploma in Economics from the London School of Economics, a BS in Mechanical Engineering and a BA in English from Tufts University.

Q. On whose behalf are you testifying in this case?

A. I am testifying on behalf of the Regroupment national des Conseils régionaux de l'environnement du Québec.

Q. Have you testified previously before the Régie?

A. While I did not testify in person, I contributed to the written testimony of Peter Bradford in R-3398-98.

2. INTRODUCTION AND QUALIFICATIONS OF PHILIP RAPHALS

Q. What is your name, position and business address?

A. My name is Philip Raphals. I am the Associate Director of the Helios Centre, 326 St. Joseph Blvd. East, Suite 100, Montreal, Quebec, H2T 1J2.

Q. Please describe the Helios Centre.

A. The Helios Centre is a non-profit research group, providing independent expertise in a broad range of energy issues. It works for a wide variety of clients, including governments, public interest groups, energy producers and distributors, and First Nations. This diversity has helped the Helios Centre understand the legitimate concerns of the full range of energy interests.

Q. Please describe your experience in the area of electric utility restructuring, regulation and planning.

A. My experience is summarized in my resume, which is attached as Exhibit PR-1. My professional activities have addressed a wide range of issues related to the planning and regulation of electric power systems, particularly with regard to hydropower systems. These issues include market structures, planning processes, green power markets, transmission regulation, security of supply and energy efficiency programs.

Q. Please describe your professional experience before beginning your current position at the Helios Centre.

A. Before co-founding the Helios Centre in 1996, I was an independent energy analyst. From 1992 to 1995, I was deputy scientific coordinator of the Great Whale Public Review Support Office, where I was responsible for the analysis of the Great Whale project's justification, on behalf of the committees and commissions charged with its review.

Q. On whose behalf are you testifying in this case?

A. I am testifying on behalf of the Regroupment national des Conseils régionaux de l'environnement du Québec.

Q. Have you testified previously before the Régie?

A. Yes, on numerous occasions. I have provided expert testimony in the following hearings: R-3398-98 (art. 167), R-3401 (HQ transmission tariff), R-3405 (general principles concerning transmission regulation), R-3410 (small hydro) and, most recently, R-3470 (HQ's supply plan).

On this occasion, I have chosen to present my testimony in English, in order to facilitate my collaboration with Mr. Woolf.

3. JOINT TESTIMONY OF TIM WOOLF AND PHILIP RAPHALS

Q. What is the purpose of your testimony.

A. The purpose of our testimony is to review and critique Hydro-Québec Distribution's Energy Efficiency Plan 2003-2006 (the Plan). It will first address HQ-Distribution's avoided costs and its technico-economic potential. It will then turn to program design, with an emphasis on the programs offered to the residential sector. Finally, we will address the budgets and rate impact analyses that were used by HQ-Distribution (HQD) in developing the Plan.

Q. How is your testimony organized?

A. Our testimony is organized as follows:

4. Guiding Principles of Efficiency Program Design.
5. Avoided Costs
6. The Technico-Economic Potential
7. Residential Efficiency Program Design.
8. Program Budgets and Rate Impacts.
9. Recommendations.

Q. What are your principle findings and recommendations?

A. We find that the Plan contains several significant flaws that will undermine the success of the programs and will limit the ability of HQD to achieve much of the cost-effective efficiency opportunities. First, we find that the avoided costs used in the Plan are inappropriate and almost certainly too low. Second, we find that the Plan does not include the full techno-economic potential for efficiency savings among HQD customers. Third, we find that the residential efficiency programs will only achieve a small portion of the cost-effective efficiency potential because they do not address some key efficiency opportunities and they do not overcome the market barriers that inhibit adoption of energy efficiency measures. Finally, we find that HQD's energy efficiency budgets are too low to capture a significant portion of the energy efficiency potential, and that budgets could be increased substantially without creating unreasonable rate impacts on customers.

We recommend that HQD be required to file a revised Plan that addresses the concerns raised in this testimony. These concerns are so significant that they cannot be addressed with small, incremental changes to the current Plan. The revised Plan should be prepared with meaningful input from energy efficiency stakeholders and interested parties. However, in order not to waste any more time, the Régie should nevertheless authorize HQD immediately to implement the programs described in the present draft Plan in a way that addresses as many of the concerns raised in this testimony as possible.

The revised Plan should address the following concerns identified in the current version of the Plan:

- The avoided cost analysis should be revisited to ensure that it accurately reflects the avoided costs of HQD over the long term.
- HQD should update the technico-economic potential analysis with the new avoided costs.
- Most of the residential efficiency programs should be substantially modified to address additional efficiency measures and to provide customers with financial incentives to adopt efficiency recommendations.
- The efficiency program budgets should be increased substantially in order to capture a larger share of the cost-effective efficiency opportunities. A doubling of the efficiency budgets would not be unreasonable.
- Rate impacts should not be used as an obstacle to prevent increases in the energy efficiency budgets. HQD can significantly increase its efficiency budgets without creating unacceptable rate impacts.

4. GUIDING PRINCIPLES OF EFFICIENCY PROGRAM DESIGN

Q. Does the Plan include certain principles to guide HQD in developing the portfolio of efficiency programs?

A. Yes, it does. These principles are described on page 26 of the Plan, and are presented below:

1. Realize the greatest possible portion of the potentials, taking into account the time horizon under consideration (2003-2006).
2. Seek equitable solutions that take all client groups into consideration.
3. Favor long-term market transformation.
4. Favor an overall client-based approach rather than an approach by product, insofar as possible.
5. Seek added value in relation to the interventions already carried out by other actors and the possibilities for synergy and complementarity.
6. Minimize the commercial and technological risks.
7. Respect recognized cost-effectiveness criteria: total resources cost test, and participant test.
8. Ensure that the impact on the Distributor's revenue requirement is acceptable for all clients.

Q. Are these appropriate principles to use in developing a portfolio of efficiency programs?

A. In general, yes. However, there are two key additional principles that should be added to this list:

9. Energy efficiency programs should be designed and implemented in such a way as to overcome the many market barriers that hinder customer adoption of energy efficiency measures.

10. Energy efficiency programs should be designed and implemented in such as way as to avoid lost opportunities and minimize cream-skimming.

Q. Why is it so important that efficiency programs overcome market barriers?

Overcoming market barriers is one of the most important aspects of successful efficiency program design and implementation. Customers face a wide variety of barriers that prevent them from installing cost-effective energy efficiency measures on their own. Residential customers face the following barriers (among others): high transaction costs, lack of awareness of efficiency measures, lack of awareness of efficiency benefits, limited access to funding, uncertainty about the performance of new and different measures, limited product or service availability, lack of financial incentive for landlords that do not pay electricity bills, and lack of ability of tenants to install efficiency measures in rented buildings.

Commercial and industrial customers face many of the same barriers as residential customers, and sometimes have additional barriers, including: lack of supply-chain and distribution support, spending budgets that limit up-front investments, budgeting systems that offer no incentive to reduce electricity bills, and lack of procedures, staff or funding to evaluate energy consumption and energy efficiency opportunities.

Energy efficiency programs that provide education and informational materials alone may be able to overcome some of these barriers – particularly lack of awareness of the availability and the benefits of efficiency measures. But they are not able to overcome many of the other barriers – particularly high transaction costs and limited access to funding – and thus they are unable to achieve a significant fraction of the potential energy efficiency savings. Successful efficiency programs must provide more than information and educational

materials to customers; they must offer direct installation of appropriate measures, and they must offer significant financial support to offset the up-front costs of efficiency measures. These points will be elaborated upon in Section 7, below.

Q. Why is it so important that efficiency programs avoid lost opportunities and minimize cream-skimming?

A. Lost opportunities are defined as those efficiency measures that become prohibitively expensive if they are not adopted at a certain point in time. One example is when a building is constructed or renovated. If efficiency measures are not adopted at the time of construction or renovation, they become much more expensive and difficult to implement later. Another example of a lost opportunity is when an existing appliance, e.g., a refrigerator, reaches the end of its natural life and a new appliance is purchased (stock turnover). Convincing a customer to purchase a new efficient appliance is much easier and less expensive than convincing a customer to replace an inefficient appliance that has not reached the end of its natural life. It is important that energy efficiency programs avoid lost opportunities, because they represent energy efficiency savings that are only available at a certain point in time, but become unavailable in the future. New buildings sometimes last as long as 50 or more years, and thus the potential for lost opportunities can be substantial and long-lasting.

Cream-skimming is defined as installing only the least-cost and most cost-effective efficiency measures for any one customer, and ignoring more expensive *but still cost-effective* measures. Cream-skimming is a type of lost-opportunity, because once a customer has been engaged to participate in an efficiency program and to install efficiency measures, it may become prohibitively expensive to engage the customer again and install additional measures. It is important that energy efficiency programs minimize cream-skimming in order to achieve the overall goal of realizing the greatest potential of efficiency savings, to equitably address all efficiency measures across all customers, and to avoid lost opportunities.

Q. Has HQD adequately applied its own principles in developing the efficiency programs in the Plan?

A. No, it has not. The Plan does not meet the first principle of realizing the greatest possible portion of the energy efficiency potential. A large portion of the energy efficiency potential in Québec will be ignored and untapped by HQD's energy efficiency programs, for two main reasons. First, the Plan does not address a number of important, cost-effective efficiency measures, and thus misses a large part of the efficiency potential. For example, lighting, refrigeration, programmable thermostats, clotheswashers and water heating measures offer significant efficiency opportunities for the residential sector but apparently are not supported by the HDQ programs.

Second, the HQD programs do not provide customers with enough support to overcome market barriers that prohibit customer adoption of efficiency measures. Most importantly, they do not provide customers with enough financial incentive to purchase and install energy efficiency measures. Years of energy efficiency program experience has demonstrated that customers must be provided with sufficient financial incentives to adopt energy efficiency measures in order for programs to be fully successful in saving energy. Too much emphasis on educational and informational materials, and not enough emphasis on financial incentives will not only miss a large portion of the potential cost-effective efficiency savings, it can also be a waste of efficiency funds and ratepayer money.

Q. Has HQD adequately applied your market barrier principle in developing the efficiency programs in the Plan?

A. No, it has not. As described immediately above, the HQD programs do not provide customers with enough support to overcome the market barriers to energy efficiency. In addition to financial support, customers often require assistance in overcoming the transaction costs associated with efficiency measures, i.e., the costs of finding the proper measure and installing it or having it installed by a professional. The HQD programs offer very little support for overcoming transaction costs, and thus will not result in significant efficiency savings.

Q. Has HQD adequately applied your lost opportunities principle in developing the efficiency programs in the Plan?

A. No, it has not. The programs in the Plan do very little to address efficiency improvements at the time of building construction or renovation – which are critical lost opportunity markets. While the Plan includes some programs to address these markets, they miss a large portion of the potential savings. In addition, the programs in the Plan do almost nothing to promote efficient equipment at the time of stock turnover – another critical lost opportunity market. Furthermore, by emphasizing thermostats in the residential programs, without addressing the many other cost-effective efficiency measures, the HQD programs essentially skim the cream off the residential market.

5. AVOIDED COSTS

Q. Please describe the marginal resource used in HQD's proposal as the basis for determining avoided costs for each end use.

A. HQD based its avoided costs on a supply cost equivalent to the cost of heritage pool ("patrimonial") electricity, to which is added the cost of a new long-distance high-voltage transmission line, which is introduced gradually from 2004 to 2007. This treatment is equivalent to adding a new large hydro plant in the far north with a unit cost of approximately 3¢ per kWh, which requires a major new transmission line.[1] At the technical conference, HQD's representative pointed out that this hypothesis was consistent with Hydro-Québec's Strategic Plan 1998-2002, which foresaw major new hydropower developments at a cost of under 3¢/kWh.

Q. Is this scenario for the marginal resource a reasonable hypothesis in the current context?

A. No, it is not.

[1] HQD-3, doc. 1.1, p. 16 and HQD-3, doc. 7, pp. 12-13.

Q. Does the equipment scenario underlying HQD's "sensitivity analysis" represent a more realistic hypothesis than the one on which the plan was based?

A. Yes, it does, in that it is based on estimated costs for HQD's post-patrimonial acquisitions. However, the avoided costs based on this scenario present other problems, which will be addressed below.

Q. Please describe the sensitivity study presented by HQD concerning its avoided costs.

A. In addition to the avoided costs described above, which form the basis for HQD's Plan and for the cost effectiveness tests used to assess it, the distributor also presented a "sensitivity analysis" based on the anticipated results of its first call for tenders for post-patrimonial power. The average power acquisition cost was estimated to be 6¢/kWh, including supply, transmission and losses.

Q. What type of power plant appears to be on the margin, for the purposes of the sensitivity study?

A. Presumably, it is a combined cycle natural gas plant.

Q. Has Hydro-Québec taken the externalities of the marginal plant into account in evaluating its energy efficiency programs?

A. No, it has not.

Q. What are the nature of these externalities, and how could they be integrated into the avoided costs?

A. The externalities associated with natural gas generation consist primarily of air emissions, including greenhouse gases and other pollutants. SCGM uses values for these externalities in its proceedings before the Régie, which could be applied here.

Q. Is it appropriate to include these externalities in the avoided costs?

A. Yes, in our view it is. Avoiding electric generation through energy efficiency results both in avoiding the direct cost of generating that electricity and the indirect costs to society (social and environmental impacts) associated with that generation.

Q. How does the sensitivity study address the differential costs of serving different types of loads?

A. The sensitivity study assumes that there is no seasonal cost variation for the marginal supply. However, it does assume that avoided costs reflect the daily peak/off-peak differentials found in the U.S. Northeast, where on-peak electricity (6 am to 10 pm, weekdays) is said to cost one cent (CAD) more than off-peak electricity.

Q. What is the basis for the conclusion that there is no seasonal cost variation for the marginal supply?

A. HQD justifies this assumption with a quote from its evidence in R-3470-01 to the effect that the capacity needed beyond the heritage pool is not greatly differentiated between winter and summer from now until 2011.[2]

This is somewhat misleading. The referenced document goes on to demonstrate that, under the medium growth scenario, additional needs for 2007 are not flat but rather would vary from 300 to 600 MW, with "modulable" supply used for the higher load periods.[3]

Q. Given this context, is it reasonable to remove all seasonal variation from the avoided costs?

No, it is not. Modulable supply will inevitably be more expensive than baseload supply, so the avoided cost for high-demand periods would be higher. Even if modulable supply is not in the short term expected to be needed for the medium growth scenario, there are many scenarios involving some combination of high demand growth and cold weather where it would be required.

Furthermore, in the longer term, a seasonal signal is bound to reassert itself. Since measures that affect the thermal envelope tend to have long useful lives, it is essential that they be evaluated against a *long term* avoided cost, which should reflect this seasonal signal.

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[2] HQD-2, doc. 3, p. 6. The correct reference is R-3470-01, HQD-2, doc. 3, p. 25.

Q. Is it appropriate to use U.S. market prices in determining Hydro-Québec's avoided costs?

A. It is quite unorthodox to do so, as this approach moves away from the underlying economic notion of long-term avoided cost and instead seeks to estimate the short-term transactional consequences for the Distributor of selling one less kilowatthour to its domestic clients. Insofar as HQD can sell those unused kilowatthours in the U.S., the Northeast market price becomes in effect the opportunity cost of consuming that kilowatthour in Quebec. However, this use of opportunity costs is at best acceptable in the short term.

Q. Assuming that reducing consumption in Quebec will result in additional export sales, must those exports be made simultaneously with the avoided consumption in Québec?

A. Not necessarily. Under the patrimonial decree (Order-in-Council 1277-2001), HQ-Distribution has great flexibility as to amount of heritage electricity it consumes in any given hour in the post-patrimonial period. This creates a corresponding flexibility in its off-system sales. Thus, it can time its sales to best take advantage of the fluctuations in spot market prices, as long as it remains within the overall limits set out by the Order-in-Council.

Q. How does that affect the value of the kilowatthours saved?

A. Generally speaking, the more flexibility HQD has in determining the moment of sale, the greater the value it can derive from its surplus kilowatthours. For example, the kilowatthours made available as a result of reduced consumption on a cold Sunday evening in winter due to reduced infiltration need not necessarily be exported that same night. Depending on the number of "batonnets" that remain available to it, HQD could select a smaller batonnet for that evening and a larger one the next morning, which, together with the output from its own resources under contract, would result in surplus kilowatthours that could be exported during the morning peak. Thus, even though the energy was saved

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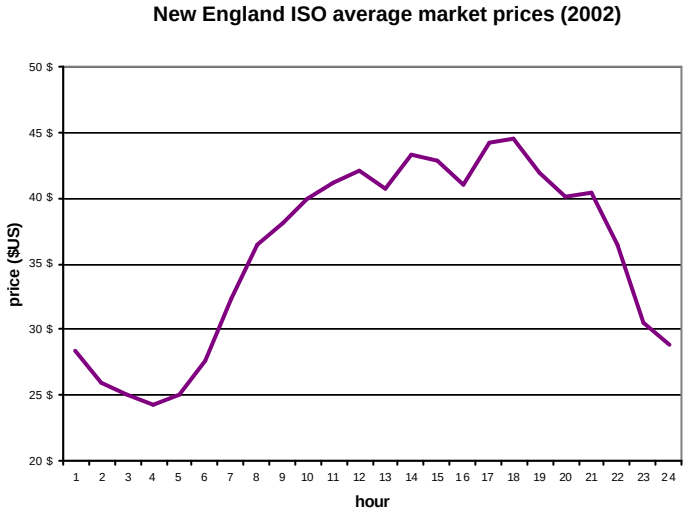
[3] Ibid., p. 27.

during an off-peak period,its value would be that of an on-peak kilowatthour. In the same way, it may also be possible for HQD to shift sales over much greater time periods, resulting in higher prices.

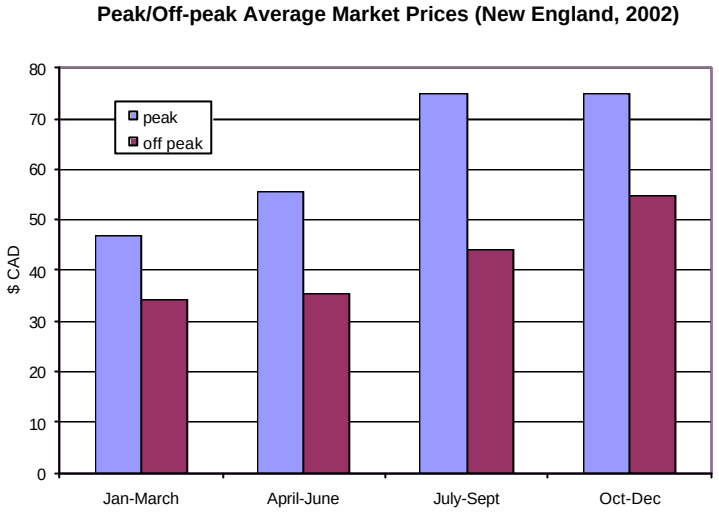
Q. Can you quantify the benefits of this type of "time shifting"?

A. Given the great uncertainties that remain as to how the "batonnet" system will work in practice, it is extremely difficult to forecast its implications for the sale of saved kilowatthours. In particular, it is probably impossible to quantify, at this point, how much flexibility HQD will actually enjoy to displace purchases and sales.

That said, it seems clear that the approach presented in the sensitivity study is excessively conservative. The typical variation between off- and on-peak market prices in the Northeast is far more than 1¢ Canadian. The following chart shows the average hourly market prices of the New England ISO in 2002.



The differential between average peak (defined as 6h-22h) and off-peak prices is shown in the following chart. We see that it ranged from CAD$13 per MWh in Jan-March to CAD$31 in July-September.



Furthermore, if we look at a more tightly defined peak period (3 pm to 8 pm), the average price rises to CAD$89 in July-September, which represents a differential of CAD$44 in relation to off-peak prices.

Q. What do you conclude from this analysis?

A. This analysis demonstrates that HQD has substantially underestimated the peak/off-peak differential in Northeast markets. Using these markets as a measure of the time value of energy saved in Quebec, as HQD proposes, would in most cases lead to considerably higher avoided costs than those described in its sensitivity analysis.

However, given HQD's ability to shift the benefit of a saved kWh from one time period to another, this approach is unlikely to provide any meaningful estimate of Hydro-Québec's avoided costs.

Q. Would it therefore not be appropriate to return to the concept of long-term avoided costs?

A. Yes, it would. Traditionally, avoided costs are evaluated under the hypothesis that enough energy will ultimately be saved to avoid or at least delay the construction or acquisition of a new generating resource. Given the particularities of the patrimonial decree, it is entirely appropriate to use this perspective here.

Q. On which resource should HQ-Distribution's avoided costs be based?

A. The long-term avoided resource should not based on the last committed resource, but on future resources that can be avoided or deferred. It is thus methodologically incorrect to base avoided costs on the contracts signed under last year's call for tenders. Even if another tender is not expected for several years, HQD should evaluate its most likely future generation resources and use their estimated costs to develop its long-term avoided costs.

Q. Is this approach likely to demonstrate the flat load shape presented in the sensitivity analysis?

A. No, it is not. That flat load shape is an artifact resulting from the combination of historic surplus capacity and from a short-term spike in industrial load growth. In the longer term, the traditional load shape of domestic load growth can be expected to reassert itself. Thus, whatever resource scenario is selected, it is reasonable to expect that it will exhibit a substantial winter peak, which in turn will result in higher avoided costs for those end uses that are highly coincident with that peak, such as electric space heating.[4]

Q. Is it possible to identify the marginal resource at this point?

A. Not with any certainty. However, we can make some preliminary observations:

a) If HQ-D continues to see combined cycle natural gas turbines as its most likely future resources, it will need to increase their forecast cost to take into account the implications of the Kyoto Accord. Assuming 400g CO_2-equivalent per kWh (the emissions of a modern CCGT) and a $15/ton market price for CO_2 credits to offset the additional emissions, the cost of natural gas generation would increase by about $6/MWh, or 10%.[5]

[4] However, the winter peak for additional needs in the future is likely to be less pronounced than the current one, due to climate change and increased use of gas space heating.

[5] This estimated carbon cost would only partially internalize the externalities described above.

b) Even if HQD sees hydropower as the marginal resource, it will probably be priced at a level very close to the one described above, given the competitive acquisition procedure currently in effect.

c) It is also conceivable that, in the future, Quebec will commit itself to meeting most of its additional needs through wind power or other "new renewable" resources. This scenario, should it occur, would likely result in even higher avoided costs.

Q. Please summarize your overall conclusions with respect to avoided costs?

A. First, we have demonstrated that neither of the two sets of avoided costs presented by HQD in its evidence provides a reasonably accurate indication of its real avoided costs. The avoided costs used for its cost-effectiveness analysis is based on a fictitious and unrealistic scenario of very low-cost new hydropower. The "sensitivity analysis" starts from a more realistic scenario, but is undermined by the unjustifiable assumptions regarding seasonal cost variations and the relative cost of peak and off-peak power.

Thus, neither set of avoided cost figures can be relied upon for developing the technico-economic potential or for analyzing proposed measures and programs.

Q. What is your recommendation with respect to avoided costs?

A. HQD should initiate a careful review of its avoided costs, as part of the process leading to a revised Plan.

6. THE TECHNICO-ECONOMIC POTENTIAL

Q. What is the role of the technico-economic potential in the development of the Plan?

A. The technico-economic potential is the starting point for the process undertaken by HQ-Distribution to develop its Plan, which included the following steps:[6]

[6] HQD-1, doc. 1, pp. 27-28.

1) analyze the composition of the technico-economic potential,

2) consult with clients and market participants,

3) evaluate possible partnerships and complementarity,

4) develop and optimize programs, including economic analysis of scenarios,

5) optimize the portfolio (synergies between programs, economizing management costs)

6) review the portfolio to ensure good coverage of the technico-economic potential as a whole and of market segmentation, adding programs when necessary.

Q. How was this potential determined or obtained?

A. For each sector other than large industry, HQ-Distribution has relied on studies carried out by Technosim.

Q. Could you please explain, in general terms, the relationship between avoided costs and the technico-economic potential?

A. The technico-economic potential refers to the total amount of energy that could be saved in a given year, if all cost-effective energy savings measures were undertaken. As such, it is a subset of the technical potential.[7] Utilities generally define "cost-effective" by comparing the measure's total costs (regardless of who ultimately pays them) to the costs (with or without externalities) that the utility would actually avoid if that measure were installed or undertaken. Since the costs vary depending on the seasonality and load shape of different end uses, each one has its own avoided cost.

Q. Which of the two sets of avoided costs discussed above was used as the basis of the Technosim studies, which define the technico-economic potential?

A. Neither one. The Technosim studies all used an estimate of current electricity *prices* as an avoided cost. Price is clearly an inappropriate indicator of HQD's avoided cost, as it reflects the cost to the consumer, not to the utility.

[7] HQD chose not to evaluate the technical potential (HQD-3, doc. 5, p. 68-69).

Furthermore, it uses current prices, without attempting to account for expected rate increases over the useful life of the measures. Finally, consistent with the choice to use the consumer's perspective, no attempt was made to reflect the varying costs of serving different load shapes.

Q. Have you been able to review the details of the technico-economic potential used in developing the Plan?

A. No. There are a number of reasons for this. First, the Technosim study simply presents the consultant's results for each end use, without presenting the precise measures evaluated, their unit costs, life spans or other relevant details. It is thus impossible to review the consultant's assumptions and calculations.

Secondly, as we have seen, the Technosim study is based on avoided costs entirely different from those used by HQD.

Finally, the technico-economic potential used by Hydro-Québec differs from the one produced by Technosim. For example, in its Plan, HQD reports a five-year technico-economic potential for the residential market (as of 2003) of 3,451 GWh, whereas the total identified in the Technosim report is 2,610 GWh. To the best of our knowledge, no detailed description or documentary support has been provided for this revision of the technico-economic potential.

Q. According to HQD's evidence, its technico-economic potential has fallen by more than two-thirds over the last ten years. Do you find the explanations offered to be satisfactory?

A. No. While the table on p. 13 of HQD-3, doc. 1.1 provides a breakdown of the differences between these two estimations, they are far from adequate. One of the most important lacunae is the deduction made for new regulations and market transformations. The amount of the reduction is quite substantial: 23.8% of the potential in the residential sector, and almost 28% of the total potential. When

questioned on this point, HQD was unable to provide any breakdown or justification for this figure.[8]

Another important factor that was overlooked is the *increase* in the technico-economic potential that should have resulted from the declining costs of many energy efficiency measures. It is therefore likely that certain measures which were not cost-effective in 1992 are so today.

Q. To summarize, do you consider the technico-economic potential as presented in HQD's filing to be adequate for the purposes of defining an energy efficiency program?

A. Clearly, it is not. Since Hydro-Québec has made it very clear that the technico-economic potential is the starting point for its reflections, this weakness undermines the entire process.

Q. What do you recommend with regard to the technico-economic potential assumptions used in developing the Plan?

A. Once its avoided costs are established, HQD should be required to file a full analysis of its technico-economic potential, including sufficient underlying data to allow expert review.

7. RESIDENTIAL EFFICIENCY PROGRAMS

Q. Please summarize the residential programs offered in the Plan.

A. The Plan includes the following programs for residential customers:

1. Personalized Energy Diagnosis.
2. Electronic Thermostats: Existing Buildings.
3. Electronic Thermostats: New Building Projects.
4. Pool Filter Timers.
5. AEÉ Inspection Plus Program.
6. AEÉ Novoclimat Program.

[8] HQD-3, doc. 5, response 8.

7. AEÉ Energy Efficiency for Limited Income Households.

8. AEÉ Energy Renovations in Low-Rent Housing Units.

Q. Is this combination of programs likely to realize the greatest possible portion of efficiency potential in the residential sector?

A. No, it is not. The first four programs address only a small portion of the residential end-uses that offer efficiency savings. Many important end-uses are completely ignored. Even the advice to be provided in the Energy Diagnosis Program, which addresses a variety of residential end-uses, misses some key efficiency measures. It also suffers from flaws that will prevent it from achieving more than a small portion of the potential cost-effective efficiency savings from the measures that are addressed. Both thermostat programs support a technology that offers limited fficiency savings, while ignoring technologies that can provide substantial cost-effective efficiency savings.[9] Finally, all of the programs above except one (timers for swimming pools) fail to provide the customer with sufficient financial incentive to adopt the efficiency measures.

Q. Please explain why the Energy Diagnosis Program is likely to achieve only a small portion of the residential energy efficiency potential.

A. The Energy Diagnosis Program suffers from three fundamental flaws, each of which will severely limit the efficiency savings from this program. *First*, it assumes that large numbers of customers will spend the time and effort to conduct their own energy analysis. *Second*, it fails to address many end uses that typically offer substantial energy efficiency savings. *Third*, the diagnostic approach alone will not be sufficient to overcome the market barriers to energy efficiency measures – financial incentives are necessary to encourage customers to make efficiency improvements.

Q. Is there a more reliable way to help residential customers adopt cost-effective energy efficiency measures?

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[9] According to HQD-3, doc. 1.1, p. 58, réponse 18.1, no decision has yet been made on the part of HQD to include programmable thermostats in these programs. For the purposes of this testimony, we will assume that the program will use non-programmable electronic thermostats.

A. An in-home energy audit that includes all the proper program elements can assist residential customers in overcoming most or all of the market barriers to energy efficiency. An effective in-home energy audit should include the following elements:

- A trained technician visits the customer's home and conducts a computer-based evaluation of all electricity end-uses, and all opportunities to increase the efficiency of electricity consumption.
- The customer is provided with a detailed analysis of the energy uses in the home, the potential energy efficiency measures, the financial incentives offered through the program, the payback period for the customer, and information regarding the benefits of energy efficiency, including the environmental benefits.
- The customer is provided with the opportunity to ask questions about the energy audit.
- Low-cost measures are directly installed at the time of the visit.
- The customer is offered rebates for purchasing efficient appliances, as appropriate.
- The customer is provided with assistance in finding, hiring and paying for a contractor to install any additional efficiency measures, such as insulation.

This combination of these elements, provided in a face-to-face visit to a home, has proven to be the most effective way of overcoming the many market barriers that inhibit residential customers from installing efficiency measures.

Q. Would the diagnostic tool offered by HQD be sufficient on its own to overcome the barriers that residential customers face in installing efficiency measures?

A. No, it would not. This tool requires too much action on the part of the customer to make the efficiency measures happen. Customers may not fully understand the results of the diagnostic tool. They may not spent sufficient time to apply the tool correctly and thoroughly. They may not be able to have their personal questions answered directly. They may not know where to find efficiency measures in their neighborhood. Some efficiency measures might not be available in their neighborhood. They may not have the time and wherewithal to install efficiency measures. They may not have the time or wherewithal to find and hire a

contractor to install the more substantial efficiency measures. They may not fully appreciate the economic or environmental benefit of the efficiency measures. They may not be willing or able to pay the up-front costs of some efficiency measures. All of these issues can be addressed with an in-home energy audit with suitable financial incentives.

Q. Are in-home energy audits more expensive than the diagnostic tool proposed by HQD?

A. Yes, they are. In fact, HQD notes that it rejected the concept of in-home energy audits because of the costs and thus the rate impact.[10] However, this approach is "penny-wise and pound-foolish." The critical issue is the amount of energy savings that can be obtained per dollar spent. The increase in energy savings from a well designed in-home energy audit program with suitable financial incentives will far outweigh the increase in costs associated with those audits.

HQD notes that their proposed diagnostic tool is "the cheapest and most efficient means to reach the greatest number of clients."[11] While this may be true, the goal is not to reach as many clients as possible. Reaching a client is useless if the client does not adopt efficiency measures. The goal is to realize the greatest portion of efficiency savings from the residential customers as a whole. In-home energy audits with suitable financial incentives will achieve this goal far better than diagnostic tools that require too much action from the customer.[12]

Q. Are there ways to minimize the expenses of home-energy audits, and increase the amount of energy savings per dollar spent?

A. Yes. It is important to ensure that in-home audits are only applied to customers who are likely to have sufficient energy savings, and who are likely to adopt

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10 HQD-3, doc. 5, response 60b.

11 Ibid.

12 The on-line audit program of Portland General Electric (Oregon) appears to have produced little results to date because a) there was insufficient funding to bring consumers to the site, b) marketing, promotions and financial incentives are critical to leading consumers to install most measures. Fred Gordon, Director of Planning, Energy Trust of Oregon (personal communication).

efficiency measures. One way to do this is to limit the in-home audits to those customers that have relatively high energy consumption levels. These customers are likely to (a) have more opportunities to adopt efficiency measures, and (b) have a greater incentive to lower their electricity bill.

One way to focus the in-home audits on the most promising customers is to limit them to only those customers that use electricity for space heating purposes. Another option is to set a threshold level of electricity consumption; only high-use customers above the threshold would be eligible for the in-home audit. Probably the most interesting option, however, is to use the results of the Diagnostic analysis to identify those customers with the greatest energy efficiency opportunities, and to provide in-home follow-up audits to ensure that high-use customers adopt a large portion of the Diagnostic recommendations.

Q. Please discuss your second concern about the Energy Diagnosis Program, that it does not support many end-uses that typically offer substantial energy efficiency savings.

A. It appears as though the diagnostics tool does not provide information for a number of important efficiency technologies.[13] While the tool is intended to address all of the major categories of end uses (space heating, ventilation, air conditioning, water heating, lighting, appliances, and other), it does not address many critical efficiency measures *within* these categories. For example, the tool apparently does not address the following significant efficiency opportunities:

- Installing programmable thermostats for space heating.
- Replacement of existing refrigerators with new efficient ones.
- Duct sealing for existing heating, ventilation and air conditioning systems.
- Replacement of existing clotheswashers with high-efficiency front-loading washers.

All of these measures have proven to result in significant efficiency savings. Programmable thermostats can reduce heating and cooling bills dramatically; replacing a 10-year old refrigerator with an efficient one can reduce its electricity

[13] HQD-3, doc. 1.1, response to request 16.1.

consumption by roughly 50%; and efficient clotheswashers can reduce electricity use and water consumption by roughly 50% per load of wash.[14] CFLs can reduce electricity consumption by roughly 75% per bulb, have declined greatly in cost in recent years and last as much as ten times longer than typical incandescent bulbs.[15]

Q. Are there reasons why measures which are cost effective in the U.S. would not be cost effective in Quebec.

A. Yes, there are. One important difference is that avoided costs and electricity rates tend to be lower in Québec than in many states in the US. Another factor that might make a difference for some measures is the high portion of customers in Québec using electricity for space heating.

Q. Is the difference in the cost of electricity sufficient to justify excluding these measures from Hydro-Québec's Energy Efficiency Plan?

A. Probably not. The relative cost of electricity is reflected in the avoided costs and the technico-economic potential. Given the shortcomings of the present filing in these two respects, as described in Sections 5 and 6, it would be imprudent to conclude that these measures are not cost-effective in Québec. Furthermore, many efficiency measures applied in the US have benefits that exceed their costs by a factor of two or more. Thus, even if the avoided costs in Québec are substantially lower than those in the US (and, if gas-fired generation is on the margin, it is not clear why they should be), this effect would still not rule out many efficiency measures.

Q. What about the use of electric space heating?

A. The widespread use of electric space heating is reflected in the so-called "cross effects," which tend to reduce the net benefit of an energy efficiency measure by increasing the use of electricity for another purpose. Thus, for example, reducing

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[14] US EPA ENERGY STAR (www.energystar.gov).

[15] While it is widely believed that CFL's are not cost effective in Quebec, this needs to be verified taking into account Hydro-Québec's real avoided costs and the current cost of the bulbs, as well as a careful analysis of the cross effects for lighting.

heat loss from certain appliances may result in an increased heating load (during heating season), and a decreased cooling load (in the summer).

Q. Is the treatment of cross effects in Hydro-Québec's filing convincing?

A. No, it is not. In most cases, insufficient information was presented to allow a careful review of the assumptions regarding cross effects, but many of the figures presented suggest that this effect has been exaggerated.

To take one example, the expected electricity savings resulting from eliminating a second refrigerator are reduced dramatically in households with electric heating. The Plan assumes that instead of 1,153 kWh per year of energy savings, the elimination of the second refrigerator will only save 505 kWh as a result of the cross effects.[16] Thus, the Plan assumes that the 56% of the energy used by the refrigerator over the course of a year directly offsets space heating needs.

Indeed, the 1992 study used to justify these values assumes, but does not demonstrate, that 100% of the energy from a refrigerator is released as usable heat, and that 96% of energy from lights is as well.[17]

This assumption is implausible. Waste heat from refrigerators is delivered primarily to the floor and the back surface, which is almost always placed against a wall. Thus, much of the heat emitted will be lost — especially in poorly insulated homes. Put differently, this is an extremely inefficient way to heat an apartment. It would take far more than 1 BTU of heat emitted at the back of the refrigerator to displace a BTU of heat emitted from a baseboard heater.

Furthermore, more efficient refrigerators will reduce the air conditioning load in a home, resulting in positive cross effects. Given that air conditioning use in Quebec is increasing (thanks in part to Hydro-Québec's active promotion), these positive cross effects can be significant. HQD claims that it has accounted for air

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16 HQD-3, doc. 1.1, p. 55.

17 Hydro-Québec and ADS Groupe-Conseil, inc., *Évaluation des effets énergétiques combinés des mesures d'économie d'énergie: Bâtiment de type : Habitation unifamiliale.* This is a study of a single house.

conditioning cross effects in its analysis, making their assumptions even more dubious.

Q. Please discuss your third concern about the Energy Diagnosis Program, that it does not provide customers with financial incentives to adopt efficiency measures.

A. One of the most important lessons from years of experience with utility-run energy efficiency programs is that significant financial incentives are necessary in order to motivate customers to take the time, make the effort, and make the investment to adopt energy efficiency measures.[18] HQD seems to have taken this into account in designing its Commercial, Institutional & Industrial (CI&I) Programs, but it has inexplicably not applied it to the residential programs. Financial incentives are just as important for residential customers as for CI&I customers. Without financial incentives, the Energy Diagnosis Program is unlikely to encourage even a very small portion of customers to adopt significant efficiency measures. It will therefore result in enormous lost opportunities, and will squander precious efficiency funds and ratepayer money.

Q. Is it common practice for energy efficiency programs to offer financial incentives to residential efficiency measures?

A. Yes, it is. Financial incentives are often the most critical element in successful efficiency programs in the US. The Northeast Energy Efficiency Partnership (NEEP) provides a good example. NEEP is a partnership of many utilities that offer efficiency programs throughout the Northeastern US, including utilities in Massachusetts, Maine, New Hampshire, Vermont, Rhode Island, Connecticut,

[18] A study conducted for the Massachusetts Energy Office in 1997 made following finding (among others) about the state-wide in-home energy audit programs:"Participant satisfaction with the ECS audit is very high, but the current design does not lead to sufficiently increased actions or energy savings. The program's educational components, while valued by customers and stakeholders, are by themselves insufficient to achieve customer actions." The study recommended that: "The program should be redefined to include a financing mechanism for installation of major energy efficiency measures." Hagler Bailly Consulting, ECS Evaluation Report, prepared for the Massachusetts Division of Energy Resources, March, 1997. Available on-line at http://www.state.ma.us/doer/ecs/contents.htm.

New York, New Jersey, Pennsylvania, District of Columbia, Delaware and Maryland.[19] NEEP provides utilities with technical and promotional support for a variety of regional energy efficiency initiatives.[20] Many of these initiatives include some form of financial incentive for purchasing efficient equipment at the time of stock turnover. Utilities have the flexibility to choose their own levels of financial incentives, but the following is a list of typical rebates offered for efficiency equipment (all figures in US dollars):

- Compact florescent bulbs: installed free during an audit, or a $3 rebate for bulbs purchased at a store.
- Exterior light fixtures: $10-$15 rebate.
- Fluorescent torchieres: $20 rebate.
- Clothes washers: $50 rebate.
- Dishwashers: $25 rebate.
- Room air conditioners: $25 rebate.
- Refrigerator replacements: $100 to $450, depending upon size and efficiency.

The list above is just an example of some measures covered by financial incentives. Additional measures are also frequently supported with financial incentives. In Massachusetts, energy efficiency program administrators sometimes provide as much as 75% of the total cost of the equipment and installation of thermal measures (e.g., insulation) in homes with electric space heating and air conditioning.[21] These program administrators have learned that this type of financial support is necessary to motivate customers, and will be offset by the significant energy efficiency savings that can be obtained.

Q. What do you recommend with regard to the Energy Diagnosis Program?

A. The Energy Diagnosis Program should be fundamentally overhauled in order to obtain greater efficiency savings. First, HQD should offer — directly or through

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[19] NEEP web site: www.neep.org.

[20] NEEP might well welcome HQD as a partner, and may be able to provide HQD with technical and promotional support for its energy efficiency programs.

[21] The Cape Light Compact Energy Efficiency Plan: 2003-2007, Draft report, January 17, 2003.

contracting organizations — in-home energy audits, at least to those customers with the greatest potential to adopt cost-effective efficiency measures. Second, it should be expanded to include those electric end-uses that are not addressed by the diagnostic tool, including programmable thermostats for space heating; replacement of old refrigerators with new efficient ones; duct sealing for existing heating, ventilation and air conditioning systems; and replacement of existing clotheswashers with high-efficiency front-loading washers. Third, HQD should provide financial incentives to cover a portion of the additional costs associated with efficiency measures.

Q. Can you be certain that this degree of financial assistance would be justified, given the very different context in Quebec, compared to the Northeast states?

A. It must of course be verified to what extent these measures are cost effective, in relation to an accurate estimate of HQD's avoided costs. In the absence of accurate estimates of avoided costs, it is not possible to verify that all the measures discussed above would prove to be cost-effective. HQD should be required to perform such an analysis, in its next draft of the Plan. We expect that the majority of the efficiency measures discussed above would be cost-effective.

Q. Under the Total Resource Cost Test approach, if an efficiency measure is cost-effective without any financial incentive, will it still be cost-effective if financial incentives are provided to customers?

A. Yes. Under the TRC approach used by HQD,[22] the cost of an efficiency measure includes both the contribution from HQD and the contribution from the participating customer (as well as any contributions that come from other parties). Thus, increasing the contribution from HQD simply decreases the contribution from the customer, but does not change the overall cost, or cost-effectiveness, of the measure.

[22] "Hydro-Québec Distribution wishes to realize all energy efficiency measures that are cost-effective based on the Total Resource Cost test, to the benefit of all its customers." HQD-3, doc. 3, p. 40.

Q. HQD argues that its experience with Écokilo demonstrates that offering free accessories does not engender total participation.[23] Has the utility correctly interpreted these results?

A. HQD reports a participatio n rate of 59% for Écokilo, which is remarkably high. In contrast, the target participation rate for the Diagnostics program is only 6.3% per year. It seems clear that the offer of free accessories (shower heads, sink aerators) in Écokilo contributed greatly to its success.

Q. Would a similar offer increase the penetration of the Energy Diagnosis Program?

Yes. For example, offering free or heavily discounted access to materials to solve infiltration problems (e.g. weatherstripping, caulk and plastic film for windows) would make the program more attractive to the general public and would also result in substantial energy savings.[24]

Q. Please explain why HQD's thermostat programs are likely to offer little efficiency savings.

A. The two thermostat programs are among the exceptions where HQD offers financial incentives to promote a particular efficiency technology for residential customers. Unfortunately, HQD seems to be poised to support an inefficient technology.[25] Non-programmable electronic thermostats are not likely to reduce electricity consumption in a meaningful way.

Once again, Hydro-Québec's estimation of the energy savings from the use of non-programmable thermostats is far from convincing. It estimates savings of 8% of total heating consumption resulting from the improved precision alone, though Technosim reports a range of 3-10% in the literature.[26]

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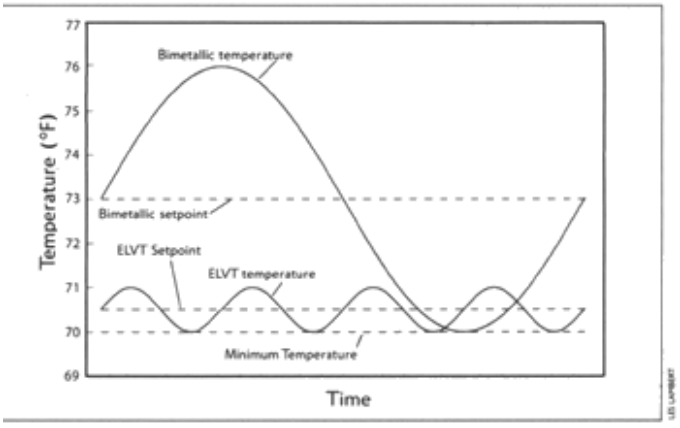
23 HQD-3, doc. 1.1, p. 45.

24 According to the program information (HQD-3, doc. 1.1, p. 55), the potential for these measures is almost as great as is that for electronic thermostats.

25 See note 8, above.

26 Technosim residential report, p. 15. It is unclear if Technosim is referring only to non-programmable thermostats, or if this figure includes the setback benefits of programmable thermostats as well.

Indeed, Technosim points out that the impact of electronic thermostats varies greatly from one home to another, largely due to differences in the way they are used.[27] The graph at right shows the "best case," where the user always sets his thermostat to ensure that he is never too cold (assuming a comfort zone of 70-71 ºF, or 20 to 20.5 ºC). In the case illustrated in the graph, there is of course a substantial energy savings. In this example, however, the room is almost always warmer than the desired temperature, and frequently substantially warmer (up to 76 ºF, or 23ºC). If, on the other hand, the person prefers to sometimes be too warm and sometimes too cool, he will set the thermostat so as to maintain a *mean temperature* that he considers comfortable. Thus, he would set the bimettalic thermostat at 70ºF (20ºC), and the temperature would vary between 67 and 73ºF (18.5 to 21.5 ºC). In this scenario, the precision-related energy gains would be negligible. The energy savings from non-programmable electronic thermostats therefore depend greatly on how each individual used the old, bimetallic thermostats.[28]



The most important potential for efficiency savings from electronic thermostats results when customers turn the setting down at night and when they are away from the home. HQ estimates that 23% of households that acquire thermostats in the "existing market" program will do so. It is unclear, however, why these gains

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27 Ibid.

28 Hydro-Québec's 1995 study, *Évaluation de l'impact énergétique relié à l'installation des thermostats électroniques dans le cadre du Programme Écono-Confort, Marché résidentiel* does demonstrate substantial energy savings from non-programmable thermostats. However, the evaluation took place over a relatively short period in a single suburban neighborhood (single-family houses with an average age of 15 years). It is not clear that the same results would be seen in a low-income urban context.

should be attributed to the thermostat program, since they can do the same thing with their old bimetallic thermostats. Furthermore, these potential savings depend upon customer behavioral patterns that are unreliable, at best. Indeed, unlike programmable thermostats, manual setback has a real impact on people's comfort, since it means that their homes will not even begin to warm up in the morning until they get out of bed and reset the thermostats. In many cases, they will have already left the house before the comfort zone is reached. This contradicts Hydro-Québec's affirmation that all measures included in the technico-economic potential must "correspond to consumers' cultural values," which includes the notion of comfort.[29]

Q. Are there other thermostat technologies that HQD should promote instead?

A. Yes. Programmable thermostats make much more sense for an energy efficiency program than the electronic thermostats offered by HQD. These thermostats can be programmed to automatically turn heating and cooling settings down, so that customers do not have to remember to do it themselves day after day. They are far more reliable and offer much more longer-lasting savings than non-programmable thermostats.

The US EPA ENERGY STAR program provides technical and promotional support for a wide variety of programmable thermostats. Many US utilities promote the installation of programmable thermostats, often with the support of financial incentives. However, the ENERGY STAR program does not support non-programmable thermostats, and we are not aware of any utility efficiency programs that do. Non-programmable thermostats are simply not considered an energy efficiency measure. Indeed, they were not even included in Hydro-Québec's own 1992 *Répertoire des mesures d'économie d'énergie.*

Q. Are installation costs properly accounted for in the Existing Building program?

[29] HQD-3, doc. 5, p. 33, response 35.

A. No, they are not. Only licensed electricians are legally authorized to install thermostats in Québec. While many consumers ignore this regulation, others would not be willing to install a thermostat themselves. Respecting this regulation would significantly increase the cost of adopting a new thermostat. Given this additional barrier, it is especially important that the most energy-efficient type of thermostat is installed the first time.

Q. Do the thermostat programs result in lost opportunities?

A. Yes, they do. By promoting non-programmable thermostats with limited potential energy savings, HQD will miss an important opportunity to install programmable thermostats with potentially very large efficiency savings. Once the non-programmable thermostats are installed, it will most likely be prohibitively expensive to replace them with more efficient programmable ones. This is especially true since licensed electricians are technically required to carry out the installation. Installing non-programmable thermostats on new buildings is especially inefficient, because that is the least expensive time to install a programmable thermostat, and because the non-programmable one could be in place for many years. Unless modified so as to require the use of programmable thermostats, HQD's proposed thermostat replacement program can only be described as wasteful and inefficient.

Q. Does the use of programmable thermostats increase capacity needs during the morning peak?

A. Yes, it does. However, if HQD can demonstrate that it is unable to handle this constraint, it should devote its resources to other cost-effective energy efficiency measures, rather than creating lost opportunities by promoting an inefficient technology like non-programmable electronic thermostats. Nevertheless, it would need to be shown that this problem is so serious as to warrant abandoning such an important efficiency opportunity.

Q. What do you recommend with regard to the two thermostat programs?

A. These two programs should be modified to require the use of programmable thermostats.

Q. Please comment on the AEÉ Inspection Plus Program.

A. In general, the AEÉ Inspection Plus Program is a well-designed program. It is important to promote efficiency at the time of housing renovations in order to avoid lost opportunities. The inspections appear to be comprehensive. The goals of providing inspections, informing occupants and owners of buildings of the potential efficiency opportunities, and training industry professionals to ensure quality efficiency improvements are all important program design elements.

However, this program suffers from the same flaw as the other residential programs: there is not enough financial support to encourage home owners and builders to adopt efficiency measures. The program requires home owners to pay for a portion of the inspection, as well as *all* of the additional costs associated with the efficiency improvements. This creates a tremendous barrier that will prevent most home owners from implementing the efficiency measures that are recommended by the inspection. Homeowners typically have to invest large amounts of money just for the renovations themselves, and they rarely have access to additional funds necessary to pay for "elective" efficiency improvements. If a portion of these funds are not provided by HQD, many efficiency measures will not be adopted, and there will be significant lost opportunities.

Furthermore, many people may choose not to invest in the inspection, knowing that they will probably be unable to afford the recommended solutions.

Q. Please comment on the AEÉ Novoclimat Program.

A. Our conclusions about the AEÉ Novoclimat Program are essentially the same as those for the AEÉ Inspection Plus Program. It is an important program in order to avoid lost opportunities, and it appears to include most of the elements of a successful new construction program. However, it does not provide any financial incentives to encourage participants to adopt efficiency measures – homeowners and builders must pay for all of the additional costs of efficiency measures.

When builders are designing and constructing a new home they often have no interest in reducing the heating and cooling costs of the building – those costs are borne in the future by the home owner. Thus, they need some financial incentive to help overcome the up-front costs associated with efficiency measures. If the home owner is involved in the design and construction of the new home, his primary concern is usually the up-front cost of the construction; he is unlikely to be able to afford substantial "elective" efficiency improvements.

Q. What do you recommend to improve the AEÉ Inspection Plus and Novoclimat Programs?

A. HQD should offer customers financial incentives to help offset the costs of the efficiency improvements. Incentives should cover the key energy aspects of the new or renovated home, including improvements to the building shell; efficient heating, ventilation and air conditioning measures; energy efficient appliances; and energy efficient lighting measures.

In the absence of financial incentives, at a minimum HQD should be required to track the rate at which customers adopt efficiency measures in both these AEÉ programs. HQD should keep track of the cost-effective efficiency measures that are recommended for all the renovation jobs and new homes, as well as the percentage of those efficiency recommendations that are adopted, by end-use type. HQD should then report these results to the Regié every six months. If it turns out that HQD is successful in achieving the implementation goals of the programs, then the programs should continue as designed. If the implementation rates are significantly lower than those expected in the Plan, then HQD should be required to offer financial incentives in order to increase the implementation rate.

Q. Please comment on the AEÉ Energy Efficiency for Limited Income Households Program.

A. In general, the AEÉ Energy Efficiency for Limited Income Households Program is well-designed. It addresses a very important component of the residential sector. It provides in-home energy audits to participants. It covers a number of different types of electricity end-uses. And, significantly, it offers free installation

of energy efficiency measures. In fact, this overall approach should be considered as model for other HQD residential programs, particularly the Energy Diagnostics Program.

Our primary concern with this program is that it does not go far enough and thus will result in lost opportunities. The program description notes that the program will include "free installation of energy efficiency products and equipment (caulking of doors and windows, weatherstripping, aerators, clappers for dryers, reduction of water-heater temperature, etc.)"[30] It appears as though the program will not address several electricity end-uses that can offer substantial efficiency savings. For example, the program does not appear to support programmable thermostats; efficient refrigerators; heating, ventilation and air conditioning measures, including duct sealing; insulation; or efficient lighting measures. If these efficiency measures are not addressed at the time of the in-home energy audit, then it will be very difficult to address them at a later date, and they will represent lost opportunities.

Q. Please comment on the AEÉ Energy Renovations in Low-Rent Housing Units Program.

A. Our conclusions about the AEÉ Energy Renovations in Low-Rent Housing Units Program are essentially the same those for the AEÉ Energy Efficiency for Limited Income Households Program. While the program addresses an important opportunity for an important type of residential customer, it does not go far enough. It appears as though the program will only address "roof insulation and building weatherization" measures.[31] Thus, it ignores some key efficiency opportunities, including water heating measures, efficient lighting measures; efficient refrigerators; heating, ventilation and air conditioning measures, including duct sealing; and programmable thermostats.

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30 Program Descriptions for the Residential Market, HQD-2, doc. 5, page 16.

31 Ibid., page 18.

Furthermore, HQD has not described the type of financial incentives that will be used to support the efficiency measures in this program. As HQD and AEÉ appear to appreciate with regard to the Energy Efficiency for Limited Income Households Program, it is essential that most or all of the incremental costs of efficiency measures be covered in a program serving limited income customers. The up-front costs pose a particularly challenging barrier for this customer type, and efficiency programs must help to overcome that barrier.

Q. What do you recommend to improve the AEÉ Limited Income and Low-Rent Housing Units Program?

A. With regard to the Limited Income Program, HQD should expand the coverage to include additional cost-effective efficiency measures. As mentioned above, the obvious candidates include programmable thermostats; efficient refrigerators; heating, ventilation and air conditioning measures, including duct sealing; insulation; and efficient lighting measures. The program should cover as much of the incremental costs of these efficiency measures as possible.

With regard to the Low-Rent Housing Units Program, HQD should also expand the program to include all cost-effective measures that are not currently included. There is no reason why the two Limited Income AEÉ programs should offer different efficiency measures, except for those cases where different measures are called for as a result of building design and existing equipment. Furthermore, HQD should cover as much of the incremental costs of these efficiency measures as possible. HQD's plans for financial support for this program should be clarified in the Plan.

8. PROGRAM BUDGETS AND RATE IMPACTS

Q. Do you have any concerns about the Plan program budgets in general?

A. Yes, the efficiency program budgets in total are much too small for an electric utility the size of Hydro-Québec. The annual energy efficiency budget is roughly

$30 million, once the programs are fully operational by 2004.[32] This budget is only 0.38% of the $7.8 billion of HQD annual revenues from domestic electricity sales. Several electric utilities in the US spend as much as one, two and even three percent of their revenues on energy efficiency programs. This relatively low investment effort suggests that energy efficiency is not a high priority for the utility.

Q. Has HQD compared its budgets to those of US electric utilities?

A. Yes. HQD notes that it used a report from American Council for an Energy Efficient Economy (ACEEE) to estimate the average amount of efficiency budgets as a percent of revenues for US electric utilities. HQD finds that the US average for energy efficiency expenses was 0.42% of revenues, based on a compilation based on data from 1998.[33] Based on this information, HQD suggests that is budgets are comparable to those of average US utilities.

Q. Do you agree with HQD's conclusion that its budgets are comparable to those of US electric utilities?

A. No. The average budget figure presented by HQD apparently includes all electric utilities in the US – including those that have no energy efficiency program at all. Including utilities with no efficiency programs significantly lower the overall average. This is not an appropriate comparison to make. Instead, HQD's budgets should be compared with those of major electric utilities that offer significant energy efficiency programs.

Furthermore, ACEEE has recently updating this study, using data from 2000. According to the draft report, efficiency spending in the Northeast increased by 43% from 1998 to 2000. Spending as a percent of revenues increased by 30% in New England and by 24% in the mid-Atlantic states.[34]

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[32] HQD-1, Document 1, page 51.

[33] HQD-3, doc. 7, response to RNCREQ Discovery Request 14.1.

[34] *State Scorecard on Utility and Public Benefits Energy Efficiency Programs: An Update*, Dan York, Ph.D., and Marty Kushler, Ph.D., December 2002 (draft).

Q. Have you compared Hydro-Québec's budgets with those of the industry leaders?

A. Yes, we have. The ACEEE website contains a table of states that have a "system benefits charge" to collect funds for energy efficiency programs.[35] It includes more recent data than the study used by HQD, cited above. The ACEEE table indicates that there are over 18 states with energy efficiency system benefits charges. The simple average energy efficiency funds across all these 18 states is roughly 1.3% of utility revenues. The weighted average (weighted by revenues) energy efficiency funds across all these 18 states is roughly 0.89% of utility revenues. Thus, HQD would have to more than double its efficiency budgets in order to be roughly in line with energy efficiency spending in states with system benefits charges.

Q. Are there other useful benchmarks for comparing energy efficiency budgets?

A. Yes. It is also informative to compare energy efficiency budgets relative to the total electricity sales of the company, in terms of ¢/kWh. This figure provides an indication of the amount of costs that are directly charged to customers through rates. In HQD's case, an annual budget of roughly $30 million divided by annual electricity sales of 152,000 GWh results in an energy efficiency charge of 0.02 ¢/kWh. In the US, the simple average of all energy efficiency charges in the 18 states with system benefits charges is 0.11¢/kWh. The weighted average (weighted by sales) is 0.07 ¢/kWh. Again, HQD's budgets are substantially lower.

Finally, the most useful measure is efficiency funding as a percent of revenues. This is a measure that takes into account differences in electricity rates between regions, and thus it is particularly useful when comparing Hydro-Québec to US jurisdictions. By this measure, HQD's performance is once again far below that of its peers. Its efficiency funding represents only 0.38% of its domestic

[35] ACEEE web site: www.aceee.org.

electricity revenues, compared to a weighted average of 1.71% for the ten states surveyed.

Q. Can you please summarize these results?

A. The table below presents a summary of the energy efficiency funds of the ten states with the largest funds, as a percentage of total revenues. It includes information on efficiency funds in millions of dollars, efficiency funds as a percent of total revenues, and efficiency charges in ¢/kWh. The first row in the table presents the data for HQD (converted to US dollars), for comparison. This suggests that HQD would have to increase its efficiency budgets by a factor of four in order to be roughly in line with the efficiency budgets in the top ten states, in terms of the percentage of total revenues.

State/Utility	Efficiency Funding (mil$ US)	Efficiency Charge (US¢/kWh)	Efficiency Funding (% of revenues)
Hydro-Québec Dist.	19.5	0.013	0.38
CT	87.0	0.30	3.00
VT	13.1	0.25	2.60
MA	117.0	0.25	2.50
WI	62.0	0.12	2.30
RI	14.0	0.21	2.10
OR	31.5	0.10	1.90
ME	17.2	0.15	1.50
MT	8.9	0.07	1.50
NJ	89.5	0.14	1.35
CA	228.0	0.13	1.30
Totals/Averages	668.2	0.17	2.01
Weighted Averages	---	0.15	1.71

Source: ACEEE web site: www.aceee.org

Q. Have you compared HQD's budgets and objectives with those of any Canadian utilities?

A. Yes, we have made a comparison with B.C. Hydro's PowerSmart program. Like Hydro-Québec, B.C. Hydro is a Crown utility that owns and operates a power system that is almost exclusively hydroelectric and that, like Hydro-Québec, makes significant export sales to the U.S. By most measures, B.C. Hydro is

roughly one-third the size of Hydro-Québec, as shown in the following table (based on 2001):

	HQD	B.C. Hydro	
Installed capacity (MW)*	31 174	11 102	36%
Domestic electricity sales (GWh)	152 212	48 131	32%
Revenues from domestic electricity sales (million $)	7 803	2 372	30%

* Including Churchill Falls, HQ's installed capacity increases to 36,602 MW, and the percentage declines to 30%.

Q. How does B.C. Hydro's PowerSmart program compare to HQD's Plan?

A. Even in absolute terms, PowerSmart is much more ambitious than the Plan. It anticipates investments almost three times as great over the next 10 years, and its anticipated energy savings by 2010 is double that of HQD, as seen in the following table, drawn from the utilities' annual reports:

	HQD	B.C. Hydro
10-year investment (M $)	216	600
2010 energy savings (GWh)	1 625	3 500

The difference in funding and in energy savings objectives is even more striking when the size difference between the two utilities is taken into account. The following table provides these figures in relation to 2001 domestic sales:

	HQD	B.C. Hydro
10-yr investments as % of 1-yr (2001) domestic revenues	2,8%	25,3%
2010 energy savings as % of 1-yr (2001) consumption	1,1%	7,3%

Thus, PowerSmart's long-term investment budget (relative to its revenues to domestic sales) is more than nine times as great as HQD's. Similarly, its long-term energy efficiency objective (relative to its annual domestic sales) is almost seven times as great.

Q. Is it appropriate to compare Hydro-Québec to B.C. Hydro?

A. Yes, it is. Above and beyond the similarities mentioned above, B.C. Hydro resembles Hydro-Québec in its past experience concerning energy efficiency.

Like Hydro-Québec, B.C. Hydro made a significant energy efficiency effort in the 1990s, but largely abandoned it toward the end of the decade. Now that it sees renewed load growth, with natural gas fired plants on the margin, it once again sees the need for an aggressive PowerSmart program. Furthermore, like Hydro-Québec, B.C. Hydro's energy efficiency programs will soon be again subject to regulatory oversight.

Q. Will the current program and budgets in the Plan result in unreasonable increases in electricity rates?

A. No. The programs currently proposed by HQD will have only a very small impact on electricity rates. HQD calculates that in the year where rate impacts are highest (2006), the additional required revenues will be $27.7 million, which is roughly 0.4% of current electricity revenues. This level of rate impact is so small that it would essentially be unnoticed by most customers.

It is also important to point out that the rate impacts are even smaller in the other years, and that they become negative by 2011 and remain negative for each year afterwards.[36] The rate impacts are negative in these later years because the costs avoided by the efficiency programs are greater than the lost revenues from the programs. Thus, any short-term rate increases from the programs will be offset by long-term rate decreases.

This effect highlights the need to maintain a long-term perspective when considering rate impacts. According to HQD's long-term projection of rate impacts, the average annual rate impact over the first ten years of the efficiency programs will be $12.4 million, which equals roughly 0.2% of current electricity revenues. The average annual rate impact over the first twenty years of the efficiency programs will be $3.8 million, which equals less than 0.1% of current electricity revenues. Clearly, the proposed efficiency programs do not run the risk of creating unreasonable increases in electricity rates.

[36] HQD-3, doc. 5, response 59.

Q. Would increased efficiency budgets and additional efficiency savings result in unreasonable rate impacts?

A. No, not necessarily. While the rate impacts will increase with increased expenditures and increased savings, they may easily remain within reasonable limits. This is especially true when the long-term rate impacts are considered.

Also, when considering rate impacts, it is important to account for the other side of the coin: reduced electricity bills. Greater efficiency budgets and greater efficiency savings, which will lead to greater rate impacts, will also lead to greater reductions in electricity bills for customers that participate in the efficiency programs. As efficiency budgets increase and more customers participate in the programs, then it is more likely that the rate impacts will be offset by efficiency savings. In other words, the increased efficiency savings have a counteracting effect on the rate impacts. This effect should be accounted for in weighing the tradeoffs between increased efficiency budgets and increased rate impacts.

Q. If HQD were to significantly increase its energy efficiency budgets and these were expected to lead to unreasonable rate increase, are there ways that HQD could mitigate the rate impacts?

A. Yes. If the energy efficiency funds were amortized over a longer time period, for example ten years instead of five, then the short-term rate impacts would be reduced considerably. A longer amortization period could be justified on the grounds that the energy efficiency savings are enjoyed over the long-term, so the costs should be recovered over the long-term. A ten-year amortization period would still be considerably shorter than those used to recover the costs of generation investments.

Q. What do you recommend, with regard to the consideration of rate impacts in developing the HQD Plan?

A. First, rate impacts should not be used as an obstacle to prevent the an increase in the budgets of the energy efficiency programs. There is still considerable room for additional efficiency expenses and savings without creating unreasonable rate impacts.

Second, HQD's efficiency budgets should be increased significantly, as described above, without being hampered by the potential threat of rate impacts. Once new program budgets have been established and new savings and participation estimates are made, then a rate impact analysis should be performed to see if the resulting impacts are acceptable.

Third, future rate impact analyses should consider the long-term (i.e., ten- to twenty-year) impacts of efficiency programs. They should also take account of the additional benefits that are likely to offset the rate impacts, including reduced bills and reduced costs of generation, transmission and distribution of electricity. Rate impact analyses should also consider how the rate impacts of efficiency investments compare with those of investments in generation, transmission and distribution of electricity. Rate impacts of demand-side investments might be much smaller than those for supply-side investments, and thus be deemed acceptable in that light.

Q. What do you recommend with regard to HQD's efficiency budgets?

A. HQD's efficiency program budgets should be increased substantially. Increased budgets would offer much greater efficiency savings, along with all of the associated reductions in electricity generation, transmission and distribution costs. Increased budgets would also make it easier for HQD to adopt many of the recommendations that we have made above with regard to increased financial incentives.

Of course, simply increasing budgets is no substitute for the use of proper methodologies for determining avoided costs and designing programs. But in the short term, as the comparisons above show, a doubling of the budgets would not be unreasonable.

9. RECOMMENDATIONS

Q. What is your recommendation with respect to the Plan as a whole?

A. As we have indicated above, HQD clearly needs to rework and resubmit its plan, including the avoided costs, the technico-economic potential and program design. The revised Plan should be prepared with meaningful input from energy efficiency stakeholders and interested parties. Ideally, HQD should establish a collaborative approach to energy efficiency program design, where stakeholders can work directly with HQD in designing efficiency programs, rather than simply critiquing the programs after they have been designed.

However, its customers should be made to wait any longer than necessary to begin to benefit from energy efficiency programs. We therefore recommend that the Régie authorize HQD to proceed with the programs set out in its draft Plan, modified in accordance with our recommendations above.

Q. Please summarize your specific recommendations.

A. Our primary recommendations are summarized as follows:

1. HQD should be required to file a revised Plan that addresses the concerns raised in this testimony. These concerns are so significant that they cannot be addressed with small, incremental changes to the current Plan.
2. The revised Plan should be prepared with meaningful input from energy efficiency stakeholders and interested parties. Ideally, HQD should establish a collaborative approach to energy efficiency program design, where stakeholders can work directly with HQD in designing efficiency programs, rather than simply critiquing the programs after they have been designed.
3. The Régie should nevertheless authorize HQD immediately to implement the programs described in the present draft Plan. However, it should do so in a way that addresses as many of the concerns raised in this testimony as possible.
4. HQD should initiate a careful review of its avoided costs, and address the issues raised above, as part of the process leading to a revised Plan.
5. Once its avoided costs are established, HQD should be required to file a full analysis of its technico-economic potential, including sufficient underlying data to allow expert review.
6. The Energy Diagnosis Program should be supplemented with an in-home energy audit program for customers with high electricity consumption. This audit program should include financial incentives to cover a portion of the additional costs associated with efficiency measures. The on-line and mail-in

diagnostics can be used to help identify the most appropriate candidates for the in-home audit.

7. The two thermostat programs should be limited to programmable thermostats. Programmable thermostats should also be encouraged for existing homes through the redesigned Energy Diagnostics/Audit Program, and in the renovation and construction of new buildings through the AEÉ Inspection Plus and the AEÉ Novoclimat programs.

8. With regard to the AEÉ Inspection Plus and Novoclimat Programs, HQD should offer customers with financial incentives to help offset the costs of the recommended efficiency improvements. Incentives should cover all key energy aspects of the new or renovated home.

9. With regard to the Limited Income Program, HQD should expand the coverage to include additional cost-effective efficiency measures. The program should cover as much of the incremental costs of these efficiency measures as possible.

10. With regard to the Low-Rent Housing Units Program, HQD should also expand the program to include all cost-effective measures that are not currently included. Furthermore, HQD should cover as much of the incremental costs of these efficiency measures as possible. HQD's plans for financial support for this program should be clarified in the Plan.

11. HQD's efficiency program budgets overall should be increased substantially. A doubling of the budgets would not be unreasonable. Increased budgets would offer much greater efficiency savings, along with all of the associated reductions in direct costs and externalities. Once new program budgets have been established and new savings and participation estimates are made, then a rate impact analysis should be performed to see if the resulting impacts are acceptable.

12. Future rate impact analyses should consider the long-term (i.e., ten- to twenty-year) benefits of efficiency programs. They should also take account of the additional benefits that are likely to offset the rate impacts, including lower bills resulting from reduced consumption. Rate impact analyses should also consider how the rate impacts of efficiency investments compare with those of investments in generation, transmission and distribution of electricity.

Q. Does this conclude your testimony?

A. Yes, it does.