DUNSKY EXPERTISE EN ÉNERGIE
énergie | environnement | économie

5492, Hutchison | Montréal
Quebec Canada H2V 4B3
dunsky@vif.com
514 779 7445

Opportunities for Accelerated Electrical Energy Efficiency in Québec: 2005-2012

Prepared by:
Eric Belliveau*
Chris Neme‡
John Plunkett*
Philippe U. Dunsky◊

For:
Regroupement national des conseils régionaux de l'environnement du Québec (RNCREQ)
Regroupement des organismes environnementaux en énergie (ROEE)
Regroupement pour la responsabilité sociale des entreprises (RRSE)

Régie de l'énergie: Case Docket R-3526-2004
Special Assessment of the Suroit Gas-Fired Power Plant

~~**April 22, 2004**~~
REVISED VERSION – May 16th, 2004

** Optimal Energy Inc.* ‡ *Vermont Energy Investment Corporation* ◊ *Dunsky Expertise en énergie*

Qualifications

Dunsky Expertise en énergie is the consulting firm of Philippe Dunsky, an independent sustainable energy consultant with over 12 years of experience in energy efficiency, renewable energy and climate change related markets and opportunities.

Throughout his career, Philippe has researched, advised, written, spoken and testified extensively on these issues for a broad range of clients including NGOs, utilities and governments. His areas of expertise include energy efficiency, alternative energy, utility regulation and energy policy. Philippe has been a guest speaker at dozens of key industry conferences, including those of the *Canadian Association of Members of Public Utilities Tribunals*, the *Canadian Electricity Association*, the *Canadian Gas Association*, the *American Wind Energy Association* and the *American Council for an Energy Efficient Economy*. He has also lectured for MBA and economics courses at four universities.

Mr. Dunsky has been involved in the design and analysis of energy efficiency projects and programs for nearly a decade. He was responsible for developing a large-scale residential efficiency program for the *Ministère des Ressources naturelles du Québec*; has assisted in the development of Gaz Métropolitain's experimental programs, has conducted detailed economic analyses of program proposals for a variety of clients, has assisted clients in a series of consultations and negotiations regarding DSM and its regulatory treatment, and has provided expert testimony on utility DSM plans on a number of occasions before the *Régie de l'énergie*. In 2000, Philippe authored *L'efficacité énergétique: manuel de reference pour la regulation des marches monopolistiques et concurrentiels*, a regulator's primer for proper treatment of demand-side resources.

Throughout his career, Philippe has served on a number of select energy, economic and environmental committees and boards, including the panel charged with revising Quebec's energy policy. Fully bilingual, he currently co-chairs a private ethical investment group, and was recently named to the Governing Council of the $250-million Canadian Green Municipal Funds.

Formerly Executive Director of the Helios Centre, an independent energy think tank, he now provides independent sustainable energy consultancy services. Philippe studied economics at the University of London (UK).

Optimal Energy, Inc. (Optimal) specializes in the design, valuation, planning, startup, and implementation for both ratepayer-funded energy-efficiency programs and market-based energy products and services, with particular expertise in the commercial sector. Optimal is known for its unsurpassed commercial energy efficiency analysis and design expertise, and for its thorough economic analysis of efficiency and renewable resources. Optimal Energy combines special expertise in commercial sector efficiency technologies with analytical strengths in economic analysis and program design and evaluation. Our clientèle includes consumer and environmental advocates, government and regulatory agencies, energy utilities and energy-service providers. Optimal recently led a team analyzing the technical, economic and achievable potential for efficiency and renewable resources in New York State. Optimal also led analysis of achievable efficiency potential in Vermont, and led a team in analyzing the achievable potential for Long Island.

Noteworthy assignments among Optimal's C&LM experience are: ongoing work in Massachusetts collaboratives on program planning and oversight of utility-administered programs, dating back to 1999; establishment and ongoing management of Efficiency Vermont (EVT), the United States' first independently administered "efficiency utility", since 1999, now operating under a second, three-year performance contract with the Vermont Public Service Board; and program planning and management support for the Long Island Power Authority (LIPA) since 1998. Optimal team members were also extensively involved in the New Jersey utility collaborative responsible for administration of statewide electric and gas efficiency programs between 1999 and 2002. We were extensively involved in the design, analysis, and oversight of comprehensive efficiency investment portfolios in Maryland form 1990-1997.

Optimal has also collaborated on several efficiency potential studies, most significantly in New York, Vermont, and Maine. We have also conducted program potential analyses in New Jersey, Maryland and Iowa, as well as assessments of several regional market transformation initiatives. Our experience also includes C&LM planning and expert testimony in Maine, New York, Connecticut, and Ontario, as well as Maryland, Indiana, Iowa and Florida. In addition, we are currently engaged in collaborative processes with Shanghai and Jiangsu provinces to develop and analyze energy-efficiency portfolios intended to alleviate China's growing electric energy and power shortages.

Vermont Energy Investment Corporation (VEIC) is an independent energy efficiency developer and service provider. VEIC's mission is to reduce the economic, social and environmental costs of energy consumption through the promotion of cost-effective energy efficiency and renewable energy technologies. VEIC advances its mission through a unique combination of activities, including the design and evaluation of utility DSM programs. VEIC has provided these services in over 20 states and eight countries (including Canada) since 1988, including lead collaborative advisors for four of New Jersey's five residential programs as part of their US $100+ million annual energy efficiency and renewable energy programs. VEIC also acts as the energy efficiency program development and delivery agent for *Efficiency Vermont*, the state's official "Efficiency Utility". Efficiency Vermont is funded by and consolidates the individual programs of 22 utilities into a single state-wide entity with a single set of rules.

Noteworthy assignments among VEIC's C&LM experience are: ongoing work in Massachusetts collaboratives on program planning and oversight of utility-administered programs, dating back to 1999; establishment and ongoing management of Efficiency Vermont (EVT), the United States' first independently administered "efficiency utility", since 1999, now operating under a second, three-year performance contract with the Vermont Public Service Board; and program planning and management support for the Long Island Power Authority (LIPA) since 1998. VEIC team members were also extensively involved in the New Jersey utility collaborative responsible for administration of statewide electric and gas efficiency programs between 1999 and 2002. We were extensively involved in the design, analysis, and oversight of comprehensive efficiency investment portfolios in Maryland form 1990-1997.

VEIC has also collaborated on several efficiency potential studies, most significantly in New York, Vermont, and Maine. We have also conducted program potential analyses in New Jersey, Maryland and Iowa, as well as assessments of several regional market transformation initiatives. Our experience also includes C&LM planning and expert testimony in Maine, New York, Connecticut, and Ontario, as well as Maryland, Indiana, Iowa and Florida.

Acknowledgements

The authors would like to thank the following internal staff who contributed to this study:

- Richard Faesy (*VEIC*)
- Toben Galvin (*VEIC*)
- Blair Hamilton (*VEIC*)
- Carole Harris (*VEIC*)
- Philip Mosenthal (*Optimal*)
- Stuart Slote (*Optimal*)
- Ken Tohinaka (*VEIC*)
- Francis Wyatt (*Optimal*)

We would also like to thank the following external colleagues for their valuable input and insights:

- Michael Blasnik (*M. Blasnik & Associates*)
- Mark Dyen (*Conservation Service Group*)
- R. Neal Elliot (*American Council for an Energy-Efficient Economy*)
- Jim Fitzgerald (*Minneapolis Center for Energy and Environment*)
- Ken Klassen (*Natural Resources Canada*)
- Kai Millyard (*Green Communities Association of Canada*)
- Michel Parent (*Technosim Inc.*)
- Carolyn Ramsum (*Natural Resources Canada*)

We of course remain solely responsible for any errors or omissions.

Note aux lecteurs francophones

Cette étude, dont plusieurs auteurs sont américains, a été rédigée en anglais. Malheureusement, les délais de production n’ont pas permis une traduction française, ce pour quoi nous nous excusons. Une telle traduction pourra toutefois être réalisée sur demande.

Table of Contents

List of Tables

List of Figures

I. Mandate

Our clients, the Regroupement national des conseils régionaux en environnement du Québec (RNCREQ), the Regroupement des organismes environnementaux en énergie (ROEÉ) and the Regroupement pour la responsabilité sociale des enterprises (RRSE) asked us to explore and assess the opportunities for accelerating Hydro-Québec's energy efficiency programs and results.

Specifically, we were asked to:

- Analyze Hydro-Québec's current demand-side management (DSM) plan and program proposals;
- Prepare a series of concrete proposals, rooted in North American best practices and considerate of Québec's own energy context, aimed at enhancing Hydro-Québec's current DSM plan and accelerating achievable energy savings; and
- Assess the costs as well as the practical feasibility of these proposals.

Our mandate covered the residential, commercial/institutional (C&I) and small and medium industrial (SMI) sectors. We did not cover opportunities in the large industrial sector, for which far more complex, often plant-by-plant analyses are required.

A note on demand-side management (DSM) savings reporting:

In reporting DSM savings, it is important to distinguish between savings "*at the meter*" and the resulting savings "*at generation voltage level*". While the former represents actual energy savings, generation voltage savings are the only appropriate way to understand the impact of DSM on the need for new supply and, as such, to compare DSM and supply-side alternatives.

Hydro-Québec's DSM filings tend to present estimated savings *at the meter*. To avoid confusion, we have retained that reporting when reproducing *only* Hydro-Québec's proposals (tables 1, 6-7 and 25-28; figures 5 and 8). All other energy savings values are reported at the generation level, including Hydro-Québec's when merged with our own.

As such, all our projected savings levels, both including and net of Hydro-Québec's, both in our tables and text, are consistently reported at the generation level.

II. Introduction

In the fall of 2003, Hydro-Québec presented an update of its demand-side management (DSM) Plan. On March 30, 2004, the utility announced additional changes aimed at increasing energy savings from the residential (low-income) sector. These changes increase overall projected savings by less than 5% by the year 2010.

After accounting for the proposed changes, Hydro-Québec has put forth a DSM plan that aims to achieve slightly more than 1.5 TWh/yr savings by the year 2011. Of this total, 0.58 TWh would come from the residential sector, 0.39 TWh from the commercial and institutional (C&I) sector, and 0.57 TWh from the small, medium and large industrial sectors.

The following table summarizes the latest version of Hydro-Québec's DSM Plan projected savings.

Table 1: Projected Energy Savings from Hydro-Québec's Proposed DSM Plan (updated to March '04)

GWh	2003	2004	2005	2006	2007	2008	2009	2010	2011
RES Diagnostic	6	43	87	130	169	209	249	249	249
RES Thermostats - EX	5	21	36	55	55	55	55	55	55
RES Thermostats - NC	0	6	12	18	18	18	18	18	18
RES Minuteries piscine	0	9	18	25	25	25	25	25	25
RES Inspec. ÉnerGuide A	2	13	28	44	60	76	92	92	92
+ volet Rénov. FR (nouv.)			5	13	21	29	37	46	46
RES Novoclimat Unifam. /	3	7	10	14	18	21	25	25	25
RES Novoclimat Log.Soc.	0	3	5	8	10	13	16	16	16
RES Visites FR AEE	3	5	8	11	13	16	19	19	19
+ volet couv. prov. (nouv.)		1	3	4	6	8	9	13	13
+ volet thermostats (nouv.)		2	4	6	8	10	12	14	14
RES Renov HLM SHQ	0	1	3	5	5	5	5	5	5
S-tot. RÉS	**19**	**111**	**219**	**333**	**408**	**485**	**562**	**577**	**577**
CI Iniatives Énerg.	0	51	107	163	216	268	325	325	325
CI Diagnostic petits (100%	0	6	11	17	22	28	33	33	33
CI Bâtiments HQ	0	3	7	10	10	10	10	10	10
CI Feux de circulation	0	1	5	10	15	20	20	20	20
CI Aide à l'implant. (petits)	0	0	0	0	0	0	0	0	0
CI Recommissioning	0	0	0	0	0	0	0	0	0
S-tot. CI	**0**	**61**	**130**	**200**	**263**	**326**	**388**	**388**	**388**
PMI Aide à la décision	0	6	12	21	27	32	35	35	35
PMI Intiatives Énerg.	0	5	24	49	72	95	119	119	119
S-tot. PMI	**0**	**11**	**36**	**70**	**99**	**127**	**154**	**154**	**154**
GI PADIGE	0	15	42	80	80	80	80	80	80
GI PIIGE	0	10	50	100	190	280	335	335	335
S-tot. GI	**0**	**25**	**92**	**180**	**270**	**360**	**415**	**415**	**415**
Total Hydro-Québec	**19**	**208**	**477**	**783**	**1040**	**1298**	**1519**	**1534**	**1534**

REF: R-3526-2004, HQ-3, doc.RÉGIE, p.22-29

Notes:
> Savings are reported "at the meter". For comparison with generation projects, these should be increased by avoided transmission and distribution losses.
> For the new additions (marked by a "+"), forecasts are provided until 2010 only. We simply extended those savings by one year.

We were given the mandate to explore additional energy efficiency opportunities not captured by Hydro-Québec's efforts. To do so, we have focused on several priority markets and end-uses that we believe are either neglected or underexploited in the above plan. In particular:

- New markets:
  - Compact fluorescent lighting (residential)
  - Efficient clothes washers (residential)
  - Efficient windows (residential)
  - Refrigerator removal (residential)
  - Other efficiency products (residential)
- Enhancements:
  - Enhanced EnerGuide for Homes program (residential)
  - Enhanced Novoclimat program (residential)
  - New construction improvements (C&I)
  - Efficient retrofit opportunities (C&I)
  - Efficient renovation opportunities (C&I)
  - Efficient remodel/replacement opportunities (C&I)
  - Improved small and medium industry approaches (SMI)

We did not address the large industrial market, which requires a much more refined, often plant-by-plant analysis.

In addressing these opportunities, we developed the sketches of programs and program modifications that borrow from North America's "best practices" in energy efficiency. We then analyzed the likely costs and energy and capacity savings associated with these additions and changes, using Québec-specific data to the extent possible.

While we present an initial "unconstrained" scenario that illustrates the breadth of achievable savings, we also analyzed a "budget-constrained" scenario. Pursuit of the constrained scenario – which includes many but not all of the initiatives listed above – would place Hydro-Québec among the continent's DSM leaders. It would also see the provincial utility return to roughly the same level of financial effort as it was intent on making in the early 1990s, prior to aborting its DSM efforts.

This report is descriptive rather than prescriptive. Indeed, we have limited our work to developing a series of options for accelerated energy savings in Québec. The choice of which, if any, of these options to pursue should be rooted in a broader analysis of the resource alternatives available to Hydro-Québec, including the *Suroît* project and any other supply- or demand-side alternatives.

III. Hydro-Québec's DSM effort in the North American context

Prior to presenting the results of our analytical work, we feel it is imperative to place this Plan in both its historical and North American contexts.

A. The Early Context

Hydro-Québec's DSM efforts can best be understood through the prism of recent North American supply/demand and DSM trends.

In the 1970s, utilities throughout the U.S. and Canada were forecasting tremendous demand growth in the electricity sector, and Québec's forecasts were no different. For example, according to the *Ministère des Richesses naturelles*' 1974 forecast, electricity demand was to have reached 225 TWh by 1990.[1] The same forecast's sensitivity analysis suggested a "99.5% probability" that demand would fall in the range of 201 to 252 TWh in that same year. Of course, 1990 electricity demand – despite very aggressive, post-forecast load growth efforts (throughout the 1980s, electric baseboard heating was strongly promoted, while significant rate benefits were provided to attract large industrial plants) –, came in at nearly *60 TWh below the lowest band* in that probabilistic range.

It was in the context of these extravagant demand forecasts that much of North America's electricity sector was busy developing both large-scale power plants (nuclear, coal, hydro) and, simultaneously, efforts designed to improve end-use efficiency (otherwise known as demand-side management, or DSM).

The result of the supply-side rush was tremendous continental supply overcapacity. Again, Québec fell well within this North American trend, having invested significantly in the *La Grande* power project. By the early 1980s, Québec was awash in surpluses and intently focused on *increasing* demand growth to meet supply. DSM, in this context, was seen to provide little benefit, and was largely left behind.

By the end of the 1980s, that decade's aggressive load growth efforts begun paying off, and Hydro-Québec was once again faced with a forecasted need for more power. While launching plans to build the Great Whale hydroelectric project, Hydro-Québec also launched a plan to invest nearly $3 billion in demand-side management programmes over a ten-year timeframe. Both plans would eventually be abandoned.

B. DSM in the Early 1990s

Hydro-Québec's first foray into significant DSM programming was presented in its 1990 Development Plan. There, Hydro-Québec proposed a 10-year DSM effort that was to culminate in 9.6 TWh annual savings by the year 2000. While the Plan had a rough start, the objective was largely maintained (revised at 9.3 TWh by 2000) in the following *Engagement de performance 1992*, and again in the subsequent 1993 Development Plan.

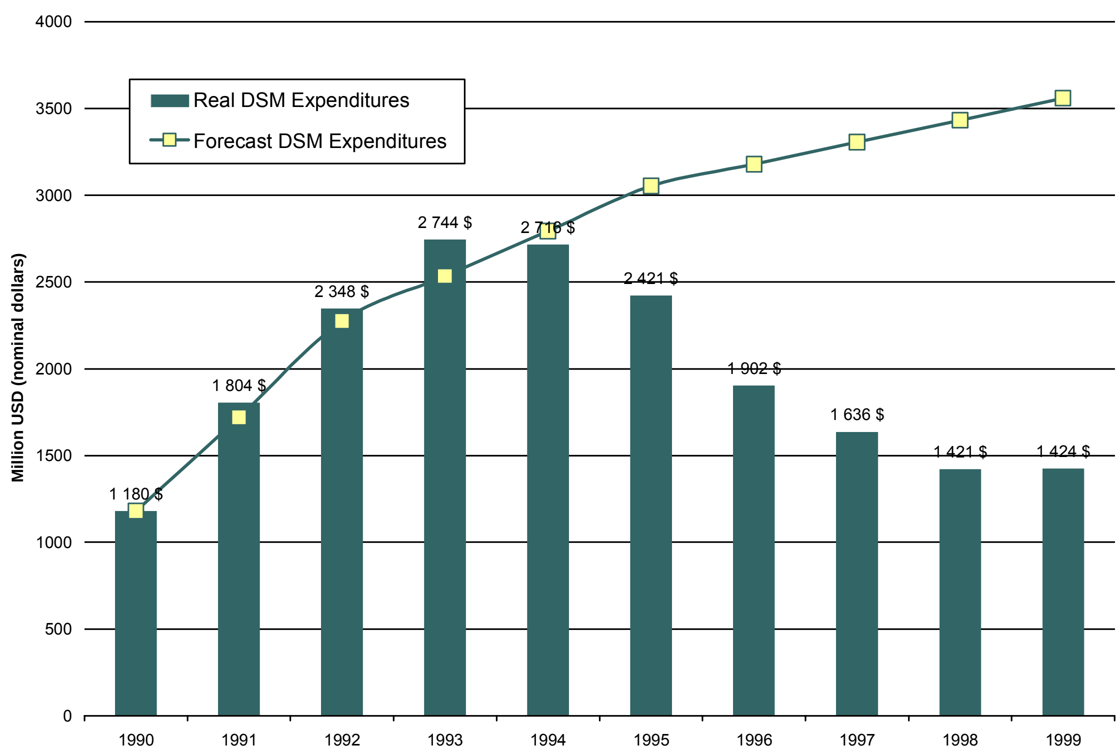
---

[1] MINISTÈRE DES RICHESSES NATURELLES, 1974. *Prévision de la consommation énergétique à long terme au Québec (1975-1990) – méthode de régression tendancielle*, p. 114.

Hydro-Québec's objectives at the time were on par with the significant efforts being expended by its utility peers throughout North America. At the time, the industry was increasingly turning toward *Integrated Resource Planning* as a conceptual planning tool, and to demand-side management as the preferred tool for balancing supply and demand.

By 1994, the possibility of radical industry restructuring to allow for competitive retail markets was being taken very seriously by nearly all utilities on the continent. Uncertain as to the future, many were returning to a "core business" strategy, cutting or eliminating expenditures that were not deemed essential. DSM spending got caught up in this trend, and by the following year, budgets begun the downward movement that would bring them to less than 50% projected levels by 1997.

Figure 1: U.S. Utility Forecast and Realized DSM Expenditures 1990-1999



References:

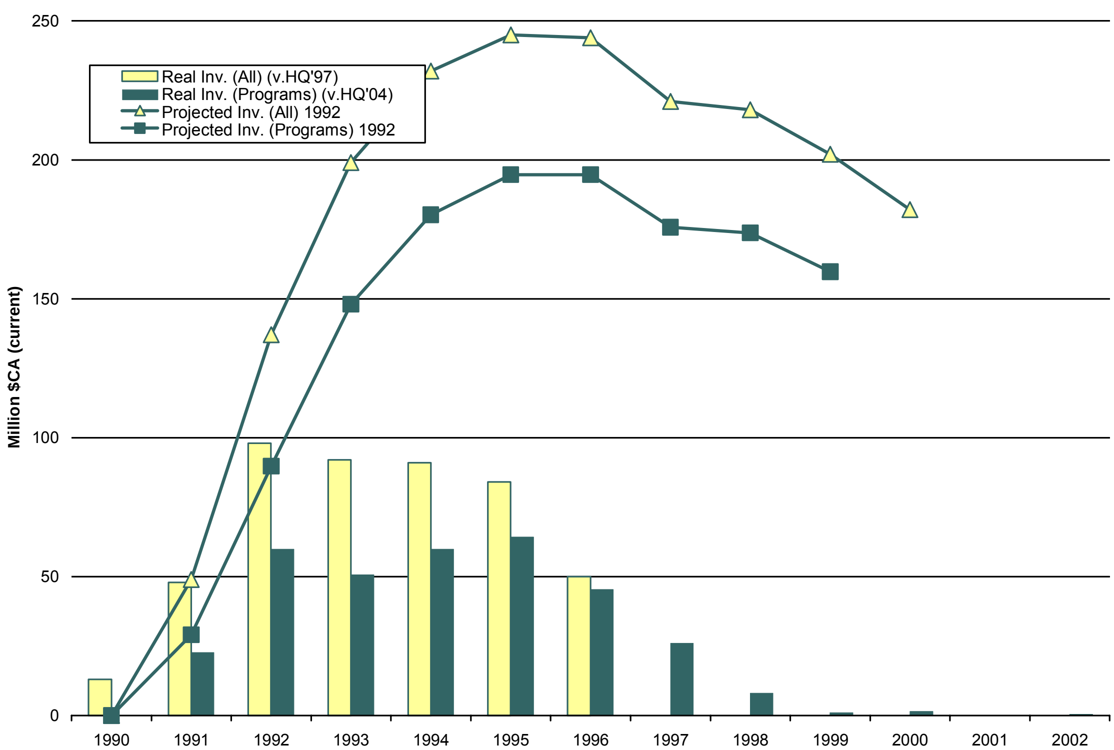
Projection: Eric Hirst, 1993. *Electric-Utility DSM Program Costs and Effects: 1991 to 2001*, p.20 (July correction insert).

Real: Eric Hirst, 1994. *Costs and Effects of Electric-Utility DSM Programs: 1989 through 1997*, p.5; EIA (DOE), 1997. *U.S Electric Utility Demand-Side Management 1995*, p.63; EIA (DOE), 1997. *U.S Electric Utility Demand-Side Management 1996*, p.63; EIA (DOE), 1999. U.S. Electric Utility Demand-Side Management Direct and Indirect Cost, 1997 and 1998 (Thousand Dollars). Washington, D.C.: U.S. Department of Energy, http://www.eia.doe.gov/cneaf/electricity/epav2/html_tables/epav2t49p1.html; EIA (DOE), 1999. Electric Utility Demand-Side Management 1998, @http://www.eia.doe.gov/cneaf/electricity/dsm98/table14.htm; EIA, 2000. Electric Power Annual 1999, Volume II, Tables 45, 48, and 49. See http://www.eia.doe.gov/emeu/aer/txt/tab0813.htm.

C. DSM in the Late 1990s: Abandonment

While Hydro-Québec was not faced with imminent retail competition, it chose to follow and even surpass the DSM budget-cutting of its North American peers. By 1995, Hydro-Québec had, for all intents and purposes, abandoned its original DSM Plan.[2] In theory, that year it put its DSM efforts "on hold" for the duration of the then-announced Public Debate on Energy. The year following, upon release of the Public Debate's report, Hydro-Québec extended the freeze until release of the government's forthcoming energy policy. When the policy was released in 1997, Hydro-Québec announced that its DSM efforts would wait for the newly-created *Régie de l'énergie* to be fully functional. Finally, when the *Régie de l'énergie* was fully functional, Hydro-Québec announced it would await its first rate filing. The company's first DSM filing to the *Régie* was approved in 2003.

Figure 2: Hydro-Québec Forecast and Realized DSM Expenditures 1990-2002



References:
Projected and real program investments: Hydro-Québec, *R-3470-2001, HQD-4, doc. 7, p. 31* and *R-3526-2004, HQ-3, doc. GRAME, p.45.*
Projected total investment: Hydro-Québec, *R-3470-2001, HQD-4, doc. 7*, p. 31. November 2001.
Real total investment: Data provided by Hydro-Québec to the *Commission permanente de l'économie et du travail de l'Assemblée nationale* in 1997.
Note: *Real total investments are only known until 1996.*

---

[2] Ironically, this was the same year the Great Whale hydroelectric project was also abandoned. The simultaneous abandonment of the single largest supply-side and nearly all demand-side options, combined with unsustainable power exports, undoubtedly contributed significantly to current concerns over future supply sufficiency.

Throughout this period, Hydro-Québec has consistently maintained that energy efficiency, along with hydropower, was its preferred tool for balancing supply and demand.

D. DSM in the Post-2000 Environment: The Comeback Kid?

Since the end of the 1990s, the move toward retail competition has slowed considerably, if not come to a rather sudden halt. Simultaneously, legislators and/or utilities and their regulators have been returning to the original view of DSM as a cost-effective DSM *core* supply-demand strategy worthy of significant effort.

The resurgence of DSM spending is illustrated by recent data concerning those U.S. states that have previously adopted a *systems benefits charge*, a special rate dedicated to financing energy efficiency programmes. A recent analysis of the average DSM funding levels in these 15 states indicates a dramatic drop of nearly 50% from 1993 through 1997, and then a dramatic increase – *more* than 50% – between 1997 and 2002-03.[3] All indications are that these numbers have and will continue to rise rapidly.

Similarly, utilities in Canada are re-entering the DSM marketplace in force, as can be seen both by B.C. Hydro's recent DSM filing and the Ontario government's recent announcements in which DSM is clearly a priority supply/demand balancing resource.[4] Manitoba's coming unveiling of a new, one-stop efficiency shop (tentatively called *Efficiency Manitoba*), coupled with significant budgetary increases (both recent and expected), yet is another example.

Hydro-Québec need be no different in this respect. While the company has clearly indicated its intention to return to DSM delivery by filing its 2003-06 plan, it still has a clear choice to make: limit its approach to what the Energy Board and/or the provincial government will find minimally acceptable, or adopt a more aggressive strategy that places DSM on the same footing as new supply among means to ensure the two are balanced. We believe, on the basis of the analyses we've conducted, that the latter will prove the most cost-effective and socially-desirable of the two.

---

[3] Martin KUSHLER, D. YORK, P. WITTE, *Five Years In: An Examination of the First Half-Decade of Public Benefits Energy Efficiency Policies*, American Council for an Energy Efficiency Economy, April 2004. Report Number U041.

[4] At the time of finalizing this report, the government had just announced an aggressive plan to install intelligent meters in all Ontario households.

IV. Summary Results

A. Introduction

As in the rest of North America, there exists throughout Québec a substantial potential for harvesting energy-efficiency resources from new and existing residential and commercial buildings and industrial facilities. This potential is a consequence of market failure: left to their own devices, most household and business electricity users have shown themselves willing to pay more to waste electricity than they are to save it. This behavior arises from a formidable array of market barriers widely recognized among regulators in Canada and the United States that authorize and require utility investments in end-use energy-efficiency improvements.

Under state regulatory and legislative direction, utilities in the northeastern, north central and western United States (US) are currently spending over CDN $3 billion annually on programs designed to overcome these barriers. Northeastern states (New Jersey to Maine) are currently spending roughly CDN $800 million annually on their efficiency investment portfolios. California is expected to spend CDN $1.3 billion annually over the next five years for all its DSM programs combined. In Canada, B.C. Hydro is investing CDN $700 million over the next ten years in its demand-side management (DSM) portfolio.[5] By raising market shares of high-efficiency technologies and practices, North American efficiency programs have mobilized strategic quantities of energy-efficiency resources, thus displacing the need for new power plants and transmission and distribution lines.

North American energy-efficiency investment portfolios are providing major contributions toward meeting growing electric energy needs. In Vermont, currently planned energy-efficiency investment has been meeting half the state's growth in electricity requirements. California efficiency investment is expected to make a similar contribution toward future energy needs, after energy-efficiency resources played a critical part in California's successful campaign to avoid blackouts during the summer of 2001. Efficiency portfolios are likewise responsible for satisfying significant fractions of growing electricity requirements in Massachusetts, Connecticut, New York and New Jersey.

Successful market intervention strategies have not only avoided considerable amounts of new and existing generation, they have permanently transformed buying and selling behavior in state and regional markets, sometimes the entire US market. Over the past fifteen years, leading-edge efficiency programs have evolved significantly. While programs differ over time and between geographic areas, they all share key features that have proven essential to successful energy-efficiency resource acquisition and market transformation: a combination of aggressive financial, marketing, information and delivery services, deployed consistently as integral parts of a sustained multi-year commitment.

[5] Contrary to Hydro-Québec's, B.C. Hydro's programs include fuel switching efforts.

B. Québec's Achievable Near-Term Potential

This report presents the results of analyses done for Hydro-Québec's markets, assuming deployment of leading-edge efficiency programs. As is often the case, the maximum achievable potential savings levels are very significant: if Hydro-Québec pursued all savings opportunities as aggressively as possible, we estimate savings would reach some 12.6 TWh/yr by 2012.

In practice, the utility and its regulators may, as is common practice elsewhere, have reason to limit the capital outlays devoted to energy efficiency. For this reason, we have devised a "Budget Constrained" scenario. This scenario is rooted in an effort to limit spending to roughly the levels Hydro-Québec was ready to spend in the early 1990s. Under this "Budget Constrained" scenario, we estimate savings would reach some 6.9 TWh/yr by 2012.

All costs and savings estimates presented below, unless stated otherwise, are *inclusive* of Hydro-Québec's current plan (i.e. ours *plus* Hydro-Québec's *minus* any overlap). They do not include residual savings from past Hydro-Québec DSM investments.[6]

Table 2: Summary Results: "Unconstrained" Achievable Scenario

	Bi-Annual Results				2005-2012
	2006	2008	2010	2012	
	Cumulative Energy Savings (GWh/yr)				
Residential	1,174	2,523	3,935	5,222	5,222
Comm./Inst.	903	2,541	4,601	6,817	6,817
Industrial	236	469	562	595	595
TOTAL	**2,313**	**5,531**	**9,098**	**12,634**	**12,634**
% of Sales Growth (starting 2004)	**28.4%**	**43.7%**	**52.4%**	**58.3%**	**58.3%**
	Cumulative Capacity Savings (MW)				
TOTAL Summer	280	815	1,470	2,143	2,143
TOTAL Winter	405	1,092	1,964	2,943	2,943
	Incremental Costs (M$2004)				
TOTAL Budget	**1,062**	**1,083**	**1,279**	**1,260**	**8,635**

Table 3: Summary Results: "Budget Constrained" Achievable Scenario

	Bi-Annual Results				2005-2012
	2006	2008	2010	2012	
	Cumulative Energy Savings (GWh/yr)				
Residential	661	1,241	1,864	2,449	2,449
Commercial./Inst.	491	1,447	2,669	3,886	3,886
Industrial	236	469	562	595	595
TOTAL	**1,388**	**3,155**	**5,095**	**6,929**	**6,929**
% of Sales Growth (starting 2004)	**17.0%**	**24.9%**	**29.4%**	**32.0%**	**32.0%**
	Cumulative Capacity Savings (MW)				
TOTAL Summer	132	432	824	1,225	1,225
TOTAL Winter	179	499	911	1,376	1,376
	Incremental Costs (M$2004)				
Total Budget	**212**	**270**	**315**	**315**	**2,028**

---

[6] Notes: Costs are inflation-adjusted 2004 dollars. Our "% of Sales Growth" in 2012 is based on a 1-year extrapolation from Hydro-Québec's 2011 forecasts. Capacity savings are approximate and exclude residual Hydro-Québec program savings.

Overall, this analysis demonstrates that (1) sufficient resources are available from efficiency investment to affect the timing of Hydro-Québec's need for new supply, and (2) these resources can be harvested at costs very competitive with those of new supply.

C. Comparison with Hydro-Québec's Plan

Our estimates of achievable efficiency potential dramatically exceed Hydro-Québec's. Our estimates of achievable costs are also significantly higher than Hydro-Québec's, with the greatest differences arising in the commercial/institutional and residential sectors. The difference seems to be attributable primarily to Hydro-Québec's apparent disregard of the rich body of experience in other North American markets with successful market intervention over the past fifteen years. Had it relied on this experience to project achievable market shares for efficiency technologies, Hydro-Québec would likely have found, as California, Vermont, and New York have recently done, that Québec's economically achievable efficiency resources exceed by several times the funding needed to meet a substantial share of new energy requirements.

North America's long history with successful energy-efficiency investment program has been extensively documented. This experience and its implications for the future were recorded and synthesized in a number of studies and reports as early as a decade ago. For example, one of this study's authors previously co-authored a series of extensive reports for the Pennsylvania Energy Office on designing energy-efficiency investment programs to procure electricity resources and transform markets. "From Here to Efficiency" drew on the experience and then-current plans of US utilities to present lessons and guidance for future efficiency investment planning.[7] Plenty of others have addressed subsequent experience with efficiency investment. One recent noteworthy example is the follow-up study by the American Council for An Energy-Efficient Economy on efficiency portfolios funded through systems-benefits charges, which updates its 1999 examination of this approach.[8]

Figure 3 is presented for illustrative purposes only. It depicts the nature of relationships between different potential scenarios, including the two cases analyzed here: "unconstrained" (maximum achievable) and "budget-constrained", as well as Hydro-Québec's currently planned initiatives.

[7] CHERNICK, Paul, John PLUNKETT and Jonathan WALLACH, *From Here to Efficiency : Securing Demand-Management Resources, Volume I and Volume II.* Resource Insight, Inc., Prepared for the Pennsylvania Energy Office, January 1993.

[8] Martin KUSHLER, D. YORK, P. WITTE, *Five Years In: An Examination of the First Half-Decade of Public Benefits Energy Efficiency Policies*, American Council for an Energy Efficiency Economy, April 2004. Report Number U041.

Figure 3: Types of Potential Scenarios

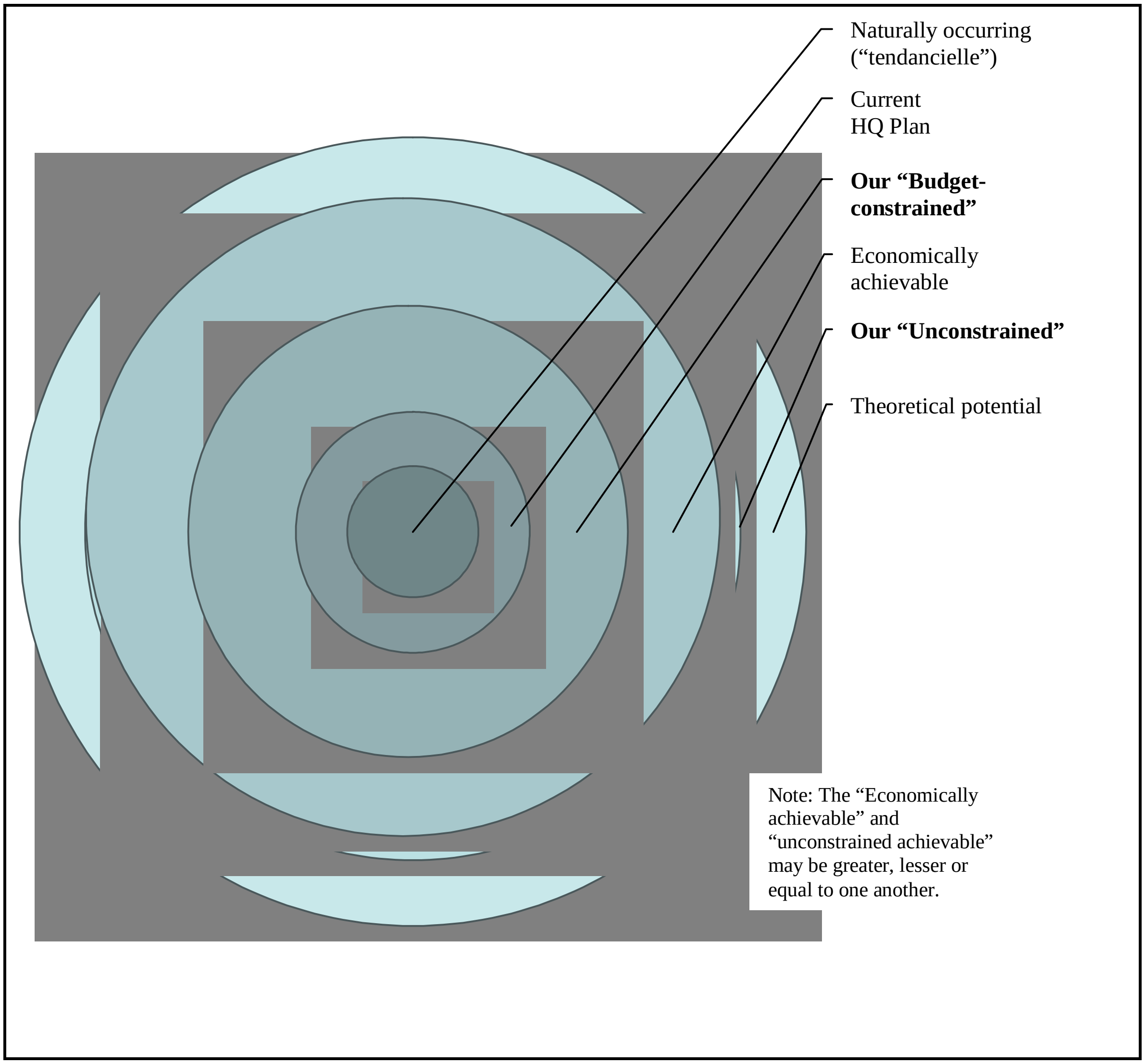


Table 4 compares our estimates of efficiency potential for Québec with recent estimates prepared for other jurisdictions. As can be seen, our "Achievable" (unconstrained) and "Budget constrained" savings estimates, when set relative to total demand, are similar if not inferior to those suggested by 10 other recent studies covering more than a dozen U.S. states. This is true despite the fact that many of these states have been pursuing aggressive DSM for more than a decade.

Table 4: Recent North American Energy Savings Potential Studies: Summary of Results

Region	Type of Study	Year	Author	Estimated Consumption Savings as % of Sales				Summer Peak Demand Savings as a % of Capacity	Years to Achieve Estimated Savings Potential	Comments
				Res.	Com.	Ind.	Total			
Quebec	- Max. Tech. Achievable - Budget constrained	2004	This Report	8% 4%	19% 7%	1% 1%	7% 4%	N.A.	8	Residential sales include farms; no farm savings estimated
California	- Technical - Economic - Max. Economically Achievable - Budget Constrained	2002	Xenergy	21% 15% 10% 8%	17% 13% 10% 7%	13% 12% 11% 4%	19% 14% 10% 6%	25% 16% 10% 6%	10	Integrated measures not addressed; agriculture included in industrial sector
Connecticut	- Technical - Max. Technically Achievable - Max. Economically Achievable	2003	GDS Associates/ Quantum Consulting	21% 17% 13%	25% 17% 14%	20% 15% 13%	24% 17% 13%	24% N.A. 13%	10	Also includes results for Southwest CT region
Massachusetts	- Max. Economically Achievable	2001	RLW Analytics / SFMC	25%	16% - C&I		N.A.	N.A.	5	Excludes non-utility impacts & low income savings/sales
New York	- Technical - Economic	2002	OEI / VEIC / ACEEE	37% 26%	41% 38%	22% 16%	37% 30%	N.A.	10	Also 5- and 20-year scenarios
Oregon	- Technical	2003	Ecotope / ACEEE / Tellus	28%	32%	35%	31%	N.A.	10	Res. includes manufactured housing
Vermont	- Max. Technically Achievable	2002	OEI / VEIC	30%	32% - C&I		31%	37%	10	Includes fuel switching; also 5-year scenario
VELCO	- Max. Technically Achievable	2002	OEI / VEIC	18%	17% - C&I		17%	23%	10	Excludes measures with little peak, that require regional coord, and emerging techs; incl. fuel switch; also 5-year scenario
AZ, CO, NV, NM, UT, WY	- Max. Economically Achievable	2002	SWEEP / ACEEE / Tellus	14%	20%	19%	18%	N.A.	8	Also 18-year scenario
NJ, NY, PA	- Max. Economically Achievable	1997	ACEEE	35%	35%	41%	N.A.	N.A.	14	Residential savings are all fuels
National	- Budget Constrained	1997	U.S. DOE	9%	8%	11%	10%	14%	13	Addresses all fuel; also 23-year scenario

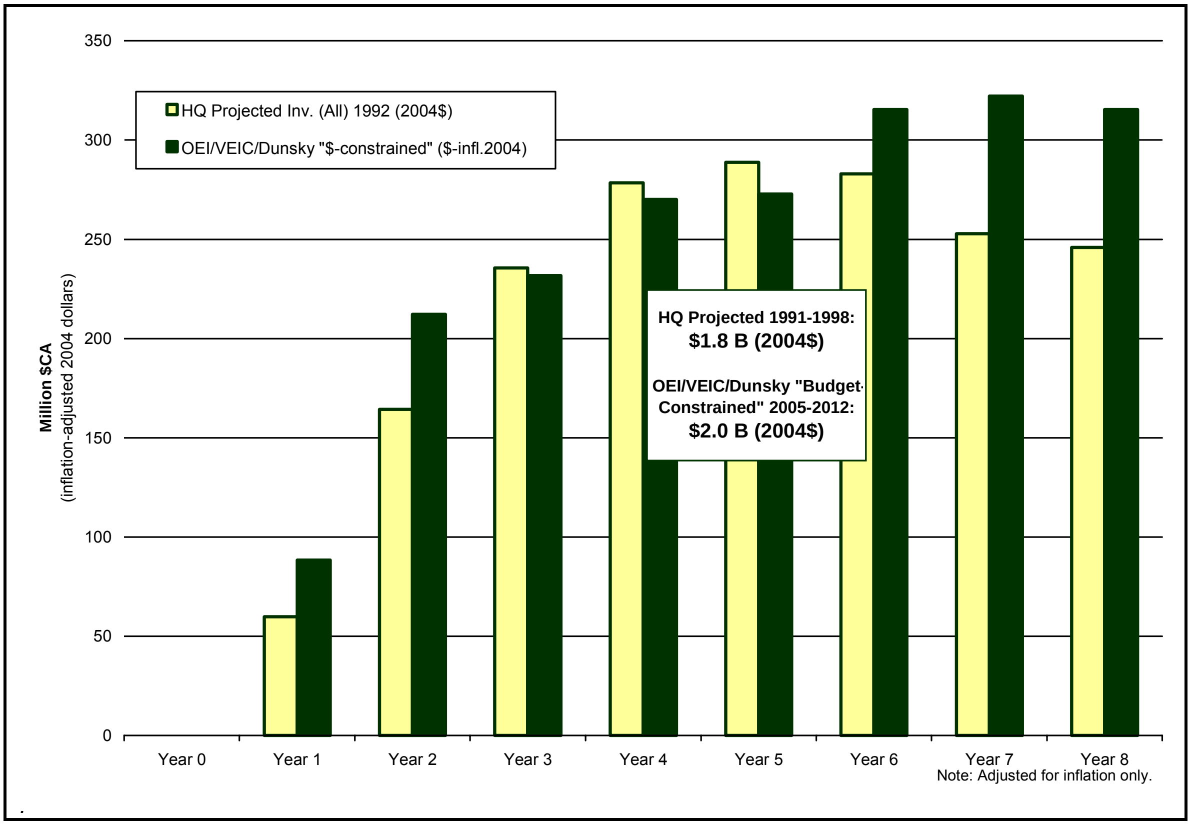
Technical potential is defined as the complete penetration of all measures analyzed in applications where they were deemed to be technically feasible from an engineering perspective.
Economic potential refers to the technical potential of those efficiency measures that are cost-effective compared to supply-side alternatives
Maximum Technically Achievable potential is defined as the amount of technical potential that could be achieved over time under the most aggressive program scenario possible.
Maximum Economically Achievable potential is defined as the amount of economic potential that could be achieved over time under the most aggressive program scenario possible.
Budget Constrained potential refers to the amount of savings that would occur in response to specific program funding and measure incentive levels.

D. Returning to Full Treatment of DSM Opportunities

Our findings are particularly telling when set against the backdrop of Hydro-Québec's intentions and efforts of the early 1990s. At the time, the leadership of Hydro-Québec had come to understand that DSM was a resource in the same way as new supply. The utility's plans at the time, soonafter largely aborted, foresaw a financial effort and energy savings on the same order of magnitude as those of comparable utilities, and strikingly similar to those foreseen in this report.

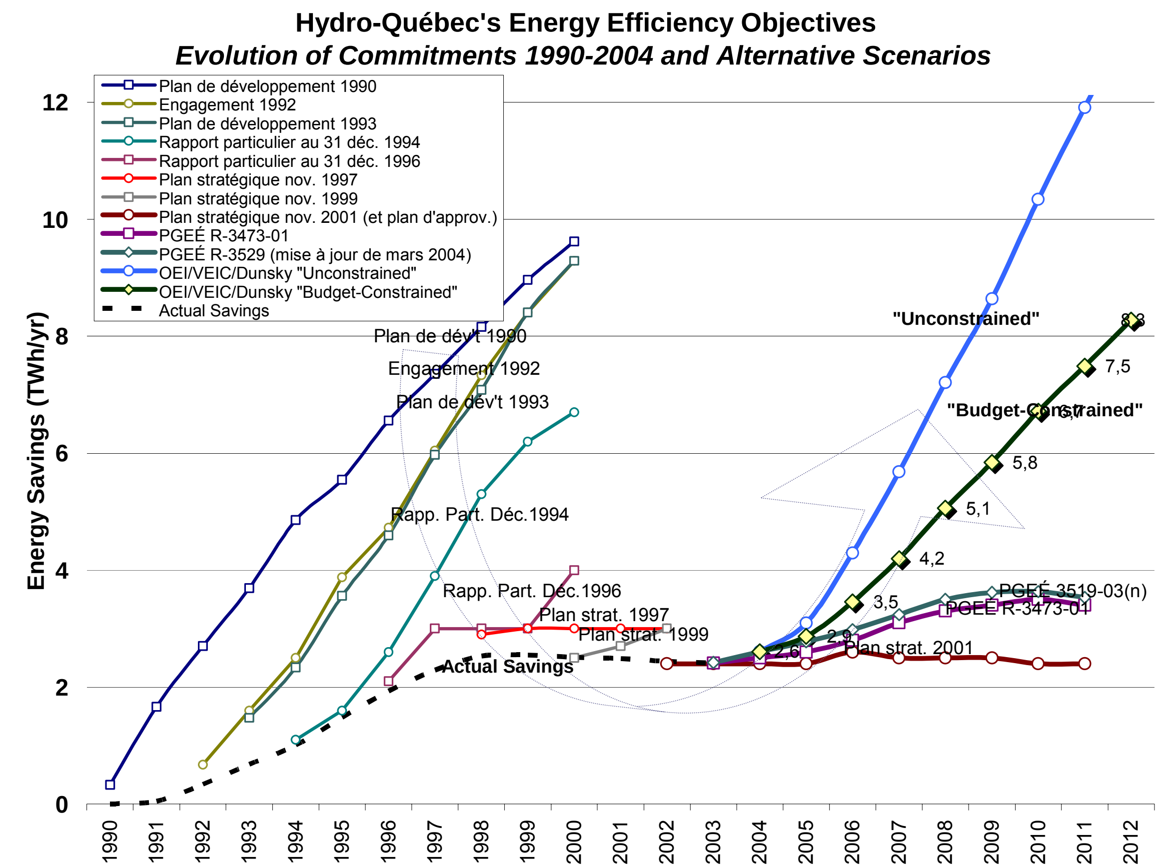
Figure 4 compares the financial commitments made by Hydro-Québec at the time with those called for under our "Budget-constrained" scenario. To ensure comparability, both sets of values are expressed in 2004 dollars.

Figure 4: Comparative Financial Efforts: HQ 1990s and OEI/VEIC/Dunsky "Budget-Constrained"



Similarly, the quantum and trajectory of energy savings from our "budget-constrained" scenario also resemble those projected by Hydro-Québec in the era when DSM was considered an energy resource, as can be seen in Figure 5.

Figure 5: Comparative Energy Savings: HQ Successive Commitments and OEI/VEIC/Dunsky "Budget-Constrained" and "Unconstrained"[9]



Notes:

> All savings are reported *at the meter*. As such, they understate by roughly 10% the resulting benefit in terms of avoided generation.

> Savings projected under our alternate scenarios ("Budget constrained" and "Unconstrained") build on the savings already generated from HQ's previous DSM activities (roughly 2 TWh/yr recurring). The same is true for all of Hydro-Québec's forward-looking plans as well.

As can be seen, following the "budget-constrained" scenario will be akin to returning to the serious commitments of the early 1990s. Such a return, coincidentally, is today in many respects the prevailing theme throughout North America.

E. Concluding Remarks

To establish the outer limits on the potential achievable contribution from efficiency, we estimated the maximum electricity savings that could be achieved throughout Québec (the "unconstrained" scenario), and the costs of doing so. As has been found by similar potential studies elsewhere,

[9] The reader should note that the projected savings from *past* Hydro-Québec efforts are added to all future projections, including our own.

the total economically achievable potential in Québec vastly exceeds the funding necessary and available to pursue it all.

Hydro-Québec need not commit itself to full pursuit of all achievable potential, however, in order for efficiency to make a significant contribution toward Québec's electric energy requirements. Hydro-Québec can instead pursue a subset of the full potential at a considerably smaller fraction of the full potential spending with less aggressive and expensive program strategies, particularly in discretionary retrofit markets (the "budget-constrained" scenario). For example, by offering financial incentives covering half instead of all retrofit project costs in the commercial sector, Hydro-Québec we estimate that Hydro-Québec could achieve nearly *three quarters of the unconstrained* market penetration results, resulting in an incentive budget of only 37.5% of that associated with the full achievable potential.[10]

Finding the optimal resource configuration, involving some subset of the total achievable potential for efficiency, is ultimately Hydro-Québec's responsibility as Québec's electricity resource portfolio manager. Should Québec decide to pursue some portion of its achievable efficiency potential, what remains to be done for the future is the development and pursuit of specific efficiency investment programs.

Our analysis examined Québec's residential, commercial/institutional and industrial sectors. The study estimates potential savings in three distinct residential markets – the "lost-opportunity" new construction, retail products and appliance markets, as well retrofit applications in existing buildings; three commercial/institutional ("C&I") lost-opportunity markets of new construction, remodeling, and equipment replacement, as well as discretionary retrofits in existing buildings; and large and small industrial customers. Our analysis accounts for differences in population and market size, building stock, heating equipment, industrial mix, and climates between Québec and the northeastern US. In the extremely brief time available to us to make our assessment, we found no other significant differences between Québec markets and the ones served by programs throughout the northeastern US, north central US and in California that would materially influence our estimates of the potential costs or performance of proven efficiency technologies or programs.

The residential section of this report details the budget constrained scenario which overlays the identified budget constrained potential available in addition to Hydro-Québec's programs. The residential section summarizes the results of the unconstrained (maximum achievable) scenario. The commercial/institutional (C&I) and small and medium industrial (SMI) analysis used a somewhat different approach – and replaces Hydro-Québec's SMI and its largest C&I program in its entirety. In contrast to the residential section of the report, the C&I section details the unconstrained scenario and summarizes the "budget-constrained" scenario. These differences arise due to the very different nature of the two end-use categories.

The analysis was informed by the authors' professional judgment, developed on the basis of our academic training and over forty years of combined experience as practitioners of analysis, planning and implementation management support for energy-efficiency investment portfolios.

---

[10] In this example, Hydro-Québec avoids paying half the cost of reaching 75% of the full market potential, while avoiding paying any of the costs of efficiency for the quarter of the full market potential.

The estimates presented here of electricity savings and costs should be regarded as expected values. In other words, actual results have a 50/50 chance of being either higher or lower than the predicted values.[11]

[11] To obtain a higher confidence level with predicted values, it would be necessary and appropriate to scale back predicted values for electricity savings, or increase predicted values for program costs. In a prior assignment for the Vermont Electric Power Company, Vermont's transmission utility, the authors developed estimates which in our professional judgment represented a 90% confidence level, consistent with the high reliability associated with transmission capacity planning for meeting summer peak demand. (See: OPTIMAL ENERGY, INC., *Assessment of Economically Deliverable Transmission .Energy-Efficiency Investments in the Inner and Metro-Area and Northwest and Northwest/Central Load Zones, Final Report April 2003*, Prepared for Vermont Electric Power Company, Inc.)

V. Methodology

Below we explain our conceptual and analytical approaches to assessing the achievable potential for electric efficiency resources in Québec.

A. Conceptual Approach: Overcoming Market Barriers

US regulators and efficiency program administrators recognize a short list of market barriers responsible for the market failure leading to under investment in cost-effective energy-efficiency technologies. These are the market barriers which intervention strategies have proven successful in overcoming, resulting in increased market share of energy-efficiency technologies over time. They are:

- *Pricing inconsistencies between electric efficiency and electric usage*: Electricity is paid for as it is used. Efficiency savings must be pre-paid. Most other market barriers are traceable to this higher first cost of energy-efficiency. Efficiency costs are especially high when market availability is limited.

- *Limited capital access*: The higher first cost of efficiency requires capital that may be rationed for other purposes, carry a high price, or be available on unfavorably short terms. Strong financial strategies overcome this barrier by offsetting the incremental first cost and/or spreading out repayment of any customer contribution to improve cash flow.

- *Split incentives and/or decision-making*: Electricity use is paid for by building occupants who do not own the property. Efficiency decisions are typically split between market actors (architects vs. developers, builders vs. owners).

- *Real and perceived but reducible risk differentials between efficiency and usage*: Individual perceptions of financial, market, technological, and implementation risk from efficiency investments can be reduced and/or diversified away through effective efficiency program strategies (e.g., elimination of first cost via financial incentives).

- *Technology unavailability*: Lack of demand due to first cost often leads to lack of availability of efficiency technologies. Successful programs have stimulated demand for and thus available supply of efficiency technologies.

- *Information scarcity*: For many individual decision-makers, accurate and reliable information on efficiency options is typically unavailable and/or unduly costly. Successful programs provide clear, accurate and reliable information to those who need it to make cost-effective efficiency choices.

- *Incontinence*. Businesses and consumers are averse to taking time away from other pursuits to learn about, decide on, and arrange for efficiency choices.

Overcoming these barriers has led to increased market adoption of cost-effective efficiency technologies. This has been the continuing objective of energy-efficiency investment programs funded by electricity and gas ratepayers in parts of the US and Canada over the past fifteen years or more. Successful programs have combined four basic strategies in various intensities and combinations in residential, commercial, and industrial markets:

- Financial (incentives to offset the first cost of efficiency, or financing to extend repayment of first cost over time);

- Marketing and promotion (methods of communicating advantages of efficiency to buyers and sellers of efficiency technologies);

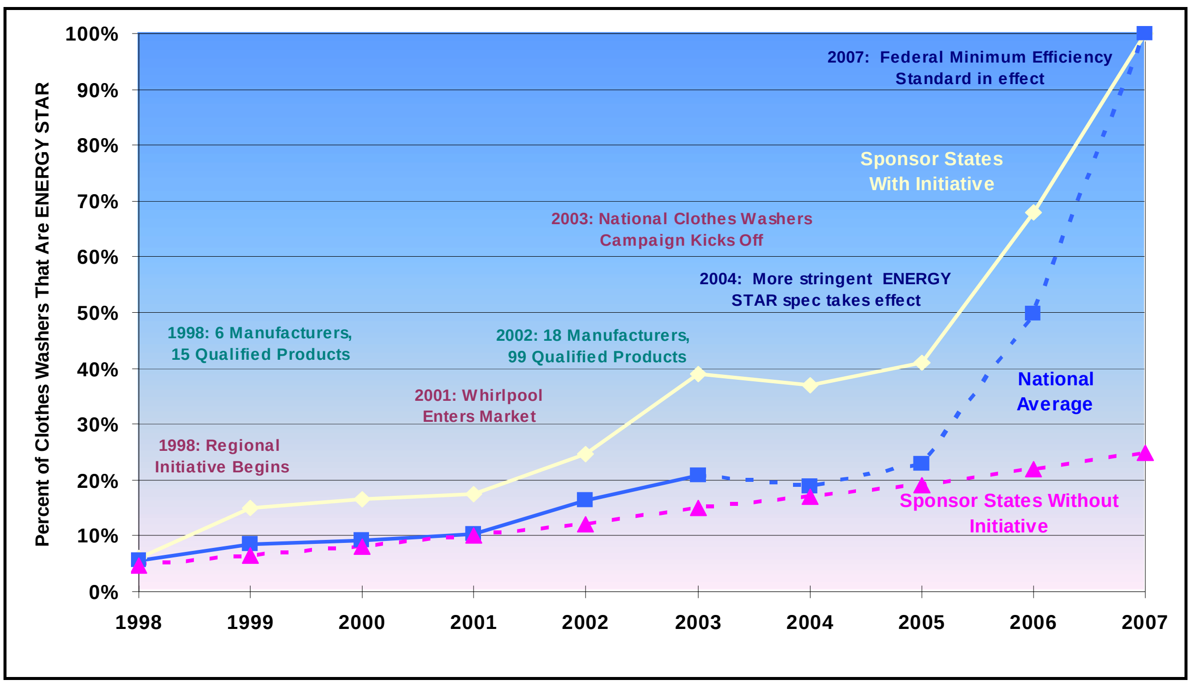
- Information and technical assistance (ranging from labels to detailed engineering analysis of complex systems); and

- Measure delivery (e.g., arranging for, management of, and payment for installation of efficiency technologies).

Over time, successful efficiency programs have used these strategies to change permanently the attitudes and behaviour of market actors throughout the chain of transactions from manufacturer to end-users. The most successful efforts have combined energy-efficiency incentive programs with regulated appliance and equipment efficiency standards and building efficiency codes.

Perhaps the most vivid example of successful market transformation is with Energy Star® clothes washers in the US. From a special-order, US $500 upgrade in the mid-1990s, horizontal-axis washers are now expected to become the minimum performance standard for new machines manufactured for sale in the US by 2007. Figure 6 shows the progression of Energy Star clothes washers in the US market. This dramatic progress in the US clothes washer market is a classic example of successful market transformation through the interplay of utility-funded efficiency programs and efficiency standards.

Figure 6: Building Market Share: The Example of Energy Star Clothes Washers in the U.S.



Québec should expect to be able to apply and modify for its own market conditions the same program strategies that have worked so well elsewhere, both previously and currently, in the procurement of efficiency resources and the transformation of efficiency markets. Hydro-

Québec's long-range efficiency resource planning should draw on this wealth of North American experience and apply it to Québec in order to replicate past and ongoing successes. The next section explains the methodology we used to apply these lessons to assess Québec's achievable efficiency potential.

B. Analysis

1) Markets and Scenarios

Our analysis examined the residential, commercial/institutional and small/medium industrials sectors.[12]

The assessment establishes results for two scenarios:[13]

A) "Unconstrained" (maximum achievable) scenario, and
B) "Budget-constrained" scenario.

The unconstrained (maximum achievable) potential in each market is developed as an *outside limit* on potential efficiency resource procurement. Since the total achievable potential often exceeds either demand growth or available DSM capital, we then proceed to develop a "budget constrained" scenario. This scenario is based on limiting overall budgets to a level roughly similar to the level Hydro-Québec projected spending in the 1990s (though never did, see section III. C on page 6). All else being equal, this is also equivalent to the spending levels of the more aggressive North American jurisdictions.

To allow for development of alternative efficiency resource portfolios, the assessment develops independent sets of projected savings and budgets for each residential and business market. In addition, the assessment contains alternative projections in key markets involving less aggressive program strategies, resulting in lower electricity savings over time but also lower program budgets. By mixing and matching the costs and savings associated with each residential and business market, one can construct efficiency portfolios producing different levels of savings for varying magnitudes of program spending. These efficiency portfolios can then be combined with different types, amounts, and timing of alternative supply options (e.g., wind and/or deferred in-service dates for new combined-cycle generation) to ensure supply and demand equilibrium.

2) Overall approach

The following table outlines the analytical steps taken for the purposes of our assessment.

---

[12] We did not address the large industrial sector, given the need, in that case, for much more detailed, often specific-plant-by-specific-plant analysis.

[13] Where applicable, we have deducted any overlap arising from markets that are addressed by both us and Hydro-Québec. For example, our residential EnerGuide program overlaps with Hydro-Québec's, as do a number of commercial sector initiatives. In order to not "double-count", where overlap exists we deduct Hydro-Québec's projected savings from ours. Conversely, we have also targeted markets not addressed by Hydro-Québec (e.g. compact fluorescent lights), and which therefore do not create any overlap.

Table 5: Analysis Methodology for Arriving at Achievable Efficiency Potential

Steps	**Analysis**
1. Define residential and business markets for consideration	> New construction > Equipment replacement > Product sales > Existing building retrofit • *Early retirement technologies* • *Supplemental technologies*
2. Characterize efficiency markets	> Size: • *Households* • *Equipment/appliance unit sales* • *Building square footage* • *Industrial output* > Composition: breakdown of electricity usage by • *Segment by building or industry type* *- Residential | Office building | Hotel | Education | Industry* • *End use* *- Lighting | Space cooling | Motor | Industrial process*
3. Identify target efficiency technologies by market segment and end use	> High-efficiency residential air-conditioning > High-efficiency motors > Integrated design in new construction
4. Characterize efficiency technologies	> Costs • Capital • Operation and maintenance (cost savings = negative costs) > Performance • Baseline efficiency (expected efficiency level now and in future absent program) • Target efficiency (expected efficiency level over time with program) • Load shape (timing of savings during year)
5. Devise conceptual program strategies for increasing market penetration of high-efficiency technologies	> Financial incentives, financing > Marketing and public awareness > Information and technical assistance > Service delivery
6. Estimate achievable market shares over time	> Base case expected without program > Target market shares • Maximum achievable market share as rapidly as possible with most aggressive proven program strategies in all markets • Staged procurement in major markets with less aggressive strategies, market shares, and program budgets, especially in lost-opportunity markets • Expected market share within program • With vs. within program captures combined effects of *- Free-ridership (market penetration within the program that would have occurred without it)* *- Free drivers (market penetration that takes place outside the program but results from the program)*
7. Prepare multi-year budget to support program strategies	> Financial incentives paid to : • End-users • Property owners/managers • ESCOs • Equipment suppliers • Service providers > Program administration • Program design and planning • Marketing • Technical service delivery • Management • Reporting and verification • Market assessment and program evaluation

3) Sector-specific approaches and uncertainties

The sections of this assessment dealing with Québec's residential, commercial/institutional and small and medium industrials efficiency potential provide further detail on how this basic methodology was applied in each sector. In general, the assessment relied on Québec data for sizing and characterizing efficiency markets. We used information developed by team members for prior efficiency potential assessments for New York and Vermont to characterize energy-efficiency technologies. We also adopted our previous projections of market shares to realize full achievable potential. For the Québec analysis we also employed the same professional judgment team members applied in their Maine analysis to project partial-potential (budget-constrained) market penetration rates within the extremely large achievable potential for retrofit savings. The analysis accounts for increases in heating loads and decreasing in cooling loads from energy efficiency measures, where appropriate.

The residential and nonresidential sections of this report compare our assessment of achievable efficiency potential with those developed by Hydro-Québec. Broadly speaking, our residential assessment found significant additional achievable potential, largely from *additional programs* aimed at markets omitted from Hydro-Québec's scenarios. In the commercial/institutional sector, our assessment found much more achievable potential than Hydro-Québec did, both under our full-potential and partial-potential scenarios. We believe the main reason for the large discrepancy is our reliance on program strategies that have proven successful elsewhere in North America. We were surprised to find that Hydro-Québec's industrial efficiency potential estimates exceed our own. Not surprisingly, however, overall we project higher levelized costs per kWh to realize the achievable savings potential we estimate, in both the residential and nonresidential sectors.

The analysis did not specifically account for essential uncertainties regarding:

- *Technology cost and performance*: While we do lack detailed knowledge of Québec baseline efficiencies, there are strong reasons to believe our estimates are reasonable for Québec. Our analysis included building types and manufacturing, general cost, availability and performance of efficiency technologies applicable to Québec.

- *Unknown market share of high-efficiency technologies*: There is no reason to believe market share is decisively different in Québec. If anything, given low prices and Hydro-Québec's inaction over the past decade, it would be reasonable to assume lower market penetration of high-efficiency technologies in Québec. Our own anecdotal personal observations confirm this suspicion.

- *Program costs and effectiveness*: There is no reason or evidence to doubt achievable market shares or the success of strategies proven effective in other markets. Nor is there reason or evidence to believe Québec program costs would be higher.

Given the much larger maximum achievable potentials, there should be little doubt concerning the ability to achieve the electricity savings projected in the "Budget Constrained" scenario. We do, however, believe it would be reasonable to establish and apply upper and lower confidence bands around our cost projections for achieving these savings. For planning purposes we recommend a bandwidth of +/- 50% on program delivery costs (separate from the technology costs themselves, about which we believe there is comparably far less uncertainty). Given that program delivery costs comprise roughly an eighth to a quarter of total efficiency procurement costs, and assuming smaller uncertainties (+/- 10%) regarding technology costs, this would translate into cost bandwidths in the range of 15% to 20% of total estimates of levelized costs per kWh.

VI. Residential Sector Analysis

A. Summary of Hydro-Québec's Plan

1) Current DSM portfolio

Hydro-Québec is currently in the process of implementing a portfolio of nine residential DSM programs. Hydro-Québec projects that those programs will produce a little more than 500 GWh of cumulative annual savings by 2010.[14] That represents less than 0.9% of forecast residential sales for 2009 and about 18% of projected load growth over the 2003 to 2009 time frame.[15] No incremental savings are projected from program activity after 2009.

Nearly half of those savings would come from the utility's Customized Diagnostics program. This program enables consumers to essentially conduct their own free electronic audit of their energy use (i.e. no energy experts visit the home). The software also provides recommendations on how energy use could be reduced. Another 16% of Hydro-Québec's projected savings would come from its EnerGuide for Homes program. In this program Hydro-Québec is piggybacking on the federal and provincial EnerGuide programs by supplementing government incentives for energy ratings. No other program produces more than 10% of Hydro-Québec's projected 2010 residential savings.

Hydro-Québec has also projected that program budgets associated with acquiring these savings will total $55.1 million (in real 2003 dollars).[16] $20.1 million – or 36% of the total – is associated with the Customized Diagnostic program. Another $14.6 million – or 26% of the total – is associated with the two thermostat programs. No other program accounts for as much as 10% of the total.

2) New proposed enhancements

In recent responses to interrogatories, Hydro-Québec has proposed enhancements to two of its programs: Low Income and EnerGuide for Homes. In the case of Low Income, Hydro-Québec has indicated that it plans to both add free electronic thermostats to the list of low cost efficiency measures installed through the program and broaden coverage of the program to the entire province of Québec. The major change to the EnerGuide program is the addition of up to $2000 in incentives for low-income customers who act on recommendations for efficiency upgrades. Hydro-Québec projects that these enhancements will add an additional 72 GWh of cumulative annual savings by 2010.[17] That would increase total savings to 576 GWh, or about 1.0% of projected residential sales for 2010, but still represent only about 18% of load growth from 2003

---

[14] HYDRO-QUÉBEC, R-3526-04, HQ-3, doc. REGIE, pp. 22-28.

[15] Hydro-Québec estimated that residential and farm sales would be 55,300 GWh in 2003 and grow to 58,500 GWh in 2010. (HYDRO-QUÉBEC, *État d'avancement du Plan d'approvisionnement 2002-2011*, October 31, 2003, p. 13.)

[16] HYDRO-QUÉBEC, *R-3526-04, HQ-3, doc. REGIE*, pp. 22-28.

[17] HYDRO-QUÉBEC, *R-3526-04, HQ-3, doc. REGIE*, p. 19.

to 2010.[18] Hydro-Québec also projects that these enhancements will add $44.9 million to its residential DSM spending (a more than 80% increase), bringing the total over the 2003 to 2010 time period to about $100 million.

Total projected program-by-program savings from Hydro-Québec current and proposed efficiency portfolios are presented in the table below.

Table 6: Hydro-Québec's Current Proposed Residential Programs: Cumulative Annual GWh Savings

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Residential										
Customized Diagnostic (EX)	6	43	87	130	169	209	249	249	249	249
Thermostats (EX)	5	21	36	55	55	55	55	55	55	55
Thermostats (NC)	0	6	12	18	18	18	18	18	18	18
Pool Timers	0	9	18	25	25	25	25	25	25	25
EnerGuide for Homes	2	13	28	44	60	76	92	92	92	92
+ Install Incentives (Low-Inc.)			5	13	21	29	37	46	46	46
Novoclimat Single Family (NC)	3	7	10	14	18	21	25	25	25	25
Novoclimat Social Housing (NC)	0	3	5	8	10	13	16	16	16	16
Direct Install (Low-Inc.)	3	5	8	11	13	16	19	19	19	19
+ province-wide coverage		1	3	4	6	8	9	13	13	13
+ thermostats		2	4	6	8	10	12	14	14	14
Direct Retrofit (Soc. Housing)	0	1	3	5	5	5	5	5	5	5
Sub-total RES	**19**	**111**	**219**	**333**	**408**	**485**	**562**	**577**	**577**	**577**

Notes:
> Savings reported "at the meter".
> While its original plan was filed in autumn 2003, the utility recently proposed additions aimed at increasing overall savings. These additions, proposed on March 30, 2004, are indicated in the table by a preceding "+".
> Hydro-Québec provided data until 2011 for initial efforts, and until 2010 for new additions. We have simply drawn them out to 2012 (i.e. no incremental gains).

3) Additional options identified

In its interrogatory responses Hydro-Québec also indicted that it considered it possible to get even more savings from these programs. More specifically, as Table 7 shows, Hydro-Québec suggested it was possible to increase cumulative annual residential savings from its programs to 767 GWh in 2010.[19] That would represent an increase of about 33% over totals with its recently proposed enhancements.

[18] Although the total annual savings are about 15% higher, they are not fully realized until a year later (i.e. 2010 rather than the 2009 end point of the previous plan). Thus, the additional savings are essentially enough to capture the same percentage of load growth over the extra year.

[19] HYDRO-QUÉBEC, *R-3526-04, HQ-3, doc. REGIE*, pp. 22-28.

Table 7: Hydro-Québec's Optional Enhanced Residential Portfolio (Non-Proposed): Cumulative Annual GWh Savings

Residential Program	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
1 Customized Diagnostic	8,0	45,1	87,3	129,6	159,5	209,.4	249,3	249,3	249,3	249,3
2 Thermostats - Existing Homes	5,0	21,0	36,0	55,0	55,0	55,0	55,0	55,0	55,0	55,0
3 Thermostats - New Homes	0,0	11,6	18,5	25,3	25,3	25,3	25,3	25,3	25,3	25,3
4 Pool Filter Timers	0,0	9,0	18,0	25,2	25,2	25,2	25,2	25,2	25,2	25,2
5 EnerGuide for Homes	2,0	13,0	28,0	52,0	79,0	108,0	138,0	168,0	168,0	168,0
6 New Construction (Novoclimat) - Single Family	3,0	7,0	11,0	17,0	24,0	33,0	44,0	56,0	56,0	56,0
7 New Construction (Novoclimat) - Social Housing	0,0	3,0	6,0	13,0	21,0	30,0	40,0	51,0	51,0	51,0
8 Low Income Direct Install	2,7	6,6	11,0	15,3	19,6	24,0	28,4	32,7	32,7	32,7
9 Social Housing Comprehensive Retrofit	0,0	0,0	2,0	6,0	12,0	21,0	33,0	45,0	45,0	45,0
10 Low Income Comprehensive Retrofit	0,0	0,0	2,0	8,0	17,0	29,0	44,0	59,0	59,0	59,0
Totals	**20,7**	**116,3**	**219,8**	**346,4**	**437,6**	**350,5**	**682,2**	**766,5**	**766,5**	**766,5**

Hydro-Québec provided no details as to what changes would yield such an increase. Nor has it explained why it has chosen not to propose acquiring this increase in savings. However, it has estimated that the approaches necessary to acquire the savings would cost about $207 million – or more than double the totals with its recently proposed enhancements.

B. Critique of Hydro-Québec's Plan

1) Hydro-Québec Residential Savings Small Compared to Others

As a whole, Hydro-Québec's proposed residential DSM portfolio is far from aggressive. It produces much less savings than it could and, indeed, much less savings than utilities in other jurisdictions have produced. As Table 7 illustrates, Hydro-Québec is proposing to acquire an average of 72 GWh of incremental annual residential savings over the 2003 to 2010 time frame.[20] That is an average of 0.13% of projected average annual residential sales over the same period. In contrast, residential DSM efforts in five different leading states have achieved savings as a percent of sales that are four to seven times as great.

To be sure, there are differences between Québec and these five states. However, these differences cannot come close to explaining why others are getting so much more savings than Hydro-Québec is proposing. Québec has lower electric rates than the others. However, the difference between Québec's very low electric rates and those of Wisconsin is similar to the difference between those Wisconsin rates and those of the "high rate" states of Vermont and California. Yet, the difference in savings between Wisconsin and the high rate states is small compared to the difference between its savings and Québec's.

[20] 576 cumulative annual GWh divided by 8 years of program activity.

Table 8: Comparison of Residential DSM Savings as a Percent of Sales

Jurisdiction	Time Period	Avg Annual GWh Savings	Avg Annual GWh Sales	Savings as % of Sales
Québec (HQ)	2003-2010	72	57 198	0,13%
Vermont	2001-2002	17	1 984	0,86%
Connecticut	2001-2002	80	11 874	0,67%
Wisconsin	2002-2003	117	21 575	0,54%
California	2001-2002	395	61 204	0,64%

Caveat: Hydro-Québec data presented *at meter*; others *at generation voltage level*. Understates HQ savings by <10%.

2) Hydro-Québec Leaves Many Key Markets Unaddressed

One of the reasons that Hydro-Québec's proposed residential savings are small is that they ignore several key markets that offer substantial electricity savings potential, including notably:

- Retail sales of compact fluorescent light bulbs (CFLs);
- Retail sales of efficient clothes washers;
- Sales – both retail and wholesale – of efficient windows; and
- Inefficient refrigerator and freezer removal and recycling.

Because these are perhaps the most significant opportunities lost in Hydro-Québec's plan, they are the focus of our analysis of new program options.

3) Some Hydro-Québec Programs Could Get More Savings

Another reason Hydro-Québec's proposed residential savings are smaller than they could be is that their designs are at times sub-optimal. In particular, Hydro-Québec's approach to retrofit weatherization is problematic. We applaud Hydro-Québec's decision to piggyback on the EnerGuide program. However, they are not putting enough resources into the program to maximize savings, nor are the resources they are putting into it optimally spent.

We address this shortcoming in our analysis as well.

4) Some Hydro-Québec Programs Are Not Being Challenged

Although we have reviewed all of Hydro-Québec's proposed residential programs, we have focused our efforts on those residential markets and DSM program proposals that appear most important in terms of savings potential. Those markets and programs were identified in the two subsections immediately above this one.

Our review of Hydro-Québec's other programs has raised questions in several cases – both about their designs and the savings forecast for them. However, given limited resources and the intention of focusing on the most important issues and opportunities, we have chosen not to raise those questions in this report.

5) Not All Residential Markets Analyzed

As noted above, Hydro-Québec's residential DSM portfolio is targeted to a relatively small list of end uses and efficiency markets. We have analyzed four additional markets in some detail. While those markets are likely to be the most important in terms of significant additional savings potential, there are other residential efficiency markets not covered in Hydro-Québec's plan, including:

- Sales of fluorescent hard-wired light fixtures;
- Sales of fluorescent torchieres;
- Sales of other efficiency appliances (refrigerators, dishwashers, room A/Cs, dehumidifiers, etc.);
- Sales of efficient central A/Cs;
- Sales of furnaces with efficient fans;
- Sales of computers with efficient internal power supplies;
- Sales of efficient consumer electronics (TVs, VCRs, etc.);
- Sales of heat pump water heaters;
- Sales of solar water heaters;
- Electric water heater fuel-switching (to fossil fuel systems); and
- Electric space heat fuel-switching (to fossil fuel systems).

Given time and budget constraints, we have not analyzed these additional opportunities.

C. Achievable Residential DSM Savings (Budget-Constrained)

As noted above, there are substantial savings possible from addressing residential efficiency markets that Hydro-Québec is currently ignoring, as well as from improving the design of at least one existing program. In this section, we discuss what those additional savings are, how they could be acquired and what the implications are for total potential savings (both from Hydro-Québec's proposed programs and our additional suggestions) in the residential market.

Given the nature of the residential market, we begin here with a presentation of programs, costs and energy savings arising from a "budget-constrained" scenario. Section D on page 35 will then briefly discuss our analysis of *unconstrained* opportunities in the residential sector.

1) Compact Fluorescent Light Bulb (CFL) Sales

Numerous efficiency potential studies across North America have suggested that lighting is the end use that offers the single largest source of residential electric energy savings potential.[21] It has also long been regarded as offering the cheapest source of residential savings (particularly in recent years as the prices of CFLs have dropped dramatically). Indeed, that has been the experience of all residential DSM efforts with which we are familiar. This is because fluorescent lighting is so much more efficient (using 65% to 75% less electricity) than incandescent lighting.

---

[21] For example, see potential study for New York (PLUNKETT et al., *Energy Efficiency and Renewable Energy Resource Development Potential in New York State, Volume 3: Energy Efficiency Technical Report*, prepared for New York State Energy Research and Development Authority, August 2003).

Of course, the very high saturation of electric space heat makes Québec somewhat different than many other regions in which residential DSM has been pursued. This reduces the electric benefits of fluorescent lighting because the reduction in electricity used for lighting is partially offset by an increase in electricity used for space heating (cross effects). More specifically, this is the case in the winter for most indoor applications of lighting in homes with electric baseboard heat, but is not the case for non-baseboard heated homes, nor for some types of fixtures, nor for summer demand in which positive cross effects (reducing air conditioner loads) exist.[22]

As Table 9 shows, our analysis suggests that given Québec's climate and energy mix, there is still substantial, low-cost electricity savings possible from a program that promotes retail sales of CFLs. Indeed, we estimate that Hydro-Québec could get nearly as much savings by 2010 from a CFL program – 521 cumulative annual GWh – as Hydro-Québec is projecting for all its residential programs.

Table 9: CFL Program: Cumulative Annual Savings and Cost (Budget-Constrained Scenario)

	2005	2006	2007	2008	2009	2010	2011	2012
Cumulative Annual GWh Savings	52	134	222	316	415	521	632	691
Cumulative Annual Winter Peak MW Savings	4	9	15	22	28	36	43	47
Cumulative Annual Summer Peak MW Savings	5	12	20	28	37	46	56	61
Total Program Costs (M$ 2004)	$7,7	$10,2	$9,1	$9,5	$8,2	$8,5	$7,0	$7,0

A number of key assumptions underlie these estimates of savings potential. They include:

- Only 90% of units sold are actually installed or remain installed.
- Installed units are used an average of three hours per day. This is consistent with both evaluation data in New England and assumptions used by programs in many different states.
- Net savings per CFL (34 kWh/year) are only 64% of lighting savings due to heating cross-effects. This assumes 60% cross effects in homes with primary electric baseboard heat, and also accounts for homes that do not have electric heat, homes with dual-fuel and/or heat pump heating systems (in which cross effects are smaller), some outdoor lighting (where all heat is lost) and some applications (i.e. recessed cans) that result in most waste heat leaking to the outdoors.[23]
- Baseline sales per home are assumed to be 0.07 per home, based on analysis of U.S. sales in states without lighting DSM programs. Baseline (pre-program) sales assumed to increase by 0.01 per home per year.[24]
- Within two years (i.e. by 2007), sales can ramp up to average approximately 0.75 per household per year. That is a level that has been achieved or exceeded in recent years by programs in the Pacific Northwest, New Jersey, California, Vermont and Wisconsin.

---

[22] Fluorescent lighting is more efficient because it converts a larger percentage of electric energy into light and a smaller percentage into waste heat.

[23] Note that we conservatively excluded any cooling benefits.

[24] For programs addressing market-driven events such as equipment sales or new construction, we compute program savings as the difference between sales or market share with the program and sales or market share without it. This is the most accurate approach for capturing the inter-related effects of both free ridership and "free drivership" (otherwise known as spillover). The ratio of baseline sales or market share to total sales or market share can be considered the market free rider rate.

Thereafter, we project sales per household to climb slowly until they level off at 1.0 per household in 2011. That is a level that has been already achieved or exceeded in several states. Moreover, the fact that CFL prices continue to fall each year suggests these sales levels should be easier to reach in the future than they have been in the past.

- Approximately 60% of CFLs sold will be rebated. The free driver rate – i.e. the rate of measure uptake that results from the program but which does not partake in the programs incentives – implicit in this assumption is consistent with evaluation results from Vermont[25] and the Pacific Northwest.[26]

Building from experience in other jurisdictions, a retail CFL program in Québec would have the following key features:

- Instant rebate coupons redeemable at any retailer willing to participate in the program. Rebates would start at $5 per CFL and decline by $1 every two years.[27]
- Extensive and regular outreach to retailers with dedicated field staff – to recruit them into the program, obtain regular feedback and sales data, provide sales staff training on how to sell CFLs to consumers, ensure adequate supplies of rebate coupons, support placement of point-of-purchase marketing materials, help retailers organize periodic special promotional events, etc.
- Aggressive consumer marketing campaign.

As Table 9 above shows, we estimate the cost of such a program in Québec at about $7-10 million per year over the next eight years. This yields a levelized utility cost of energy savings of $0.015 per kWh. The levelized societal cost (utility *plus* participant costs net of benefits) is $0.006 per kWh. The latter is lower than the utility's cost because of savings associated with eliminating the need to buy many shorter-lived incandescent bulbs over the CFL's useful lives. However, due to time constraints, we were not able to include the added costs of increased fossil fuel consumption in homes with non-electric heat.

2) Efficient Washer Sales

Today, every major appliance manufacturer produces an efficient clothes washer (usually horizontal-axis) in addition to standard efficiency units. This has been one of the great successes of the U.S. Environmental Protection Agency's ENERGY STAR program and the various regional and state programs that worked with it. Energy Star washers save energy in three different ways: (1) reducing the amount of water, and therefore hot water, used per cycle; (2) removing more moisture from clothes, thereby reducing drying time and dryer energy use; and (3) reducing electricity used by the washer motor itself.

Although higher federal efficiency standards adopted in the U.S. and soon to be adopted by Canada (Modified Energy Factor or MEF of 1.04 in 2004, increasing to 1.26 in 2007) will increase the efficiency of baseline or standard models, there are still significant savings to be had from

---

[25] XENERGY, *Final Report: Phase 1 Evaluation of the Efficiency Vermont Efficient Products Program*, prepared for the Vermont Department of Public Service, June 10, 2003.

[26] NORTHWEST ENERGY EFFICIENCY ALLIANCE, *2001 Market Activities Report*.

[27] It may also be worth considering "up-stream" rebates to manufacturers and/or retailers who guarantee specific Québec sales levels.

promoting higher efficiency models (i.e. those with an average MEF of about 1.7 or higher). Indeed, as Table 10 shows, we estimate that an efficient washer program in Québec could generate cumulative annual savings of about 89 GWh by 2010. That is comparable to or greater than all but one or two of Hydro-Québec's residential programs.

Table 10: Washer Program: Cumulative Annual Savings and Cost (Budget-Constrained Scenario)

	2005	2006	2007	2008	2009	2010	2011	2012
Cumulative Annual GWh Savings	16	40	53	65	77	89	100	111
Cumulative Annual Winter Peak MW Savings	3	8	10	12	15	17	19	21
Cumulative Annual Summer Peak MW Savings	2	6	8	9	11	13	14	16
Total Program Costs (M$ 2004)	$6,5	$4,7	$5,3	$5,2	$5,2	$3,5	$3,4	$3,4

A number of key assumptions underlie these estimates of savings potential. They include:

- Per unit annual savings of 421 kWh, declining to 163 kWh in 2007. This assumes an average MEF per efficient appliance of 1.80 (the average in Vermont was 1.71 in 2002, but it is expected to increase in 2004 and beyond as the ENERGY STAR standard increases). It also assumes, based on our analysis of available data, that the use of cold water washing in Québec is similar to that assumed in the U.S.[28] An additional adjustment is made to account for Québec saturation of electric water heating (91% saturation), and heating cross effects on the portion of savings from the washer motor.
- Annual washer sales of 205,000 per year and baseline market share of 21.5% in 2003 for Québec based on information provided by a Canadian appliance manufacturer. Baseline market share of high efficiency units is assumed to increase by one percentage point each year.
- Program market share of 40% in 2005, ramping up to 60% by 2007 and staying at that level thereafter. The 60% market share is a value already achieved in Vermont (3rd quarter of 2003).[29]
- Approximately 60% of efficient washers sold will be rebated. The free driver rate implicit in this assumption is consistent with evaluation results from Vermont.[30]

---

[28] Per unit washer savings were based on an extensive analysis conducted by the U.S. Department of Energy in support of its recent decision to increase minimum federal efficiency standards for clothes washers (U.S. DEPARTMENT OF ENERGY, *Final Rule Technical Support Document (TSD): Energy Efficiency Standards for Consumer Products: Clothes Washers*, December 2000). That analysis assumed that for the most common types of washers, 14% of all wash cycles are "hot water", 49% are "warm water" and 37% are "cold water". If warm is comprised of half hot and half cold water, then the weighed average use of hot water wash is about 40%. Note that the U.S. DOE estimate of washer savings also assumes that a warm rinse is used only 27% of the time and that a cold rinse is used all other times. This suggests that the weighted average use of hot water rinse is about 14%. A Québec survey of consumers suggested that 49% of all households washed only with cold water and another 20.6% used cold water "often" (HYDRO-QUÉBEC, *R-3473-2001, HQD-3, doc. 5, annexe 1* (data from an Ad Hoc study, February 2001)). If "often" also means hot is used half the time and cold the other half, these Quebec survey data suggest that hot water is also used for approximately 40% of washes. It is unclear from the survey whether consumers were referring to the temperature of water in wash mode, rinse mode or both. Our analysis conservatively assumes they meant wash mode only and that the use of hot water for rinsing is much less common, just as assumed in the U.S. DOE analysis.

[29] State market share data from U.S. Environmental Protection Agency's and U.S. Department of Energy's Energy Star program, compiled and distributed electronically by D&R International. Data are currently available only through the third quarter of 2003.

Building from experience in other jurisdictions, an efficient washer program in Québec would have the following key features:

- Mail-in rebate coupons of $100 in the first year (to get initial attention from retailers and consumers), declining to $50 in subsequent years. Efforts would also be made to leverage additional seasonal manufacturer rebates, as has been done successfully in the U.S. in recent years.
- Extensive and regular outreach to retailers with dedicated field staff – to recruit them into the program, obtain regular feedback and sales data, provide sales staff training on how to sell efficient washers to consumers, ensure adequate supplies of rebate coupons, support placement of point-of-purchase marketing materials, help retailers organize periodic special promotional events, etc.
- Aggressive consumer marketing campaign.

As Table 10 above shows, we estimate the cost of such a program in Québec to average less than $5 million per year over the next eight years. This yields a levelized utility cost of energy savings of $0.032 per kWh. The levelized societal cost is $0.111 per kWh without accounting for reductions in costs associated with modest fossil fuel savings and substantial water savings.

3) Efficient Window Sales

With Québec's cold climate and high saturation of electric space heat, efficient windows have the potential to save considerable electricity. We define efficient windows as those that would meet the U.S. Environmental Protection Agency's ENERGY STAR standard (u-value of less than or equal to 0.35, which can typically be met with double-pane low-e argon windows). Although it is typically not cost-effective to replace existing double-paned windows purely for energy savings, it is likely to be cost-effective to convince consumers already in the market for new windows (either for new homes or replacements for existing homes) to pay the incremental cost to up-grade to efficient windows. As Table 11 shows, we estimate that a program promoting such up-grades at the time of purchase in Québec could generate cumulative annual savings of about 131 GWh by 2010. That is greater than all but one of Hydro-Québec's residential programs.

Table 11: Windows Program: Cumulative Annual Savings and Cost (Budget-Constrained Scenario)

	2005	2006	2007	2008	2009	2010	2011	2012
Cumulative Annual GWh Savings	8	23	45	75	103	131	158	185
Cumulative Annual Winter Peak MW Savings	5	15	29	47	65	83	100	117
Cumulative Annual Summer Peak MW Savings	0	0	0	0	0	0	0	0
Total Program Costs (M$ 2004)	$2,4	$2,4	$2,4	$2,4	$2,4	$2,4	$2,4	$2,4

A number of key assumptions underlie these estimates of savings potential. They include:

- Annual savings of 75 kWh per m^2 of window area – the same as Hydro-Québec's estimate for upgrading from standard two-pane to two-pane with low-e.[31]

---

[30] XENERGY, Final Report: Phase 1 Evaluation of the Efficiency Vermont Efficient Products Program, prepared for the Vermont Department of Public Service, June 10, 2003.

[31] HYDRO-QUÉBEC, *R-3526-04, HQ-3, doc. GRAME*, p.38.

- Average annual window sales in Québec of 1.2 million. This is an extrapolation (based on number of residential households) of industry data for the northeastern U.S.[32]
- Baseline market share of 35% in 2005, growing approximately one percentage point per year. This is similar to the market share in the northeastern U.S.[33]
- Program market share of 45% in 2005, ramping up to and leveling off at 75% in 2008. This is consistent with the experience of the Northwest Energy Efficiency Alliance's ENERGY STAR Windows program.[34]

Building from experience in the Pacific Northwest, an efficient windows program in Québec would have the following key features:

- Extensive and regular outreach to manufacturers and retailers with dedicated field staff – to recruit them into the program, obtain regular feedback and sales data, provide sales training on how to sell efficient washers to consumers, support placement of point-of-purchase marketing materials, etc.
- Co-op advertising with manufacturers and retailers.
- Technical assistance to manufacturers on window design and production processes for producing them cost-effectively.

As Table 11 above shows, we estimate the cost of such a program in Québec to be $2.4 million per year over the next eight years. This yields a levelized utility cost of energy savings of $0.007 per kWh. The levelized societal cost is $0.058 per kWh without accounting for reductions in costs associated with fossil fuel savings in non-electrically heated homes.

We recognize that our proposed windows program would overlap to some extent with Hydro-Québec's DSM plan. To avoid any double-counting, we adjust for this overlap in the residential summary section (see page 35).

4) Inefficient Refrigerator/Freezer Turn-Ins

Approximately 20% of all Québec households have a second refrigerator.[35] Such refrigerators are typically relatively old and much less efficient than new models. In many cases they are also

---

[32] Note that the ratio of northeastern U.S. (New England, New York and New Jersey) households to Québec households (roughly 5 to 1) is very similar to the ratio of new housing starts in the northeastern U.S. to new housing starts in Québec.

[33] QUANTEC and NEXUS MARKET RESEARCH, "Baseline Characterization of the Residential Market for ENERGY STAR Windows in the Northeast", Prepared for Northeast Energy Efficiency Partnerships, May 21, 2002.

[34] The Northwest Energy Efficiency Alliance began its program in 1997 with a market share of 15%. By 2002 the market share had grown to 70% and the program was ended (see: http://www.nwalliance.org/projects/projectoverview.asp?PID=37). We conservatively assume that Hydro-Québec would need to continue its marketing effort through the entire eight year period to maintain its market share.

[35] NATURAL RESOURCES CANADA, Office of Energy Efficiency, Commercial/Institutional Sector, Québec, Secondary Energy Use and GHG Emissions by Energy Source, Historical Database – February 2003.

not used much. In addition, it is likely that a substantial fraction of Québec households have older primary refrigerators and freezers that are relatively inefficient (compared to new models). Thus, a program that promotes removal, recycling and disposal of both second refrigerators and inefficient primary refrigerators and freezers (the latter presumably being replaced with new models), has the potential to generate substantial electricity savings. Such programs have been run in a number of different jurisdictions in recent years, perhaps most notably in California.

As Table 12 shows, we estimate that such a refrigerator turn-in program in Québec could generate cumulative annual savings of more than 300 GWh by 2010. That is greater than any single current Hydro-Québec residential program. However, this program would also come at a high cost; as such, we have excluded it from the "budget-constrained" scenario. It is presented below for the reader's information only, and later as part of the "unconstrained scenario".

Table 12: Refrigerator / Freezer Turn-In Program: Cumulative Annual Savings and Cost (Unconstrained Scenario only)

	2005	2006	2007	2008	2009	2010	2011	2012
Cumulative Annual GWh Savings	23	73	133	197	259	312	338	337
Cumulative Annual Winter Peak MW Savings	1.5	4.7	8.5	12.7	16.6	20.1	21.8	21.7
Cumulative Annual Summer Peak MW Savings	4.4	14.1	25.8	38.3	50.2	60.6	65.6	65.3
Total Program Costs (M$ 2004)	$22,1	$50,5	$62,6	$70,7	$70,7	$64,5	$60,6	$60,8

A number of key assumptions underlie these estimates of savings potential. They include:

- Average electricity consumption from both second refrigerators and older inefficient primary refrigerators and freezers of 1153 kWh/year – i.e. Hydro-Québec's estimated consumption for second refrigerators.[36]
- Reduction of savings due to heating cross effects of 56% for homes with electric baseboard heating – also a Hydro-Québec estimate.[37] After adjusting for homes with fossil fuel heat, dual-fuel heat, and heat pumps, the average system-wide savings were reduced by 40%.
- Free rider rate of 45%, based on recent evaluation of California program suggested net-to-gross savings ratio of between 0.47 and 0.62.[38]
- Program can remove 40% of all second refrigerators over six years (2005 through 2010).
- Program can capture 10% of primary refrigerator and freezer replacements in first year (2005), ramping up to 50% by 2009.

Building from experience in California, British Columbia and elsewhere, the refrigerator/freezer turn-in program in Québec would have the following key features:

- $75 rebate for removal of second refrigerator and $100 rebate coupon for purchase of a new ENERGY STAR qualified refrigerator for removal of a primary unit.
- All units removed are properly recycled and disposed.

[36] HYDRO-QUÉBEC, *R-3473-2001, HQD-3, doc. 8*, p. 16.

[37] Ibid.

[38] DALY, Eric, Val JENSEN and Bruce WALL, "Evaluation of the Energy and Environmental Effects of the California Appliance Early Retirement and Recycling Program", in Proceedings of the 2003 Energy Program Evaluation Conference, pp. 833-843.

- All work, including consumer marketing, is performed on a turn-key basis by a hired program contractor.

As Table 12 above shows, we estimate the cost of such a program in Québec to average less than $60 million per year over the next eight years. This yields a levelized utility cost of energy savings of $0.210 per kWh. The levelized societal cost is $0.336 per kWh after accounting for costs associated with accelerating the time-table for purchase of new refrigerators (only for the portion of the program target at early retirement of inefficient existing refrigerators).

5) Enhanced EnerGuide Program

6)

Hydro-Québec has proposed to piggyback on the national EnerGuide program (implemented in Québec by the Québec Energy Efficiency Agency (AEE)) primarily by providing an additional incentive to reduce the cost of the EnerGuide ratings and providing training to trade professionals to underscore the importance of energy efficiency in renovations and ensure proper treatment of thermal envelops of buildings. In its latest proposal, Hydro-Québec has suggested that it will also provide an average per home incentive of $2000 to defray the cost of efficiency improvements for low income participants only.

Hydro-Québec has projected that the program will provide 27,000 non-low income initial audits/ratings between 2003 and 2006 and that 41% of those (i.e. 11,000) will implement recommended efficiency upgrades. Hydro-Québec recently projected that the program will provide 3725 additional initial audits/ratings for low income households between 2004 and 2006 and that 85% of those (i.e. 3166) will implement efficiency upgrades.[39] Hydro-Québec is projecting that the average savings per treated home will be about 4000 kWh per year.

We believe that there are several ways to improve the performance of this program. First, Hydro-Québec could expand its offer of incentives for efficiency improvements (rather than just for initial audits/ratings) to non-low income households. We have our doubts as to whether Hydro-Québec will actually be able to get 41% of households to implement efficiency measures without greater support. Indeed, to date only 2% of the homes that got an initial audit/rating in Québec actually followed through on efficiency measures and got a follow up inspection.[40] This is entirely consistent with more than a decade of experience across North America on audit programs. Put simply, consumers like inexpensive audits, but in most cases are not willing to act on their often costly recommendations without substantial financial support. Thus, Hydro-Québec should be able to substantially increase both overall participation in the initial audit/rating and, more importantly, follow through on recommended measures, by offering a substantial incentive for installation of efficiency measures to non-low income households as well as to low income households.

We would suggest that the offer be based on the number of points the efficiency of the home is improved (not to exceed the cost of the installation), so that consumers are strongly encouraged to install the measures that generate the greatest savings. Given the EnerGuide program experience in Québec to date, it would appear that an incentive on the order of $300 to $400 per

---

[39] HYDRO-QUÉBEC, *R-3526-04, HQ-3, doc. REGIE*, p. 18.

[40] Canadian government data on number and percent of "B" evaluations in Québec.

point improvement in the energy rating would yield an average rebate of approximately $2000 per home.[41]

Second, Hydro-Québec could help target-market the program to the highest users of electric space heat through telemarketing and/or other means. This should substantially increase the average annual kWh savings per participant.

Third, Hydro-Québec should help (financially and otherwise) the AEE develop and implement an “arranging service” to make it easier for consumers to follow up on recommendations. In our experience, one of the biggest barriers to consumer action on audit recommendations (after the cost) is the hassle, uncertainty and risk associated with selecting a contractor they can trust and establishing a contract for work to be performed. This is a role the auditor/rater can potentially play with sufficient training. It should make it easier to “close the deal”, increasing the percentage of initial inspections that result in efficiency improvements.

Fourth, Hydro-Québec should enable the inspectors/raters to install low cost efficiency measures (e.g. hot water conservation measures and CFLs) at the time of the initial audit/rating. This will increase total program savings.

As Table 13 shows, we believe these changes would increase program savings to 630 GWh per year by 2010. That represents over a four-fold increase in savings over even the expanded (i.e. addition of new low income component) Hydro-Québec proposal. This yields a levelized utility cost of energy savings of $0.020 per kWh, or $0.041 on a societal basis. Of course, the cost of the program would also be substantially higher than Hydro-Québec has proposed, totaling more than $300 million – or about eight times the cost of Hydro-Québec’s proposed program – over the 2005-2010 time period.

Table 13: Enhanced EnerGuide Program: Total Cumulative Annual Savings and Cost (Budget-Constrained Scenario)

	2005	2006	2007	2008	2009	2010	2011	2012
Cumulative Annual GWh Savings	65	145	242	355	484	630	791	969
Cumulative Annual Winter Peak MW Savings	40.8	91.7	152.9	224.2	305.8	397.5	499.4	611.5
Cumulative Annual Summer Peak MW Savings	0.1	0.3	0.5	0.8	1.1	1.4	1.8	2.2
Total Program Costs (M$ 2004)	$22,2	$27,3	#32,2	$37,0	$41,7	$46,3	$50,7	$55,0

Table 14 summarizes the difference between the savings and costs we estimate for the proposed program design we analyzed and those Hydro-Québec estimates for its proposed program design. As such, this table presents the net additional savings of our proposed changes.

Table 14: Enhanced EnerGuide Program: Incremental Cumulative Annual Savings and Cost (Budget-Constrained Scenario)

	2005	2006	2007	2008	2009	2010	2011	2012
Cumulative Annual GWh Savings	43	97	167	254	356	492	653	831
Cumulative Annual Winter Peak MW Savings	26.8	61.1	105.5	160.1	224.9	310.4	412.3	524.4
Cumulative Annual Summer Peak MW Savings	0.1	0.2	0.4	0.6	0.8	1.1	1.5	1.9
Total Program Costs (M$ 2004)	$18,6	$21,0	$26,0	$30,8	$35,4	$40,8	$50,7	$55,0

A number of key assumptions underlie these estimates of increased savings potential. These include:

[41] Data from the federal government suggests that the average Québec home that has received a post-installation “B” inspection saw an increase in its Energy Rating of 6 points (from 62 to 68).

- 10,000 audits/ratings are conducted in 2005, with the number growing by 2500 per year.
- 75% of audits/ratings homes receiving audits/ratings implement space heating efficiency upgrades. This is less than the 85% value Hydro-Québec assumed for a similar incentive offering for low income customers.
- Average net savings (after adjusting for assumed free riders) of 7800 kWh/yr per home implementing recommended efficiency upgrades. This is based, in turn, on several other key assumptions. Chief among these are that, as a result of target marketing, the average baseline heating consumption of homes installing efficiency upgrades is 25,000 kWh/year. We also assume that the average space heat savings per home, from those homes receiving weatherization treatment, will be 30%. This is consistent with results to date from Québec participants in the EnerGuide program.[42]

D. Summary of Achievable Residential DSM Savings (Constrained and Unconstrained)

In this section we summarize the savings possible from both a "budget-constrained portfolio" and a more aggressive "unconstrained" achievable scenario further below.

The "budget constrained" portfolio includes Hydro-Quebec's proposed portfolio plus three new programs we discussed above – CFL, washer and windows – and the enhancements to the EnerGuide program also discussed previously. This scenario, from which we have excluded the refrigerator removal program due to its high unit costs, is presented first.

The "unconstrained" scenario includes Hydro-Quebec's proposed portfolio; even more aggressive versions of the CFL, washer and windows programs discussed above; the refrigerator removal program discussed above but excluded from the constrained scenario; a more aggressive space heat retrofit program; more aggressive residential new construction programs; and very rough approximations of what could be achieved from aggressive efforts to promote retail sales of other efficient products.

1) Budget-Constrained Scenario

As Table 15 shows, we estimate that the additions and changes to the residential DSM portfolio that we have analyzed, if all employed, would have the effect of almost tripling – from 637 to 1864 – the annual GWh savings realized in 2010.

---

[42] Data on the Québec program to date suggest that the average home receiving a post-treatment inspection/rating realized annual savings of 33 gigajoules. That translates to over 9000 kWh for an electrically-heated home.

Table 15: Budget-Constrained Summary: Residential Cumulative Annual GWh Savings

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
New/Improved Programs										
CFLs	0	0	52	134	222	316	415	521	632	691
Washers	0	0	16	40	53	65	77	89	100	111
Windows	0	0	8	23	45	75	103	131	158	185
Frig Removal	0	0	-	-	-	-	-	-	-	-
EnerGuide - Enhanced	0	0	65	145	242	355	484	630	791	969
Gross Total	**-**	**-**	**140**	**343**	**562**	**811**	**1,080**	**1,370**	**1,681**	**1,955**
Overlap - Windows	0	0	(0)	(1)	(2)	(4)	(5)	(5)	(5)	(5)
Overlap - EnerGuide	0	0	(22)	(49)	(75)	(102)	(128)	(138)	(138)	(138)
Net Total	**-**	**-**	**118**	**293**	**485**	**706**	**947**	**1,227**	**1,538**	**1,812**
HQ Programs	21	123	235	368	450	535	620	637	637	637
Grand Total	**21**	**123**	**353**	**661**	**936**	**1,241**	**1,567**	**1,864**	**2,175**	**2,449**

As Table 16 and Table 17 indicate, winter and summer peak demand savings would be dramatically higher as well (Hydro-Québec's plan projects aggregate capacity savings (from all sectors) of 280 MW "at meter" by 2010; no sectoral breakdown was provided to us).

Table 16: Budget-Constrained Summary: Residential Cumulative Annual Winter Peak MW Savings

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
New/Improved Programs										
CFLs			4	9	15	22	28	36	43	47
Washers			3	8	10	12	15	17	19	21
Windows			5	15	29	47	65	83	100	117
Frig Removal			-	-	-	-	-	-	-	-
EnerGuide - Enhanced			41	92	153	224	306	397	499	612
Gross Total			**52**	**123**	**207**	**306**	**414**	**533**	**662**	**797**

Caveat: Excluding net Hydro-Québec program savings.

Table 17: Budget-Constrained Summary: Residential Cumulative Annual Summer Peak MW Savings

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
New/Improved Programs										
CFLs			5	12	20	28	37	46	56	61
Washers			2	6	8	9	11	13	14	16
Windows			-	-	-	-	-	-	-	-
Frig Removal			-	-	-	-	-	-	-	-
EnerGuide - Enhanced			0	0	1	1	1	1	2	2
Gross Total			**7**	**18**	**28**	**38**	**49**	**60**	**72**	**79**

Caveat: Excluding net Hydro-Québec program savings.

As Table 18 indicates, the net incremental cost of implementing all the new and expanded residential initiatives analyzed in this report would start at $35.4 million in 2005 and grow to about $55.9 million by 2010. The enhancements to the EnerGuide program would account for just over half of the cost of the new and expanded initiatives in 2005 and three-quarters of their cost by 2010. In net present value terms, the deployment of all the new programs and program enhancements in our budget-constrained scenario that we analyzed would lead to a four-fold increase in spending between 2005 and 2010.

Table 18: Budget-Constrained Summary: Residential Annual Budgetary Cost

(Millions Real 2004$)	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
New/Improved Programs										
CFLs	$ -	$ -	$ 7.7	$ 10.2	$ 9.1	$ 9.5	$ 8.2	$ 8.5	$ 7.0	$ 7.0
Washers	$ -	$ -	$ 6.5	$ 4.7	$ 5.3	$ 5.2	$ 5.2	$ 3.5	$ 3.4	$ 3.4
Windows	$ -	$ -	$ 2.4	$ 2.4	$ 2.4	$ 2.4	$ 2.4	$ 2.4	$ 2.4	$ 2.4
Frig Removal	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
EnerGuide - Enhanced	$ -	$ -	$ 22.2	$ 27.3	$ 32.2	$ 37.0	$ 41.7	$ 46.3	$ 50.7	$ 55.0
Gross Total	$ -	$ -	$ 38.8	$ 44.6	$ 49.1	$ 54.2	$ 57.5	$ 60.6	$ 63.5	$ 67.7
EnerGuide Overlap	$ -	$ -	$ (3.5)	$ (5.9)	$ (5.8)	$ (5.7)	$ (5.5)	$ (4.7)	$ -	$ -
Net Total	$ -	$ -	$ 35.4	$ 38.7	$ 43.3	$ 48.5	$ 52.0	$ 55.9	$ 63.5	$ 67.7
HQ Programs	$ 4.7	$ 15.7	$ 18.3	$ 16.2	$ 13.2	$ 13.2	$ 13.2	$ 8.3	$ -	$ -
Total	$ 4.7	$ 15.7	$ 53.7	$ 54.9	$ 56.5	$ 61.7	$ 65.1	$ 64.2	$ 63.5	$ 67.7

Table 19 summarizes the levelized cost of the programs analyzed, both from the utility perspective and the societal perspective.[43] As the table makes clear, some of the programs we have analyzed save electricity much less expensively than others. The windows program would produce savings at a utility cost of less than 1 ¢/kWh, whereas the washer program would cost 3.2 ¢/kWh. From a societal perspective, the CFL program would be the least expensive, producing savings at a cost of 0.6 ¢/kWh; the washer program would be the most expensive, producing savings at a cost of 11.1 ¢/kWh.

All told, the portfolio of three additional and one enhanced program we analyzed produces savings at a combined utility cost (after adjusting for overlaps with Hydro-Québec programs) of 1.8 ¢/kWh That is very similar to the 1.7 ¢/kWh we have estimated for Hydro-Quebec's proposed portfolio.[44] The portfolio of new programs and program enhancements in our residential budget-constrained scenario would generate savings at a societal cost of 3.8 ¢/kWh.

Table 19: Budget-Constrained Summary: Levelized Cost of New/Enhanced Programs

	2004 $	
	utility	society
CFLs	$ 0,015	$ 0,006
Washers	$ 0,032	$ 0,111
Windows	$ 0,007	$ 0,058
Frig Removal	n.a.	n.a.
EnerGuide - Enhanced	$ 0,020	$ 0,041
Gross Totals	$ 0,018	$ 0,038
Net Totals	$ 0,019	$ 0,038

2) Unconstrained Achievable Scenario

Numerous studies have suggested that it is possible to capture substantially greater savings than are currently being captured in DSM efforts across North America if additional financial resources could be devoted to the task. In this part of our report, we present estimates of what such a funding-unconstrained, maximum achievable residential potential would be.

---

[43] Again, note that the societal analysis does not account for increased fossil fuel usage from some programs (e.g. CFLs) or decreases from others (e.g. washers and windows). Nor does it account for reductions in water use (e.g. from efficient washers).

[44] Note that this is computed assuming Hydro-Quebec's estimates of savings from its programs are reasonable and accurate. As noted above, we have some doubts about some of the company's claims. However, we have not analyzed them in sufficient detail to draw definitive conclusions.

Our estimates include additional savings that could be captured: (a) from more aggressive targeting of the three new markets (CFLs, washers and windows) included in our "budget constrained scenario"; (b) from an even more aggressive (i.e. beyond our enhanced EnerGuide program) electric space heat retrofit program; (c) by including the refrigerator removal program discussed above; (d) from more aggressive efforts in the residential new construction market (using the Novoclimat standard, but achieving much greater participation); and (e) through programs aimed at increased retail sales of other efficient products.[45] In contrast with the four new or enhanced programs analyzed for the "budget constrained scenario", our analysis of the unconstrained achievable potential generally assumes that rebates or other incentives equal to 100% of the incremental cost of efficiency upgrades would be provided for all measures. Thus, while the savings potential is substantially higher than in the budget constrained scenario, the costs are higher still.

As Table 20 shows, it would be possible to acquire on the order of 3935 GWh of savings from the residential sector by 2010. That is more than six times what Hydro-Québec has proposed to acquire and about twice what we estimate is possible with a more limited set of less expensive programs.

Table 20: Unconstrained Summary: Residential Cumulative Annual GWh Savings

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
New/Improved Programs										
CFLs	0	0	54	148	267	387	480	573	666	705
Washers	0	0	44	106	130	154	177	199	222	244
Windows	0	0	36	79	125	170	215	259	302	344
Frig Removal	0	0	23	73	133	197	259	312	338	337
EnerGuide - Enhanced	0	0	92	216	370	555	771	1,017	1,295	1,603
Novoclimat- SF Enhanced	0	0	28	84	177	288	419	567	716	865
Novoclimat- MF	0	0	3	5	8	11	13	16	19	22
Other Retail	0	0	62	162	261	362	451	536	609	650
Gross Total	**-**	**-**	**342**	**872**	**1,471**	**2,124**	**2,784**	**3,481**	**4,167**	**4,768**
Overlap - Windows	0	0	(2)	(4)	(6)	(9)	(11)	(11)	(11)	(11)
Overlap - EnerGuide	0	0	(22)	(49)	(75)	(102)	(128)	(138)	(138)	(138)
Overlap - Novoclimat	0	0	(6)	(13)	(20)	(26)	(34)	(34)	(34)	(34)
Net Total	**-**	**-**	**312**	**807**	**1,370**	**1,988**	**2,611**	**3,298**	**3,984**	**4,585**
HQ Programs	21	123	235	368	450	535	620	637	637	637
Grand Total	**20.976**	**123**	**547**	**1,174**	**1,821**	**2,523**	**3,232**	**3,935**	**4,621**	**5,222**

Table 21 and Table 22 show the estimated winter and summer peak demand savings that are possible from an unconstrained, maximum achievable residential program portfolio.

[45] Note that our estimate of savings and costs available from "other retail" markets is the crudest part of this analysis. Given the relatively small savings involved as well as the severe budgetary and time constrains for our work, we adopted the following approach for this more complex sector: We began by reviewing our recent comprehensive analysis of efficiency potential for the state of New York. We estimated the percentage of total New York "retail" savings and costs that were attributable to the other retail measures (i.e. measures other than those analyzed for the Québec portfolio discussed above). After a few adjustments to reflect differences between Québec and New York (e.g. lower saturations and usage of air conditioning), we assumed that percentage would apply to Québec as well. Thus, contrary to the remainder of our measures, this is only a very rough approximation.

Table 21: Unconstrained Summary: Residential Cumulative Annual Winter Peak MW Savings

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
New/Improved Programs										
CFLs			4	10	18	26	33	39	46	48
Washers			8	20	25	30	34	38	43	47
Windows			23	50	79	108	136	163	190	217
Frig Removal			1	5	9	13	17	20	22	22
EnerGuide - Enhanced			58	136	233	350	486	642	817	1 012
Novoclimat- SF Enhanced			18	53	112	182	264	358	452	546
Novoclimat- MF			2	3	5	7	9	10	12	14
Other Retail			7	19	30	42	52	62	71	75
Gross Total			121	296	511	757	1 031	1 334	1 652	1 981

Caveat: Excluding net Hydro-Québec program savings.

Table 22: Unconstrained Summary: Residential Cumulative Annual Summer Peak MW Savings

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
New/Improved Programs										
CFLs			5	13	24	34	42	50	59	62
Washers			6	15	19	22	26	29	32	35
Windows			-	-	-	-	-	-	-	-
Frig Removal			4	14	26	38	50	61	66	65
EnerGuide - Enhanced			0	1	1	1	2	2	3	4
Novoclimat- SF Enhanced			2	5	11	17	25	34	43	52
Novoclimat- MF			0	0	0	1	1	1	1	1
Other Retail			7	18	29	40	50	60	68	72
Gross Total			24	66	109	154	196	237	271	292

Caveat: Excluding net Hydro-Québec program savings.

Of course, as noted above, the cost of a maximum, unconstrained effort to acquire savings would exceed to a significant degree the “budget constrained portfolio” discussed. Indeed, as Table 23 shows, the cost of the maximum achievable scenario, in net present value terms, is over eight times as great as the cost of the “budget constrained portfolio” and more than 39 times the cost of Hydro-Québec’s proposal over the 2005 to 2010 time period. This is indicative of the general principle that the last increments of savings cost the most to acquire. However, it should be noted that one program – Other Retail – accounts for about 35% of the maximum portfolio’s cost (while only contributing about 15% of the energy savings). [46]

[46] It should be emphasized that « other retail » is an amalgamation of many different efficiency technologies and markets. As a whole it is a very expensive resource. However, that aggregate picture masks considerable variation in the cost-effectiveness of its various component parts. Indeed, there are efficiency measures in it whose levelized cost per kWh of savings would be comparable to or less expensive than measures included in our budget-constrained scenario. As noted above, due to resource constraints, we have not attempted to identify and separately quantify all such less expensive opportunities in Québec.

Table 23: Unconstrained Summary: Residential Annual Budgetary Cost

(Millions Real 2004$)	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
New/Improved Programs										
CFLs	$ -	$ -	$ 13.8	$ 17.6	$ 20.9	$ 17.7	$ 14.9	$ 12.4	$ 12.3	$ 12.2
Washers	$ -	$ -	$ 55.5	$ 69.5	$ 35.2	$ 34.6	$ 33.9	$ 33.2	$ 32.6	$ 32.0
Windows	$ -	$ -	$ 38.1	$ 41.8	$ 43.1	$ 42.3	$ 41.4	$ 40.6	$ 39.9	$ 39.1
Frig Removal	$ -	$ -	$ 22.1	$ 50.5	$ 62.6	$ 70.7	$ 70.7	$ 64.6	$ 60.6	$ 60.8
EnerGuide - Enhanced	$ -	$ -	$ 48.9	$ 63.6	$ 77.8	$ 91.5	$ 104.6	$ 117.3	$ 129.5	$ 141.3
Novoclimat- SF Enhanced	$ -	$ -	$ 17.1	$ 32.1	$ 51.5	$ 60.2	$ 68.6	$ 76.6	$ 75.0	$ 73.5
Novoclimat- MF	$ -	$ -	$ 2.4	$ 2.4	$ 2.3	$ 2.3	$ 2.2	$ 2.2	$ 2.1	$ 2.1
Other Retail	$ -	$ -	$ 221.3	$ 276.0	$ 222.5	$ 216.2	$ 207.2	$ 196.5	$ 191.5	$ 188.3
Gross Total	$ -	$ -	$ 419.2	$ 553.4	$ 516.0	$ 535.4	$ 543.6	$ 543.5	$ 543.6	$ 549.2
EnerGuide Overlap	$ -	$ -	$ (3.5)	$ (5.9)	$ (5.8)	$ (5.7)	$ (5.5)	$ (4.7)	$ -	$ -
Novoclimat Overlap	$ -	$ -	$ (1.1)	$ (1.1)	$ (1.2)	$ (1.2)	$ (1.2)	$ -	$ -	$ -
Net Total	$ -	$ -	$ 414.7	$ 546.4	$ 509.0	$ 528.6	$ 536.8	$ 538.8	$ 543.6	$ 549.2
HQ Programs	$ 4.7	$ 15.7	$ 18.3	$ 16.2	$ 13.2	$ 13.2	$ 13.2	$ 8.3	$ -	$ -
Total	$ 4.7	$ 15.7	$ 433.0	$ 562.6	$ 522.2	$ 541.7	$ 550.0	$ 547.1	$ 543.6	$ 549.2

As Table 24 shows, the levelized cost per kWh is also greater. Indeed, the net levelized utility cost per kWh for the entire portfolio – 7.3 cents per kWh – is about *four times the average levelized cost for the entire "budget constrained" portfolio*. Removing the two least cost-effective programs – Refrigerator Removal and Other Retail –, however, brings the levelized utility cost down to a competitive 4.1 cents per kWh.

Table 24: Unconstrained Summary: Levelized Cost of New/Enhanced Programs

	2004 $	
	utility	society
CFLs	$ 0,027	$ 0,011
Washers	$ 0,127	$ 0,105
Windows	$ 0,064	$ 0,055
Frig Removal	$ 0,210	$ 0,336
EnerGuide - Enhanced	$ 0,030	$ 0,039
Novoclimat- SF Enhanced	$ 0,032	$ 0,035
Novoclimat- MF	$ 0,051	$ 0,055
Other Retail	$ 0,299	$ 0,320
Gross Totals	$ 0,070	$ 0,078
Net Totals	$ 0,073	$ 0,080
Net Total w/o Frig & Retail	$ 0,041	$ 0,041

VII. C&I and SMI Sector Analyses

A. Summary of Hydro-Québec's Plan

The following describe both Hydro-Québec's current C&I and SMI sector programs, as proposed to the *Régie de l'énergie* in its R-3519-2003 docket, as well as alternative options considered but not proposed.

1) Current DSM Portfolio

- Commercial and Institutional (C&I)

Hydro-Québec is currently implementing four commercial and institutional programs: the *Energy Initiatives* program, an automated, customizable *Diagnostics* program, a program aimed solely at its own buildings and, finally, a *Traffic Lights* program. Table 25 shows Hydro-Québec is projecting these programs will produce 388 GWh[47] of cumulative annual savings by 2009, representing 1.1% of the 2009 C&I sector sales forecast.[48] Hydro-Québec projects no additional savings after 2009.[49]

Table 25: Hydro-Québec's Current Proposed C&I Programs: Cumulative Annual GWh Savings

HQ's C&I Plan (GWh/yr)	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Initiatives	0	51	107	163	216	258	325	325	325	325
Diagnostics	0	6	11	17	22	28	33	33	33	33
HQ Buildings	0	3	7	10	10	10	10	10	10	10
Traffic Lights	0	1	5	10	15	20	20	20	20	20
Financial aid for Small Customers	0	0	0	0	0	0	0	0	0	0
Re-commissioning	0	0	0	0	0	0	0	0	0	0
Total	**0**	**61**	**130**	**200**	**263**	**316**	**388**	**388**	**388**	**388**
> Note: All savings reported "at the meter"										

Three quarters of the projected Commercial and Institutional sector savings come from the *Energy Initiatives* program. This program depends upon Hydro-Québec's customers (or their design professionals) developing savings estimates projects for which Hydro-Québec may agree to provide incentives. Hydro-Québec uses an evaluation tool that it has developed to estimate the amount of incentive that will be provided to the customer.

The *Energy Initiatives* program will pay financial incentives the cover a portion of the incremental equipment cost and labor, although it is not clear how these differ between new and existing buildings. The Hydro-Québec budget for these programs reaches $72 million by 2009.

---

[47] HYDRO-QUÉBEC, *R-3526-04, HQ-3, doc. RÉGIE*, p.22-28.

[48] HYDRO-QUÉBEC, *État d'avancement du Plan d'approvisionnement 2002-2011*, October 31st, 2003, p.13.

[49] While Hydro-Québec recently announced proposals to enhance two residential DSM programs (see page 22 above), no such enhancements were proposed for the remaining end-use sectors.

Recent information from Hydro-Québec indicates the HQ buildings program will be discontinued in 2006 and the traffic light program by 2008. Hydro-Québec indicates their buildings have been upgraded and the traffic light program will have succeeded in transforming the market by that date.

- Small and Medium Industry (SMI)

Hydro-Québec's industrial programs – SMI and Large industrial – are essentially the same as the commercial and institutional programs with web-based diagnostic tools for smaller customers and custom incentive initiatives for larger ones. An added demonstration program for large industrial customers helps foster the development of new energy saving processes. These programs, like the C&I programs, stop active GWh acquisition in 2009.

Table 26 shows the savings that come from the programs are small, never over 0.4% of sales in a given year, of which 80% comes from the *Energy Initiatives* effort.

Table 26: Hydro-Québec's Current Proposed SMI and LI Programs: Cumulative Annual GWh Savings

Industrial Plan (GWh/yr)	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
SMI Decision Making Assistance	0	6	12	21	27	32	35	35	35	35
SMI Initiatives	0	5	24	49	72	95	119	119	119	119
Large Industries Demonstration	0	15	42	80	80	80	80	80	80	80
Large Industries Initiatives	0	10	50	100	190	280	335	335	335	335
Total		**36**	**128**	**250**	**370**	**487**	**569**	**569**	**569**	**569**
> Note: All savings reported "at the meter"										

While we present the *large industrial* numbers here, it is important to note that we did not examine these in the course of our work. As such, we have left Hydro-Québec's large industrials programs, costs and projected savings intact.

2) Additional options identified

In answers to interrogatories received on April 2nd, 2004, Hydro-Québec presented revised scenarios with new programmatic options. While Hydro-Québec does not appear to be proposing these options at the current time, we present them here nonetheless.

- Commercial and Institutional (C&I)

In the C&I sector, re- or retro-commissioning and financial aid to small customers are indicated as options for increasing savings, but Hydro-Québec neither provided any detail nor, in fact, chose to propose them. Nonetheless, it is noteworthy that according to the utility, these two programs would, if implemented, provide an additional 190 GWh/yr by 2009. Table 27 summarizes Hydro-Québec's projected results from this enhanced option.

Table 27: Hydro-Québec's Optional Enhanced C&I Portfolio (Non-Proposed) : Cumulative Annual GWh Savings

C&I (non-HQ-proposed) Alternative Plan (GWh/yr)	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Initiatives	0	51	117	182	244	305	367	428	428	428
Diagnostics	0	6	11	17	22	28	33	39	39	39
HQ Buildings	0	3	7	10	10	10	10	10	10	10
Traffic Lights	0	1	10	25	35	40	40	40	40	40
Financial Aid for Small Customers	0	0	5	15	30	50	50	120	120	120
Re-commissioning	0	0	0	10	30	50	70	70	70	70
Total	**0**	**61**	**150**	**259**	**371**	**483**	**570**	**707**	**707**	**707**
> Note: All savings reported "at the meter"										

Also included in the revised plan are a 91% boost in spending and a 32% increase in GWh to the *Energy Initiatives* program.

- Small and Medium Industry (SMI)

Hydro-Québec's alternative scenario also includes enhancements to the SMI sector program portfolio. Specifically, the scenario includes slight increases in the *Energy Initiative* program (this option is also noted for the large industrials sector). Together, the cumulative effect of these additional efforts amounts to less than 0.3% of total industrial sales. Table 28 summarizes Hydro-Québec's projected results from this non-proposed, enhanced option.

Table 28: Hydro-Québec's Optional Enhanced SMI and LI Portfolio (Non-Proposed): Cumulative Annual GWh Savings

Industrial Programs - Other scenario GWh	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
SMI Decision Making Assistance	0	6	12	21	27	32	35	35	35	35
SMI Initiatives	0	5	25	51	76	100	125	150	150	150
Large Industries Demonstration	0	15	42	80	80	80	80	80	80	80
Large Industries Initiatives	0	10	50	100	190	280	335	370	370	370
Total	**0**	**36**	**129**	**252**	**373**	**392**	**575**	**635**	**635**	**635**
> Note: All savings reported "at the meter"										

It is important to recall that while we present these "alternative options", they are not currently proposed by Hydro-Québec.

As can be seen in Table 29, Hydro-Québec's current plan's overall projected efficiency gains for the commercial, institutional and industrial sectors are small when compared to other North American programs devoted to securing maximum cost-effective savings. Even a doubling to account for the "optional", enhanced version would remain small when set in relation to others' efforts.

Table 29: Comparison of Commercial and Industrial Savings as a Percent of Sales

Jurisdiction	Time Period	Avg Annual GWh Savings	Avg Annual GWh Sales	Savings as % of Sales
Québec (HQ)	2003-2010	120	111 501	0,11%
Vermont	2001-2002	19	3 552	0,53%
Connecticut	2001-2002	205	17 957	1,14%
Wisconsin	2002-2003	52	45 201	0,12%
California	2001-2002	870	148 036	0,59%

Caveat: Hydro-Québec data presented *at meter*; others *at generation voltage level*. Understates HQ savings by <10%.

B. Critique of Hydro-Québec's Plan

1) Commercial and Institutional

The greatest single shortcoming in Hydro-Québec's Commercial/Institutional and Small and Medium Industrial programs is their apparent failure to distinguish between lost-opportunity markets such as new construction, and discretionary markets such as early-retirement retrofits. Aggravating this problem is the failure to deploy the full array of proven program strategies to overcome the pervasive market barriers unique to lost-opportunity and retrofit markets. The programs administered by Hydro-Québec partially address two of the most prevalent market barriers, first cost[50], and the lack of information concerning efficient products, but fail to address many others.

Hydro-Québec's commercial programs cannot be considered aggressive when compared to the vast experience in North America with intervention in the C&I markets. The commercial programs consider only the larger customers (smaller customers are left with web-based audit tools) and wait for customers or their agents to bring projects to Hydro-Québec. One of the reasons why our achievable savings analysis reports savings higher than Hydro-Québec's is because their approach is narrower and does not seem to attack all market barriers.

A more detailed discussion of specific critiques of aspects of Hydro-Québec's plan is presented below.

- Barriers

Hydro-Québec's programs do not take into account the full breadth of interacting barriers to efficiency that companies face when considering efficiency investments. Offering companies fixed per-kWh incentives for pre-developed projects may succeed in attracting some retrofit projects but experience elsewhere suggests this strategy is unlikely to garner widespread participation or high market share, especially not in lost-opportunity markets such as new construction, renovation and equipment replacement. Program plans for companies like National Grid Transco, a recognized leader in efficiency programs, indicate the need for a variety of approaches to

[50] First cost differences can be overcome by prescriptive incentive programs that encourage the stocking of efficient equipment by vendors.

properly address the market.[51] Hydro-Québec's strategy assumes the customer has an understanding about energy efficiency and its attributes. Barriers such as availability of the equipment and expertise, vendor motive for stocking the equipment, efficient equipment seen as a business risk, and competing demands for capital investment dollars are not addressed by the program.

- Free Riders

Hydro-Québec's efficiency programs aimed at the retrofit market appear to be targeted to those who already know about and will invest in efficiency measures. While appropriate to a certain extent, limiting the offering to these customers will tend to increase free ridership.[52] As such, the net savings attributable to Hydro-Québec's program may be smaller than Hydro-Québec expects.

- Trade Ally Support

Other utility programs from around North America have spent considerable time and effort convincing trade allies and other market actors to participate in their programs. Vendors must be convinced to adjust the stocking pattern of technologies that will likely experience increased market share. Engineers and architects require training so they can incorporate higher efficiencies into their design; building operators need training on system optimization; and building owners need to understand how to instruct design teams to take advantage of efficiency program intricacies that maximize incentives.

Hydro-Québec makes the statement in its initial program description that "*entrepreneurs, engineering firms and energy management companies will play the role of ambassadors for the program and also work with the customers on energy efficiency projects.*" This statement suggests a lack of understanding regarding market actor motivation. Programs elsewhere spend significant resources training and encouraging engineers to participate, since they do not usually come on board without direct program contact. Even with direct contact, future participation is not guaranteed. To have engineers form the cornerstone of program outreach is not realistic. There is no "magic bullet" or single strategy that will work in all applications aside from encouraging steady forward momentum on all fronts.

- Selling the Program

Hydro-Québec seems to largely expect the C&I market to "come to it". Marketing the program and establishing trust with customers are almost completely relationship-driven through contacts with key decision makers in the design and development communities. Program staff must seek and pursue leads early and aggressively - and sell enthusiastically and convincingly to an often skeptical audience. The market can be seen as a series of individual negotiations. Each negotiation is both complex and unique and each is subject to its own analysis and its own planning process. The best programs - those with years of experience and aggressive and committed staff - continue to struggle to match the program design with the realities of the marketplace. Hydro-Québec speaks little of staff and their customer relationships, yet these are the crux of a successful C&I program. Hydro-Québec will not achieve aggressive savings goals if it is largely counting on its customers becoming informed about energy efficiency on their own.

---

[51] NATIONAL GRID USA, 2004. *2004 Energy Efficiency Plan Massachusetts Electric and Nantucket Electric*. National Grid USA, Westborough, Massachusetts.

[52] Free riders are defined as those customers who take incentives but would have undertaken the efficiency measure without it.

- Customer Participation

Hydro-Québec efficiency program descriptions for the commercial and institutional market offer little detail about how they will encourage customers to enroll in programs. There is no description in program literature about how Hydro-Québec will do the outreach, marketing and advertising required to inform potential program participants the program even exists.

- Role of Energy Service Companies (ESCOs)

Hydro-Québec program incentives are based on overall energy savings of completed projects. This leaves few businesses besides energy service companies (ESCO) with the capability of understanding the market well enough to invest the time and effort needed to pursue the incentives offered by Hydro-Québec. The new construction market is mentioned as one of the targets for the *Energy Initiatives* program, but even where the ESCO community is active, Hydro-Québec has not pursued the new construction market. The amount of money being offered in incentives, and the hurdles that customers must overcome to pursue them, may make even well-established ESCO think twice (see Table 30).

- New Construction Markets

Hydro-Québec's strategies and incentive structures suggest they are only targeting existing buildings, even though new construction is mentioned as a target market. Programs from around North America have found that in order to affect the level of the efficiency in the new construction market, all aspects of the market must be simultaneously targeted. This multi-pronged approach is missing from Hydro-Québec's approach.

- Cream-skimming

Hydro-Québec's *Energy Initiatives* approach ostensibly promotes comprehensiveness, but does little to ensure that approved projects actually are comprehensive. The track record of ESCOs working in conjunction with standard-offer programs like Hydro-Québec's in the U.S. reveals a pattern of "cream-skimming:" ESCOs often pursue only the most cost-effective measures (e.g. lighting), leaving more expensive yet still cost-effective measures undone. The utility reaps inexpensive savings, but at the expense of comprehensiveness. This "cream-skimming" renders the remaining measures economically unviable for years to come.[53]

- Standard Offer Strategy

Hydro-Québec's initiatives for commercial/institutional customers are essentially "Standard Offer" programs. Standard offer programs have been used for years from New Jersey to California. They offer a standard price per kWh of electricity savings. Some standard offer programs offer different prices for savings from different end-uses. The appeal of such programs is that they resemble supply auctions. By offering to pay a specified price per kWh of savings, a utility can assure that it is paying less than it would otherwise pay to acquire supply. It also relieves the utility of the trouble of working directly with customers and other market actors to develop efficiency projects. Energy-service companies and/or customers themselves can take the initiative and present projects ready for review and approval.

---

[53] Take for example, a lighting and HVAC project that offers a three-year payback. If only the one-year payback lighting is upgraded while the five-year payback HVAC is not, the customer is left with an undesirable payback period for the HVAC only, and is disinclined to undertake the project at a future time.

From a planning perspective, standard offer strategies are understandably appealing. However, an increasing body of evidence is pointing to what are, at best, mixed results.

Indeed, evaluations of results in California and New Jersey indicate that standard-offer programs are best suited to retrofit projects among commercial and especially institutional customers.[54] Most savings have resulted from lighting retrofits. These efforts have not generally succeeded in achieving comprehensive savings that span savings opportunities across all facility end-uses. Nor have standard-offer programs succeeded in making substantial inroads to lost-opportunity markets like new construction, remodeling and market-driven equipment replacement. Standard offer programs also have not garnered significant penetration among industrial customers.

The lack of comprehensiveness in standard-offer programs is a consequence of the very design of the programs. To be sure, the savings cost less than supply as programs are designed with a relatively low standard-offer price. This creates an incentive for cream-skimming: project developers have no incentive to invest in savings that cost more than the standard-offer price. The lower the offered price, the wider the gap between what efficiency savings are worth to the utility (avoided costs) and the upper limit on efficiency investment.

Yet solving the problem by raising the offered price shrinks the economic savings available to the utility. All efficiency savings available for less than the cost of the standard-offer price end up as profit to the project. More successful program designs that pay incentives covering most or all the costs of efficiency investments capture a greater share of the difference between cost and value to the utility system.

Standard-offer programs have not succeeded in garnering a significant fraction of lost-opportunity markets. The main reason for this lack of success is that standard-offer strategies do not directly address the unique market barriers associated with time-sensitive lost-opportunity markets. For example, new commercial construction projects already involve a wide variety of complicated transactions between a multitude of market actors. Introducing a new set of transactions into this process is practically doomed to failure from the outset. Bluntly stated, not many time-pressured architects, engineers, and developers can be realistically expected to alter their already-complicated transactions to take on the burdens of participating in the standard-offer initiative. The result is likely to be relatively low market penetration, high free ridership (as mentioned earlier), and little long-term market transformation.

Hydro-Québec's proposed standard offer program in particular offers relatively low incentives (¢/kWh) and, in addition, puts limits on payback and total incentives which serve to make the actual per-kWh investment by Hydro-Québec less that the advertised amount. For the reasons stated above, this is unlikely to result in the depth of savings that well-run programs achieve. Table 30 shows the comparable incentive levels that some other utilities offer. (Note that the only incentives lower than Hydro-Québec's are limited to lower-cost lighting measures.)

---

[54] See George R. EDGAR, Martin KUSHLER and Don SCHULTZ, *Evaluation of Public Service Electric & Gas Company's Standard Offer Program, Final Report*, October 14, 1998. Prepared for Public Service Electric & Gas Company. Also Charles GOLDMAN, J. ETO, R. PRAHL (Prahl and Associates), and J. SCHLEGEL (Schlegel and Associates), *California's Nonresidential Standard Performance Contract Program*, August 1998.

Table 30: Standard-Offer Program Comparisons[55]

Utility	Measures	Annual ¢US/kWh
NYSERDA	Lighting	6
	Motors & other pre-approved measures	10
	Cooling	20
CON ED	Lighting	6
	Motors & other pre-approved measures	10
	Cooling	28.8
LIPA	Comprehensive Mix	15-29
NSTAR – large	Comprehensive Mix	11
NSTAR – small	Comprehensive Mix	24
HQ- C&I	Comprehensive Mix	**~10**
HQ – SMI	Comprehensive Mix	**~7.5**

- Lack of Prescriptive Incentives

Related to the discussion of standard offer strategy and trade ally outreach is Hydro-Québec's decision to exclude prescriptive measures from its program. Prescriptive rebates are often the carrot that utilities use to jump-start fledgling programs with trade allies. Other North American utilities spend up to half of their available incentive pool on such incentives, which in turn provides *more* than half of their energy savings. To exclude prescriptive rebates is to ignore the market actors that they are meant to influence, increasing the cost per kWh and/or reducing savings.

2) Small and Medium Industrials (SMI)

Hydro-Québec's approach to and expectations for the industrial sector suffers from many of the same basic shortcomings found in the commercial sector. Although Hydro-Québec's projections of electricity savings are reasonable, our analysis indicates that savings expectations are probably overly optimistic given limitations in the proposed program strategies. While the level of projected GWh savings is plausible, we do not believe the method or allocated spending for procuring the savings is sufficient. Therefore, the costs associated with realizing Hydro-Québec's projected savings are likely to be higher than budgeted. Again, Hydro-Québec relies too much on market forces to find and implement the efficiency measures required to meet program goals.

While it is certainly reasonable to expect an active ESCO market for large industrial customers, the offering of $0.10 for the first year kWh saved. Standard offer program payouts in other parts of North America can be seen in Table 30 in US dollars. The incentive level at which Hydro-Québec is willing to pay will likely result in lighting and some motor measures, but not comprehensiveness.

---

[55] For New York programs, see http://www.coned.com/sales/business/bus_energy_manage.htm; www.NYSERDA.org; www.LIPOWER.org; and NSTAR – 2004 Energy Efficiency Plan Feb 2004. Hydro-Québec's incentives are stated in U.S. dollars.

C. Approach to C&I and SMI Analysis

Only with proper design and implementation can energy efficiency programs achieve maximum potential. Correctly designed programs identify market barriers and implement individual strategies to overcome them.

Barriers exist at all levels, from manufacturers to end-users. Understanding these barriers and developing integrated strategies for overcoming them is the hallmark of successful programs investing in business customer electric energy resources.

The analysis for this report combines a tremendous amount of research and experience in North American efficiency markets. The technologies suggested are neither exotic nor risky, although more efficient technologies are often more expensive. As a result, these are often not first and foremost in the minds of the designers and specifiers, nor are high-efficiency technologies necessarily sitting on the shelves of the local vendor.

1) Overcoming Market Barriers

The commercial and industrial market has specific barriers to the consideration of energy efficiency in the construction and renovation of commercial buildings and in the replacement of existing equipment. The following list addresses the most widely-recognized market barriers with a brief explanation of how they impede efficiency investment:

- *The pressure of time:* The controlling factor on many construction projects is time, as measured by a construction schedule aimed towards an occupancy date. This pressure creates a tremendous bias in favor of the known technology, the tried-and-true building design and the conventional lighting configuration.

- *Higher First Cost:* While not always the case, there is a perception that energy efficient measures are more costly than conventional ones. When it is the case, as discussed below, first cost almost always dominates the decision criteria.

- *Lack of Information and High Search and Verification Costs*: Lack of clear, unbiased information about the costs, savings and reliability of energy efficient equipment and design techniques is a major issue for professionals designing new buildings and building managers seeking replacement equipment. Customers have difficulty identifying reliable technologies and contractors to properly install them, and have in the past often looked to their regulated utility and to public programs for unbiased guidance in this area.

- *Uncertainty About Performance of Complex, Unfamiliar Technologies:* Energy consumption is a peripheral concern to all but the largest and most energy-intense industrial customers or very large commercial enterprises, such as restaurant chains or large owner-managed property developers. The average customer is understandably reluctant to risk application of unfamiliar technologies in an area that accounts for a relatively small share of their enterprise costs.

- *Product Unavailability:* Manufacturers are reluctant to develop, and distributors are reluctant to stock, high efficiency equipment if demand is uncertain and competition remains first-cost based. This limitation maintains the situation of low sales volumes, perpetuates the cost difference between standard and premium equipment and affirms client reluctance to specify a product that may not be available when needed.

- *Misplaced or split Incentives*: The innate structure of the commercial real estate development market, which places a first-cost pressure on designers and equipment specifiers, will continue to give highest consideration to the initial installation cost of efficiency measures and design features in new construction. Subsequent “building consumers” - owners and tenants, - will continue to bear higher life-cycle energy costs as a result. The split incentive in this market is not unlike that in the residential rental markets.

- *Unfamiliar energy options are seen as potential business risks that far exceed the prospects of energy savings:* Energy savings options often involve energy-consuming devices that are central to business profitability, customer comfort, or worker productivity. For example, lighting usually represents the largest share of the electric bill in offices, professional buildings and retail outlets. But lighting can also greatly impact product presentation (as in a clothing store), patient mood (as in a doctor or dentist’s office) or overall efficiency in an office environment.

The prevalence of market barriers to efficiency investment is widely recognized among administrators of large-scale efficiency investment programs and the utility regulators who oversee them in the United States. A market barrier is any condition or circumstance that restrains minimization of total social costs of delivering energy service. In utility resource planning, costs experienced by customers can be reduced or eliminated through market intervention.

Economic theory holds that true social costs include only those input requirements for providing a given quantity of service that cannot be reduced. If it cost a utility $0.02/kWh to install a lighting measure, and customers $0.20/kWh when doing this on their own, the true social cost is still $0.02/kWh.[56]

Many of the most formidable market barriers to energy efficiency depend on the requirement that organizations and individuals obtain information, plan procedures, take risks and raise their own capital to substitute energy efficiency for energy consumption. Utilities provide those services for their customers on the supply side. The real test of whether an impediment to energy efficiency investment qualifies as a true market barrier is to discern whether market intervention can eliminate it. When utilities provide services on the demand side equivalent to those that they provide on the supply, many market barriers disappear. Well-designed programs attack these barriers on all levels to fundamentally change the market both immediately and over time.

2) Commercial and Industrial Markets Analyzed

A conservation market segment refers to a particular type of decision-making within the two broad types of markets—the lost-opportunity market and the discretionary retrofit market.

The lost-opportunity market comprises the following three market segments:

1. New construction and expansion;
2. Replacement of existing equipment when it fails or reaches the end of its useful life; and
3. Remodeling, renovation or rehabilitation unrelated to energy efficiency.

---

[56] KRAUSE, FLORENTIN and Joseph ETO. *The Demand Side: Conceptual and Methodological Issues, vol. 2 of the Least-Cost Utility Planning: A Handbook for the Public Utility Commissioners*. Washington, DC: National Association of Regulatory Utility Commissioners, 1988.

Retrofit markets, which involve discretionary decisions made solely for the purpose of improving energy efficiency, encompass two additional market segments:

1. Addition of supplemental measures, including equipment or material absent from an existing building or process (e.g. insulation); and
2. Early retirement of still-functioning but inefficient equipment.

For the purposes of our analysis, we've divided the commercial market into three segments, as follows: **(1) new construction, (2) retrofit**, **(3) renovation** and **(4) remodel and replacement.** By far the largest sector is the retrofit sector, especially medium-sized customers.

- New Construction and Renovation Markets

There is a market-driven opportunity to achieve energy efficiency and transform design and equipment specification practices at minimal cost when new commercial buildings are designed and constructed, and when existing ones are renovated or expanded. Utility programs that successfully establish relationships with, and gain the respect of, the building design and construction communities are well-positioned to provide timely design and analytic assistance, as well as incentives for measures or design options which exceed local common practice, often at little incremental equipment cost if the intervention can take place early enough in the design process. Programs that have been in operation for a number of years have had demonstrable success in upgrading standard equipment specifications and design practices in their jurisdictions (as confirmed by program evaluations throughout North America). This change in common practice establishes a rationale and platform to upgrade building energy codes to ratify and lock-in the gains facilitated by utility programs. Periodic energy code updates in New York, Massachusetts and Vermont have made some of the incentives offered in those states obsolete. When codes change, utility program efforts can target more emerging technologies continuing the upward trend toward more and more efficient equipment and design.

The best utility programs combine sophisticated assistance to the owner's design team with incentives, both delivered in a manner and on a schedule that fits within, and complements, the overall project timeline. Program options include a comprehensive approach to the building design, if the owner is reached early enough in the design stage, or a more prescriptive approach that captures efficiencies once the design or building process is underway. The former has presented a wider range of design options than the latter, which looks more at equipment upgrades.

At the beginning of the design process, when a proposed building is still in the concept stage, a wealth of opportunities exists to significantly reduce its lifetime energy operating costs. Buildings can be designed and oriented to take advantage of natural energy gains and losses, daylighting, site contours and vegetation, etc., as well as the full array of high efficiency equipment options. The further the building progresses into design, the more the fundamental design choices regarding energy efficiency are irreversible, or changeable only at considerable expense. In the later stages of design, choices must, of necessity, focus on equipment substitutions where higher efficiency measures can be easily substituted for their conventional counterparts.

- Remodel/Replacement Market

Building remodeling is in some respects similar to new construction, involving many of the same market participants and activities. Changes are being made within an existing facility, typically in the commercial office and retail sectors, to accommodate new tenants or to update physical layout and appearance. Energy savings opportunities that arise in these situations are primarily in the areas of lighting and HVAC. The primary audiences to influence in a remodel situation are the building owner/manager and the fit-up or renovation contractor in his employ. Designers and engineers are seldom involved in remodel projects. For the same reasons as in new construction standard practice design and standard efficiency equipment are the norm. Therefore, as discussed with the new construction/renovation market, the best opportunity to implement efficiency measures is at the beginning of the design stage.

The replacement of energy-using equipment is a market-driven event that occurs in cycles according to the lives of the equipment installed. Once equipment is purchased and installed, it is unlikely to be modified until its useful life expires. Thus, it is critical to address efficiency opportunities at the time of equipment selection and installation.

In the overall commercial and industrial market, HVAC equipment enjoys a large market share and often represents as much as 40% of the total electric consumption of a facility. Intervening in the decision process and upgrading HVAC equipment to a higher Energy Efficient Rating (EER) level, can create savings lasting fifteen years. If the opportunity to upgrade equipment is lost, there may not be another one for fifteen years.

- Retrofit Market

Market-driven/lost opportunity programs have the potential to permanently transform markets, thereby ensuring the capture of durable and widespread savings at relatively low cost. However, the vast majority of current and near-future electric consumption and savings potential is found in existing buildings and equipment. While many smaller commercial facilities are regularly renovated or remodeled, most are not. In addition, most remodels are performed for cosmetic or functional reasons, and often leave much of the energy consuming equipment in place. Compounding this situation, the level of efficiency of in-place mechanical and electrical equipment is often substantially below not only new *high efficiency* equipment, but also new *standard* equipment.

Large businesses are targets of many utility programs and rightly so. They are influential and their needs are a major concern of the utility staff. The top 10% largest C&I customer accounts can account for 30% to 40 % of overall sector load. However, large businesses are not the only resource for potential savings. Large businesses possess the resources and expertise to evaluate and implement efficiency projects. Small and medium industrials also represent a significant efficiency potential but do not have the wherewithal to research, finance and implement even simple projects.

Numerous barriers exist that prevent smaller business customers from pursuing energy efficiency on their own. Barriers including limited access to capital and an inability to devote the necessary time and expertise to identify opportunities and managing installations often prevent participation in utility programs geared toward larger or more generalized C&I markets. Because smaller C&I customers generally face high transaction costs for efficiency projects and limited savings potential, they are not targeted by most energy service companies. Utilities often ignore these smaller businesses because of the transaction costs. However, since most jobs are created by small business, helping this part of the market pays disproportionately large economic development dividends.

3) Efficiency Potential Analysis Approach

This report has two scenarios. The first is the unconstrained, maximum achievable energy efficiency potential for Hydro-Québec's territory. The second analysis, called "budget constrained", assumes the same maximum potential for the new construction, renovation and remodel/replacement markets but reduces the costs – and therefore penetration rates and savings – in the single largest sector: retrofit [57]. Both analyses present efficiency potential in terms of electric energy, i.e., gigawatt-hours (GWh) and peak capacity, i.e. megawatts (MW). The economic and achievable potential estimates are all subsets of, and derived from, the universe of technical potential for electricity savings from efficiency technologies.

The analysis used in this research examined thousands of efficiency applications to different buildings, industries, and markets.

Table 31 indicates the number of efficiency technologies and practices analyzed in the commercial and industrial sectors. It also shows the different markets in each sector to which these technologies and practices were applied, along with the end uses and market segments covered in the potential analysis.

In the commercial sector, for example, the study examined 87 technologies and practices applicable to nine end-use categories in four markets involving nine building types. Thus, the commercial efficiency potential analysis dealt with 2,163 technology and practice applications.

Table 31: Technologies and Practices Examined in the Efficiency Potential Analysis

	COMMERCIAL & INSTITUTIONAL (C&I)	SMALL AND MEDIUM INDUSTRIAL (SMI)
Number of Technologies	**87**	**39**
Markets	New construction	New construction
	Renovation	Process overhaul/Replacement
	Remodel/Replacement	Retrofit
	Retrofit	
End Uses	Cooling	Motor systems
	Exterior lighting	Lighting
	Interior lighting	HVAC
	Office equipment	Industry-specific processes
	Refrigeration	
	Space heating	
	Water heating	
	Whole building	
	Miscellaneous	
Market segments	**9 building types:**	**4 SMI sectors:**
	Education	Manufacturing
	Grocery	Mining
	Health	Construction
	Lodging	
	Office	
	Restaurant	22 specific industries
	Retail	
	Warehouse	
	Other	

[57] We assume a 50% reduction in offered incentive (100% of installed cost to 50% of installed cost) which results in a 70% reduction savings and 85% reduction in costs.

Starting with an Excel-based spreadsheet initially assembled for analysis done for NYSERDA[58], Québec data were disaggregated by building type and end-use and entered into the model. Growth rates from Hydro-Québec projections were used to show how sales increased over time. The resulting analysis uses a combination of Québec data[59] and NY State building data to calculate achievable potential estimates for Hydro-Québec's territory. The two territories differ in many respects. The prevalence of electric heat in Québec and cooling load in New York are among the most significant differences. For analytical purposes, the most important effect of these differences in the C&I and SMI markets would be to transfer more savings from cooling to heating loads.

The analysis considers only technologies and practices that currently exist or are anticipated to be available by 2012. Innovative technologies and practices continually emerge, and such new technologies and practices not considered here will create additional future savings opportunities.[60]

For the purposes of this analysis we are assuming free-ridership numbers are net of free drivers. Free drivership is the opposite of free-ridership, in that it refers to savings from energy efficiency measures installed outside of, but because of, the program, (e.g. businesses that buy high efficiency light bulbs without applying for rebates.) Table 32 lists the free-ridership rates used in the analysis.

Table 32: Assumed Free-Ridership Rates (net of Free Drivers)

Market Sector	Unconstrained (Max Achievable) Scenario	Budget Constrained Scenario
New construction **Renovation** **Remodel / replacement**	25%	
Retrofits	3%	10%

---

[58] OPTIMAL ENERGY, Inc., AMERICAN COUNCIL FOR AN ENERGY-EFFICIENT ECONOMY, VERMONT ENERGY INVESTMENT CORPORATION and CHRISTINE T. DONOVAN ASSOCIATES, *Energy Efficiency and Renewable Energy Resource Development Potential In New York State.* Prepared for New York State Research and Development Authority (NYSERDA), Final Report. August 2003.

[59] NATURAL RESOURCES CANADA, Office of Energy Efficiency, Commercial/Institutional Sector, Québec, Secondary Energy Use and GHG Emissions by Energy Source, Historical Database – February 2003.

[60] More information on the approach that was taken can be read in OPTIMAL ENERGY, Inc., AMERICAN COUNCIL FOR AN ENERGY-EFFICIENT ECONOMY, VERMONT ENERGY INVESTMENT CORPORATION and CHRISTINE T. DONOVAN ASSOCIATES, *Energy Efficiency and Renewable Energy Resource Development Potential In New York State.* Prepared for New York State Research and Development Authority (NYSERDA), Final Report. August 2003.

D. Achievable C&I and SMI DSM Savings

1) Introduction: successful program strategies

The commercial, institutional and small and mid-sized industrial markets discussed here share several common characteristics that set them apart from residential markets. The C&I and SMI markets are almost completely relationship-driven through contacts with key decision makers in the design and development communities. The residential market, by contrast, can be influenced through mass-market advertising. Program staff must seek out and pursue leads early and aggressively and sell enthusiastically and convincingly to an often-skeptical audience. Each deal is both complex and unique, and each is subject to its own analysis and its own negotiation process. The best programs, those with years of experience and aggressive and committed staff, continue to struggle to match the vision of how the utility program should work within the ever-changing realities of the marketplace. Hydro-Québec is attempting to be successful in these same markets.

All successful programs have several components in common:

- Dedicated trained staff – both internal and external;
- Marketing support;
- Properly designed incentives; and
- Appropriate minimum efficiency requirements linked to reasonable estimates of efficiency baselines.

These critical success factors are borne out by program experience among leading utilities in North America, both in the US and Canada. For example, BC Hydro notes that to administer its programs effectively a significant amount of internal labor is required in the long and intense, mostly face-to-face sales process. The technical aspects of projects need to be approved, but as importantly, the savings must be verified from established baselines. Having enough internal staff to undertake the process of selling the program attributes is important. Staff may be internal to the organization or consultants to provide additional specific expertise where needed.

Ideal programs begin their early entry in the market with prescriptive measure incentives aimed at stimulating demand for efficient technologies in the marketplace. Prescriptive measures are a recognized set of readily applicable efficiency technologies that customers can purchase to upgrade the level of efficiency of everyday purchases. Instead of replacing a burned-out T-12 fixture, a standard incentive is available based on the cost differential between the T-12 fixture and its more efficient replacement, the T-8. The customer can buy the more efficient technology without the cost premium. No pre-approval is necessary. The fixture is purchased, the form filled out and the incentive is sent.

Marketing the program to trade allies informs future program partners about the necessary steps to participate. The vendors and manufacturers respond by bringing equipment that meets the program requirements into the distribution channels. As program marketing efforts begin to influence the various decision makers responsible for specifying and designing energy efficiency into buildings, the equipment is more readily available. The process of educating and training the market actors responsible for energy related purchase and design decisions is ongoing and thorough. Continued intervention in the market with incentives aimed further and further up the chain of distribution begins to transform the marketplace perception of energy efficient design and practice. The ideal incentive is paid to the manufacturer who then responds by making only efficient stock available to the end-user.

2) C&I New construction

Our proposed C&I New Construction program would be based on successful initiatives promoting the installation of comprehensive efficiency measures with a systems approach that capitalizes on interactions between technologies across multiple end-uses. For example, the program would encourage buildings to be “commissioned” to ensure that lighting, HVAC and other systems perform according to the intended design.

An aggressive effort in this market will structure customized financial incentives to offset as much as the full incremental installed costs for the optimal package of cost-effective measures. It will also provide incentives or direct payment to cover the full cost of design assistance and commissioning, where appropriate.

Specifically, the C&I New Construction initiative would pay the full incremental design cost associated with efficiency measures incurred by the customer’s design team to ensure that efficiency options are fully addressed during the design stage. At the customer’s option, and to maintain quality control, the program could also facilitate and manage design services using a third party subcontractor. This would include, where appropriate, full interactive simulation modeling to account for measure and system interactions and develop comprehensive design solutions.

- Efficiency technologies addressed

Measures designed to address efficiency opportunities in new buildings include:

> Improved interior lighting equipment, controls and design; including high efficiency fluorescent fixtures, and pulse start metal halide
> Heating, ventilating and air conditioning (HVAC) equipment and controls including:
  - high efficiency window and central air conditioning units
  - air and water source heat pumps, chillers
  - optimization of HVAC distribution and control systems
  - energy management systems; and stove hoods
> Hot water equipment efficiency upgrades and fuel choice.
> High performance window glazing
> High efficiency clothes washers
> High efficiency refrigeration equipment
> Integrated building design
> Whole building commissioning

Our analysis of the costs and savings of deploying this program in Hydro-Québec’s territory is presented in Table 33 below. As can be seen, we estimate savings to reach 68 GWh/yr by 2010 and 115 GWh by 2012.

Table 33: New Construction Program: Cumulative Annual Savings and Cost

Commercial New Construction	2005	2006	2007	2008	2009	2010	2011	2012
Cumulative Annual GWh	1	18	27	44	51	68	93	115
Cumulative Annual Winter Peak MW Savings	0.2	2.5	3.7	5.9	7.0	9.2	12.6	15.5
Cumulative Annual Summer Peak MW Savings	0.4	5.7	8.4	13.7	16.1	21.2	29.1	36.1
Incremental Program Costs & Incentives (K Real 2004$)	$ 1,667	$ 23,505	$ 12,523	$ 23,828	$ 11,200	$ 23,480	$ 36,748	$ 32,536

Key assumptions underling the analysis results shown in Table 33 include:

- New construction is 90% of all new growth. If growth is flat, new construction is held at 0.25% of new sales and the existing load shrinks. This explains some of the fluctuation in yearly energy savings and spending.

- NY State code (IECC 2001, including ASHRAE/IESNA 90.1-1999) is the baseline for new construction and new equipment purchases.

- Measure costs were developed and then administrative adders were applied as a proxy for the costs of running the program. For example, we applied a 100% administration cost adder to New construction costs.

- 100% of incremental cost paid by program.

Table 34 lists the penetration rates used for the analysis. Note that penetrations are applied only to opportunities above the baseline.[61]

Table 34: Unconstrained (Maximum Achievable) Penetration Assumptions

	2005	2006	2007	2008	2009	2010	2011	2012
MD1	5%	19%	33%	46%	60%	62%	64%	66%
MD2	2%	9%	16%	23%	30%	32%	34%	36%
MD3	0%	0%	0%	0%	0%	0%	0%	0%
RET1	1%	7%	12%	18%	23%	30%	38%	45%
RET2	0.5%	3%	6%	9%	12%	18%	23%	29%
RET3	0%	0%	0%	0%	0%	0%	0%	0%

Notes: *MD = Market-driven (new construction, renovation, replacement/remodel).*
RET = Retrofit.
1,2,3 refer to the level of difficulty in capturing savings or the complexity of the measure.

3) C&I Existing Customers

The initiative targeting existing customer facilities would promote high-efficiency, discretionary retrofit opportunities and equipment replacement at the time these events naturally occur, such as equipment replacement upon failure, and activities related to building remodeling and renovation. As with new construction efforts, financial incentives would be designed to cover the full incremental installed costs of efficient measures (i.e., the full labor and equipment installation costs and the incremental labor and equipment costs associated with replacement).

In the case of retrofits in particular (where the bulk of savings opportunities lies), we have developed two scenarios: the unconstrained scenario, in which the program would cover the full incremental costs for projects requiring redesign of existing facilities, and the “Budget constrained” scenario, in which half of such costs would be covered. At the customer’s option, the initiative would reimburse costs related to extra efforts undertaken by the customer’s designers/vendors; added project facilitation and/or design management; the procurement of additional technical assistance, or engaging retrocommissioning and commissioning services.

---

[61] These rates are based on the team’s professional judgment, in consideration of historical program penetrations.

Initiative staff or subcontractors would provide services as appropriate if competitive solicitations are unsuccessful.

- Efficiency technologies addressed

Measures would comprehensively address efficiency opportunities in existing buildings, including retrofit, renovation and remodel/replacement situations, such as

> Improved interior and traffic lighting equipment, controls and design including:
- high efficiency fluorescent lamps
- ballasts
- reflectors and fixtures
- pulse start and high efficiency metal halides

> Heating, ventilating and air conditioning (HVAC) equipment and controls including:
- high efficiency window and central air conditioning units
- air and water source heat pumps
- chillers
- optimization of HVAC distribution and control systems
- energy management systems
- stove hoods

> Hot water equipment efficiency upgrades including fuel choice
> High performance window glazing
> Appliances, including high efficiency clothes washers and vending machine “miser” control
> High efficiency refrigeration equipment
> Retrocommissioning and commissioning of buildings

While all building types and electrical efficiency opportunities would be eligible for inclusion in the initiative, specific target markets could be addressed to achieve rapid and significant savings, particularly winter coincident peak impacts. These markets include: hospitals, schools and colleges, groceries and other refrigeration users, water and wastewater treatment facilities, and customers with high levels of cooling/heating energy intensity.

Our analysis finds a very large potential for energy efficiency in existing buildings in Hydro-Québec territory. This is consistent with potential studies done is other parts of North America and with reports of program accomplishments published by the Northwest Energy efficiency Alliance on retrocommissioning.[62] The following three sections show the achievable potential for the C&I existing building market broken down by market segment.

- C&I Retrofit

Retrofit opportunities are by far the largest source of efficiency savings in the C&I sector. Existing buildings represent a vast field of efficiency opportunities waiting to be captured. We analyze both the maximum achievable (or “unconstrained”, see Table 35) and “budget constrained” (Table 36) savings potential of the retrofit market.

The “budget constrained” scenario contained in Table 36 analyzes the effect on potential when program incentives are reduced from 100% of installed cost (the unconstrained scenario) to 50%. It is important to note that the supply curve for efficiency in this sector is not linear. In order to achieve the maximum potential, creating incentives to entice the last stubborn customers,

[62] NORTHWEST ENERGY EFFICIENCY ALLIANCE, *Commissioning in Public Buildings*, Report Number E03-107, February 14, 2003, see http://www.nwalliance.org/resources/reportdetail.asp?RID=112.

incremental cost spending must be at its peak. We estimate that by reducing the incentive, and thus participation, to only cover 50% of the installed cost, savings will drop by 70%, incentives will drop by 85%, and the non-incentive portion of the budget will drop by 55%.

In the maximum achievable scenario, we assume 80% of medium to large customers who receive 100% of the project cost will complete the project.[63] Small customers, on the other hand, may need even more of an incentive to participate such as direct installation.

For small customers, the initiative would facilitate direct installation of all retrofit measures, either by using a network of private contractors solicited to develop and manage measure installations or by allowing customers to rely on their own contractors with construction management assistance from program technical staff. The initiative would cover all construction management and project facilitation costs and also underwrite all technical and design assistance for retrofit and replacement measures. In the "budget constrained" scenario, this group would also experience a sharp drop-off in program participation.

Table 35: New Retrofit Program: Cumulative Annual Savings and Cost (Unconstrained)

Commercial Retrofit	2005	2006	2007	2008	2009	2010	2011	2012
Cumulative Annual GWh	89	588	1,080	1,562	2,034	2,760	3,478	4,188
Cumulative Annual Winter Peak MW Savings	11.5	76.4	140.4	203.2	264.6	359.7	453.9	547.0
Cumulative Annual Summer Peak MW Savings	21.7	143.4	263.7	381.6	496.6	669.8	840.2	1,007.6
Incremental Program Costs & Incentives (K Real 2004$)	$ 76,558	$ 429,704	$ 453,691	$ 418,036	$ 406,728	$ 604,384	$ 593,411	$ 581,771

Table 36: New Retrofit Program: Cumulative Annual Savings and Cost (Budget-Constrained Scenario)

Commercial Retrofit	2005	2006	2007	2008	2009	2010	2011	2012
Cumulative Annual GWh	26.6	176.3	324.0	468.6	610.1	827.9	1,043.5	1,256.4
Cumulative Annual Winter Peak MW Savings	3.5	22.9	42.1	61.0	79.4	107.9	136.2	164.1
Cumulative Annual Summer Peak MW Savings	6.5	43.0	79.1	114.5	149.0	200.9	252.1	302.3
Incremental Program Costs & Incentives (K Real 2004$)	$ 15,606	$ 87,591	$ 86,636	$ 85,213	$ 82,908	$ 123,198	$ 120,961	$ 118,589

The "unconstrained" scenario represents massive energy efficiency expenditures, far beyond what any other region has undertaken. This is normal, in that most North American studies observe potential savings far beyond available resources. As such, the unconstrained scenario is only indicative of the achievable opportunities that exist. The "budget constrained" scenario, however, is indicative of what a leading-edge region such as Québec may wish to undertake.

- C&I Renovation

2012 cumulative energy savings from renovation makes up 13% of the commercial and institutional markets analyzed.

Renovation, as defined in this report, is the process of rehabilitating at least three of the major systems in a facility such as lighting, HVAC, shell and refrigeration. Renovation is a harder market to capture because, like new construction, the depth of savings achieved is often dependent on how early one can intervene in the process of design.

Nonetheless, we have found significant opportunity for savings in the renovation markets analyzed, as indicated in Table 37 below.

---

[63] MOSENTHAL, P. and M. WICKENDEN, *The Relationship Between Financial Incentives and Measure Adoption in the Small C&I Retrofit Market*, Proceedings of the ACEEE Summer Study, 2000.

Table 37: New Renovation Program: Cumulative Annual Savings and Cost

Commercial Renovation	2005	2006	2007	2008	2009	2010	2011	2012
Cumulative Annual GWh	14	71	165	292	443	592	735	870
Cumulative Annual Winter Peak MW Savings	2.1	10.3	23.9	42.2	64.1	85.6	106.3	125.9
Cumulative Annual Summer Peak MW Savings	5.1	25.6	59.4	105.1	159.3	212.7	263.6	311.7
Incremental Program Costs & Incentives (K Real 2004$)	$ 9,039	$ 36,936	$ 61,849	$ 84,367	$ 101,590	$ 101,146	$ 97,663	$ 93,354

- C&I Replacement/Remodel

Replacement and remodel are handled together because they are market driven events. Replacement refers to what happens when the piece of equipment has failed and needs replacement; remodel refers to when a commercial space changes hands and is refit. This process usually involves lighting and maybe some HVAC redistribution but is not as thorough in its replacement of systems.

This market is very hard to affect change, which is reflected in the relatively small savings attributed to it. Table 38 shows the potential from these two markets combined.

Table 38: New Replacement/Remodel Program: Cumulative Annual Savings and Cost

Commercial Replacement/Remodel	2005	2006	2007	2008	2009	2010	2011	2012
Cumulative Annual GWh	26	129	297	523	791	1,056	1,312	1,556
Cumulative Annual Winter Peak MW Savings	3.5	17.0	39.3	69.2	104.9	140.1	174.1	206.6
Cumulative Annual Summer Peak MW Savings	7.5	36.1	83.0	145.6	220.1	292.9	362.2	427.6
Incremental Program Costs & Incentives (K Real 2004$)	$ 159	$ 1	$ 1,042	$ 1,411	$ 1,698	$ 1,673	$ 1,603	$ 1,520

All of these existing building markets – retrofit, renovation and replacement/remodel – are premised on key assumptions including:

- Administrative adder for the replacement market is 25% and retrofit is 15%;
- Retrofit baseline penetration of efficient measures is assumed to be 0%;
- Existing market growth is 10% of new sales unless growth is flat. In cases where growth is flat, new construction is still occurring, thus existing sales can be negative.; and
- 100% of installed cost included in program spending.

4) SMI All Customers

The industrial analysis for this report reviews the small and medium sized industrial customer classes (SMI). Large industrial customers were not analyzed because of the specific nature of measures, mostly process, that are applicable. The potential analysis done for Hydro-Québec by CIMA reflects the inherent difficulty in ascertaining the potential for large businesses.[64] We did not attempt to examine this analysis and Hydro-Québec's savings and spending assumptions in this area, and thus assume they are correct.

- Understanding the SMI market

Market barriers to efficiency investment in the small and medium industrial sector are even more acute and problematic than those impeding efficiency investments in the commercial sector. Accordingly, program strategies to overcome market barriers to efficiency investment by industrial

---

[64] CIMA, *Identification du potentiel d'amélioration de l'efficacité énergétique en grande entreprise* : *Rapport d'étude*, November 26, 2002.

customers closely resemble approaches that have succeeded among the commercial customers. Highlights of major differences between industrial and commercial market barriers include:

- Industrial customers use even shorter payback periods than do commercial customers on average;
- Electricity makes up an even smaller portion of business expense than it does in the commercial sector;
- Business cycles for capital investment are more complex; and
- Process driven savings require staff expertise and experience to reduce customer perception of risk to business profitability. Owners often are not willing to risk changes to process for the sake of efficiency unless they are very comfortable with the new technology.

Like the commercial sector, the industrial sector needs prompting to realize significant increases in the level of energy efficiency. The same market barriers that affect commercial businesses persist in the industrial sector. Barriers to industrial markets go farther into areas of competitiveness and even international protocols that inhibit pricing flexibility. Market strategies for intervention include working with trade allies and other market actors, providing incentives for technical expertise and industrial design, as well as for technologies. The technologies included in industrial applications include:

- Sensors and Controls
- Energy Management Systems
- Membrane Technology Wastewater
- Advanced Industrial HVAC
- Energy Information Systems
- Efficient Transformers (Tier 1)
- Efficient Transformers (Tier 2)
- Duct/Pipe Insulation
- Heat Recovery Food Industry - Low Temperature
- Cooling and Storage
- Electric Supply System Improvements
- Microwave Processing
- Radio Frequency (RF) Heating and Drying
- Efficient Lighting Design -- Office
- Efficient Lighting Design -- Manufacturing
- Efficient Lighting Design -- Warehouse
- Efficient Lighting Fixtures and Lamps -- Office
- Efficient Lighting Fixtures and Lamps -- Manufacturing
- Efficient Lighting Fixtures and Lamps -- Warehouse
- Advanced Motor Designs
- Motor Management
- Advanced Lubricants
- Motor System Optimization
- Compressed Air System Management
- Air Compressor Systems Advanced Controls
- Pump Efficiency Improvement
- Fan system Efficiency
- Efficient Cell Retrofit Designs

- Advanced Forming/Near Net Shape Technology
- Liquid membrane Technologies-Chemicals
- Gas Membrane Technologies-Chemicals
- Advanced Cleanroom HVAC (Electronics)
- Advanced Cleanroom HVAC (Pharmaceuticals)
- Membrane Technology -- Food Industry
- Freeze Concentration
- Efficient Refrigeration Systems
- Ultraviolet (UV) Curing
- Electric Infrared (IR) Heating and Drying
- Optimization of Aeration Systems

Attitudes and behavior among buyers and sellers of efficiency technologies in the industrial sector are also susceptible to permanent change due to market transformation strategies. Targeting market barriers on a sustained basis from as many directions as possible is essential. Most of the energy manager training and educational opportunities mentioned in the Commercial and Institutional section above apply in this sector as well.

Incentives offered to the industrial sector must be large enough to attract the attention of businesses that are inundated with proposals to save money. Since energy makes up such a small a portion of overall expenses, incentive packages must include options for industry-specific technical expertise and turn-key implementation, removing the barrier of resources including staff time and energy issue expertise and risk. Buying down an industrial efficiency project to a one-year payback can often make all the difference in the project's likelihood of completion. In this case, customer investment can be financed out of the operating budget, often under the direct control of the facility management. Covering longer-term paybacks often require approval by corporate finance. Ultimate approval of efficiency projects with payback periods beyond one year can be problematic, since they are in competition with other capital investment opportunities seen as essential to the core business of the customer.

- Our SMI Initiative

The small to medium industrial sector programs differ from the commercial sector in one key respect – the program is not broken out into separate markets. Industrial programs are driven by the market events that occur when industrial businesses decide to upgrade, build, replace or retrofit their facilities or process lines. An industrial business determines when a DSM program is appropriate not vice-versa. It is the job of the DSM program staff to have the relationships in place with customers and market infrastructure - trade allies and other market actors – to take advantage of this customer-driven market event. For this reason, it is important to organize the program approach from the customer perspective rather than the market perspective.

Program experience from elsewhere suggests a successful program puts an emphasis on staff development and technical expertise. The best programs will provide continuous outreach to customers and trade allies much like the C&I programs, and in fact, many industrial programs share staff with CI&I programs. Trade ally development, marketing and direct mail are strategies that have similar appeal to C&I and industrial customers.

Industrial customers generally require more technical expertise from program staff and consultants. In order for Hydro-Québec to introduce a strong SMI program, it has to spend the time and effort on the right staff and consultant resources.

The analysis of the SMI industrial market for Québec assumes a moderate participation in replacement, remodel and retrofit markets with less participation in new construction. Industrial new construction markets have been very hard to break into for many North American DSM programs due to business cycle timing, lack of applicable technical expertise from program staff and proprietary design processes.

The results from our industrial analysis are shown in Table 39. In our experience, market penetrations are harder to achieve, and thus lower than in the commercial sector, resulting in significantly lower savings from a given industrial population.

Table 39: New SMI Program: Cumulative Annual Savings and Cost

SMI	2005	2006	2007	2008	2009	2010	2011	2012
Cumulative Annual GWh	6	17	28	44	61	78	94	111
Cumulative Annual Winter Peak MW Savings	0.8	3.4	7.6	14.4	23.7	35.5	49.9	66.8
Cumulative Annual Summer Peak MW Savings	0.8	3.6	8.1	15.0	24.6	36.6	51.2	68.3
Incremental Program Costs & Incentives (K Real 2004$)	$ 1,125	$ 1,501	$ 1,470	$ 1,930	$ 1,890	$ 1,454	$ 1,424	$ 1,395

Key assumptions underling the analysis results shown in Table 39 include:

- Administrative adder for industrial sector is 15%;
- Program assumes measures cost bought down to one-year payback (average measure starts out at 2 years – 50% cost share); and
- Financing is also used to achieve buy-down.

E. Summary of Achievable C&I and SMI DSM Savings (Constrained and Unconstrained)

In this section we summarize the costs and savings possible from both an unconstrained and a "budget-constrained" approach to the C&I and SMI sectors.

The "budget constrained" portfolio includes Hydro-Quebec's proposed portfolio *minus* its most important program, the standard-offer *Energy Initiatives* program, which we replace with a set of more hands-on approaches. The unconstrained scenario is similar to the budget-constrained one, except that the incentives offered in our replacement programs cover the full incremental cost of all measures, whereas the former only covers half of such costs.

1) Budget-Constrained Scenario

As Table 40 shows, we estimate that the additions and changes to the CI and SMI DSM portfolio that we have analyzed, if all employed, would have the effect of multiplying by a factor of five – from 542 to 2786 – the annual GWh savings realized in 2010.

Table 40: Budget-Constrained Summary: CI/SMI Cumulative Annual GWh Savings

GWh Energy Savings	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
New Programs					Cumulative Annual					
Retrofit	-	-	26.6	176.3	324.0	468.6	610.1	827.9	1,043.5	1,256.4
New Construction	-	-	1.2	18.1	26.9	43.5	51.3	67.6	92.7	114.9
Renovation	-	-	14.3	71.1	165.2	292.2	443.1	592.0	734.7	869.9
Replacement/Remodel	-	-	26.3	128.7	297.0	522.6	791.2	1,056.1	1,311.6	1,556.1
SMI	-	-	5.5	16.6	27.7	44.3	60.9	77.5	94.1	110.8
GROSS TOTAL	-	-	74.0	410.8	840.8	1,371.3	1,956.6	2,621.2	3,276.6	3,908.0
Overlap (Initiatives)		-	(61.8)	(123.6)	(182.2)	(228.5)	(302.5)	(302.5)	(302.5)	(339.8)
Overlap (SMI Initiatives)		-	(26.5)	(54.1)	(79.5)	(104.9)	(131.4)	(131.4)	(131.4)	(131.4)
NET TOTAL		-	(14.3)	233.1	579.1	1,037.9	1,522.7	2,187.3	2,842.7	3,436.8
HQ Programs (excluding large industrial)										
C&I			143.5	220.8	290.4	348.9	428.4	428.4	428.4	428.4
SMI	-		39.7	77.3	109.3	140.2	170.0	170.0	170.0	170.0
GRAND TOTAL	-	-	168.9	531.1	978.8	1,527.0	2,121.1	2,785.7	3,441.1	4,035.1

As Table 41 and Table 42 show, winter and summer peak demand savings would be dramatically higher as well (Hydro-Québec's plan projects aggregate (all sectors combined) savings of 280 MW at meter by 2010; we did not obtain a sectoral breakdown).

Table 41: Budget-Constrained Summary: CI/SMI Cumulative Annual Winter Peak MW Savings

Winter MW Savings	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
New Programs					Cumulative Annual					
Retrofit	-	-	3,5	22,9	42,1	61,0	79,4	107,9	136,2	164,1
New Construction	-	-	0,2	2,5	3,7	5,9	7,0	9,2	12,6	15,5
Renovation	-	-	2,1	10,3	23,9	42,2	64,1	85,6	106,3	125,9
Replacement/Remodel	-	-	3,5	17,0	39,3	69,2	104,9	140,1	174,1	206,6
SMI			0,845	3,4	7,6	14,4	23,7	35,5	49,9	66,8
GROSS TOTAL	-	-	10,0	56,0	116,5	192,7	278,9	378,3	478,9	578,9

Caveat: Excluding net Hydro-Québec program savings.

Table 42: Budget-Constrained Summary: CI/SMI Cumulative Annual Summer Peak MW Savings

Summer MW Savings	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
New Programs					Cumulative Annual					
Retrofit	-	-	6,5	43,0	79,1	114,5	149,0	200,9	252,1	302,3
New Construction	-	-	0,4	5,7	8,4	13,7	16,1	21,2	29,1	36,1
Renovation	-	-	5,1	25,6	59,4	105,1	159,3	212,7	263,6	311,7
Replacement/Remodel	-	-	7,5	36,1	83,0	145,6	220,1	292,9	362,2	427,6
SMI			0,8	3,6	8,1	15,0	24,6	36,6	51,2	68,3
GROSS TOTAL	-	-	20,34	114,0	238,0	393,9	569,1	764,4	958,3	1 146,0

Caveat: Excluding net Hydro-Québec program savings.

As Table 43 indicates, the net incremental cost of implementing all the new and expanded C&I initiatives analyzed in this report would start at $14.4 million in 2005 and grow to about $251 million by 2010. The retrofit program would account for about half of the cost of the new initiatives.

Table 43: Budget-Constrained Summary: CI/SMI Annual Budgetary Cost

Budget (Thousand 2004 dollars)	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
New Programs					Inflation-adjusted 2004 $					
Retrofit	0 $	0 $	15,606 $	87,591 $	86,636 $	85,213 $	82,908 $	123,198 $	120,961 $	118,589 $
New Construction	0 $	0 $	1,667 $	23,505 $	12,523 $	23,828 $	11,200 $	23,480 $	36,748 $	32,536 $
Renovation	0 $	0 $	9,039 $	36,936 $	61,849 $	84,367 $	101,590 $	101,146 $	97,663 $	93,354 $
Replacement/Remodel	0 $	0 $	159 $	629 $	1,042 $	1,411 $	1,698 $	1,673 $	1,603 $	1,520 $
SMI	0 $	0 $	550 $	1,100 $	1,101 $	1,654 $	1,655 $	1,657 $	1,658 $	1,660 $
GROSS TOTAL	0 $	0 $	27,020 $	149,760 $	163,152 $	196,473 $	199,051 $	251,154 $	258,633 $	247,658 $
Overlap (C&I Initiatives)	0 $	0 $	(9,152 $)	(9,057 $)	(10,736 $)	(10,147 $)	(10,119 $)	0 $	0 $	0 $
Overlap (SMI Initiatives)	0 $	0 $	(3,443 $)	(3,738 $)	(3,291 $)	(3,048 $)	(2,990 $)	0 $	0 $	0 $
NET TOTAL	0 $	0 $	14,426 $	136,965 $	149,125 $	183,277 $	185,942 $	251,154 $	258,633 $	247,658 $
HQ Programs (excluding large industrial)										
C&I	2,324 $	11,912 $	10,854 $	10,868 $	11,552 $	10,946 $	10,293 $	0 $	0 $	0 $
SMI	1,733 $	3,559 $	4,030 $	4,186 $	3,729 $	3,462 $	3,396 $	0 $	0 $	0 $
GRAND TOTAL	4,056 $	15,471 $	29,310 $	152,020 $	164,406 $	197,686 $	199,630 $	251,154 $	258,633 $	247,658 $

2) Unconstrained Achievable Scenario

Numerous studies have suggested that it is possible to capture substantially greater savings than are currently being captured in DSM efforts across North America if additional financial resources could be devoted to the task. In this part of our report, we summarize our estimates of what such a funding-unconstrained, maximum achievable residential potential would be.

For the purposes of this report, we focused our estimate of the *unconstrained* potential on a doubling of the incentives offered in the retrofit program. This substantially increases overall DSM costs more than the proportional increase in savings.

As Table 44 shows, it would be possible to acquire on the order of 4661 GWh of savings from the residential sector by 2010. That is more than eight times what Hydro-Québec has proposed to acquire and somewhat less than twice what we estimate is possible with a more limited offer of incentives.

Table 44: Unconstrained Summary: CI/SMI Cumulative Annual GWh Savings

GWh Energy Savings	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
New Programs					Cumulative Annual					
Retrofit	-	-	88.7	587.7	1,079.9	1,562.1	2,033.5	2,759.8	3,478.2	4,187.9
New Construction	-	-	1.2	18.1	26.9	43.5	51.3	67.6	92.7	114.9
Renovation	-	-	14.3	71.1	165.2	292.2	443.1	592.0	734.7	869.9
Replacement/Remodel	-	-	26.3	128.7	297.0	522.6	791.2	1,056.1	1,311.6	1,556.1
SMI	-	-	5.5	16.6	27.7	44.3	60.9	77.5	94.1	110.8
GROSS TOTAL	-	-	136	822	1,597	2,465	3,380	4,553	5,711	6,839
Overlap (Initiatives)		-	(118.1)	(180.0)	(238.5)	(284.8)	(358.8)	(358.8)	(358.8)	(396.1)
Overlap (SMI Initiatives)	-	-	(26.5)	(54.1)	(79.5)	(104.9)	(131.4)	(131.4)	(131.4)	(131.4)
NET TOTAL	-	-	(9)	588	1,279	2,075	2,890	4,063	5,221	6,312
HQ Programs (excluding large industrial)										
C&I		67.3	143.5	220.8	290.4	348.9	428.4	428.4	428.4	428.4
SMI	-	12.1	39.7	77.3	109.3	140.2	170.0	170.0	170.0	170.0
GRAND TOTAL		79	175	886	1,678	2,564	3,488	4,661	5,819	6,910

Table 45 and Table 46 show the winter and summer peak demand savings that are possible from an unconstrained, maximum achievable residential program portfolio.

Table 45: Unconstrained Summary: CI/SMI Cumulative Annual Winter Peak MW Savings

Winter MW Savings	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
New Programs					Cumulative Annual					
Retrofit	-	-	11,5	76,4	140,4	203,2	264,6	359,7	453,9	547,0
New Construction	-	-	0,2	2,5	3,7	5,9	7,0	9,2	12,6	15,5
Renovation	-	-	2,1	10,3	23,9	42,2	64,1	85,6	106,3	125,9
Replacement/Remodel	-	-	3,5	17,0	39,3	69,2	104,9	140,1	174,1	206,6
SMI			0,8	3,4	7,6	14,4	23,7	35,5	49,9	66,8
GROSS TOTAL	-	-	18	109	215	335	464	630	797	962

Caveat: Excluding net Hydro-Québec program savings.

Table 46: Unconstrained Summary: CI/SMI Cumulative Annual Summer Peak MW Savings

Summer MW Savings	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
New Programs					Cumulative Annual					
Retrofit	-	-	21,7	143,4	263,7	381,6	496,6	669,8	840,2	1 007,6
New Construction	-	-	0,4	5,7	8,4	13,7	16,1	21,2	29,1	36,1
Renovation	-	-	5,1	25,6	59,4	105,1	159,3	212,7	263,6	311,7
Replacement/Remodel	-	-	7,5	36,1	83,0	145,6	220,1	292,9	362,2	427,6
SMI			0,8	3,6	8,1	15,0	24,6	36,6	51,2	68,3
GROSS TOTAL	-	-	36	214	423	661	917	1 233	1 546	1 851

Caveat: Excluding net Hydro-Québec program savings.

Of course, as noted above and seen in Table 47, the cost of a maximum, unconstrained effort to acquire savings would exceed to a significant degree – roughly triple – the "budget constrained portfolio" discussed previously.

Table 47: Unconstrained Summary: CI/SMI Annual Budgetary Cost

Budget (Thousand 2004 dollars)	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
New Programs					Inflation-adjusted 2004 $					
Retrofit	0 $	0 $	76,558 $	429,704 $	453,691 $	418,036 $	406,728 $	604,384 $	593,411 $	581,771 $
New Construction	0 $	0 $	1,667 $	23,505 $	12,523 $	23,828 $	11,200 $	23,480 $	36,748 $	32,536 $
Renovation	0 $	0 $	9,039 $	36,936 $	61,849 $	84,367 $	101,590 $	101,146 $	97,663 $	93,354 $
Replacement/Remodel	0 $	0 $	159 $	629 $	1,042 $	1,411 $	1,698 $	1,673 $	1,603 $	1,520 $
SMI	0 $	0 $	1,125 $	1,501 $	1,470 $	1,930 $	1,890 $	1,454 $	1,424 $	1,395 $
GROSS TOTAL	0 $	0 $	88,549 $	492,275 $	530,576 $	529,572 $	523,106 $	732,137 $	730,848 $	710,575 $
Overlap (C&I Initiatives)	0 $	0 $	(9,152 $)	(9,057 $)	(10,736 $)	(10,147 $)	(10,119 $)	0 $	0 $	0 $
Overlap (SMI Initiatives)	0 $	0 $	(3,443 $)	(3,738 $)	(3,291 $)	(3,048 $)	(2,990 $)	0 $	0 $	0 $
NET TOTAL	0 $	0 $	75,954 $	479,479 $	516,550 $	516,377 $	509,997 $	732,137 $	730,848 $	710,575 $
HQ Programs (excluding large industrial)										
C&I	2,324 $	11,912 $	10,854 $	10,868 $	11,552 $	10,946 $	10,293 $	0 $	0 $	0 $
SMI	1,733 $	3,559 $	4,030 $	4,186 $	3,729 $	3,462 $	3,396 $	0 $	0 $	0 $
GRAND TOTAL	4,056 $	15,471 $	90,839 $	494,534 $	531,831 $	530,785 $	523,686 $	732,137 $	730,848 $	710,575 $

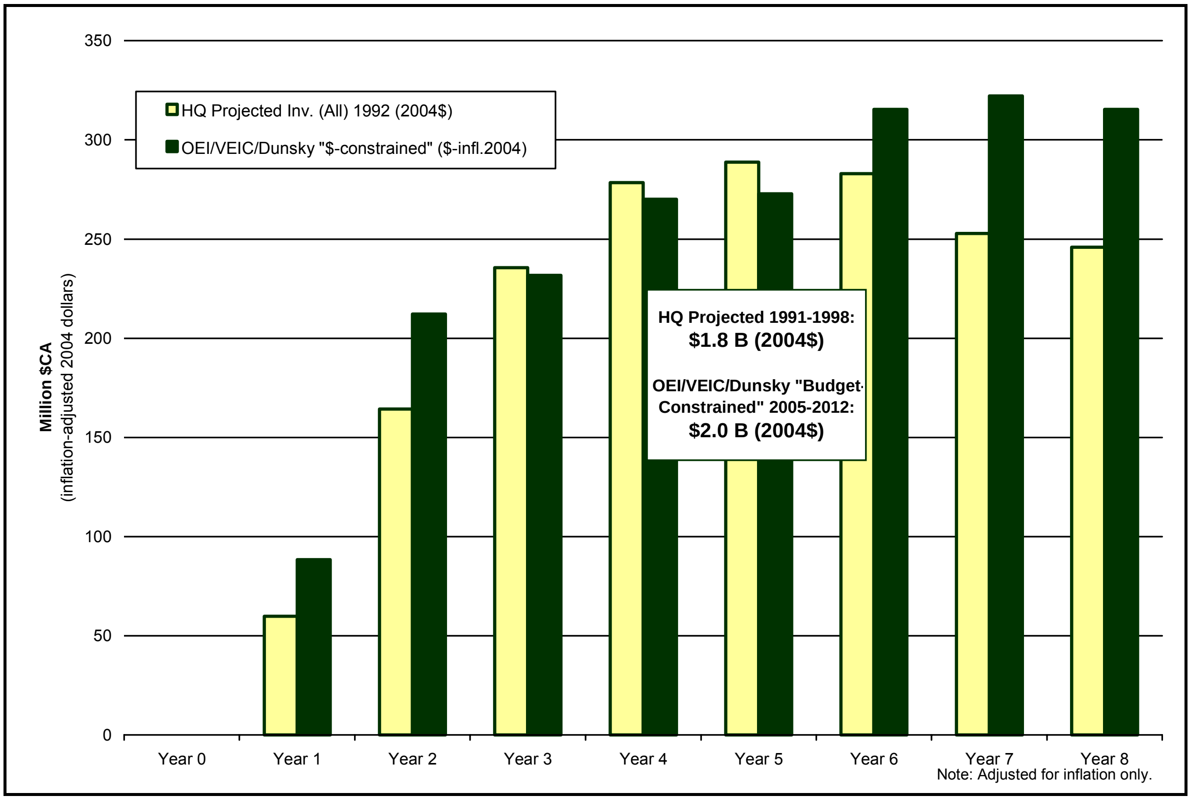
This is indicative of the general principle that the last increments of savings cost the most to acquire. We are not recommending pursuit of this scenario.

VIII. Conclusion

The results of our analysis indicate that Hydro-Québec could significantly increase the energy and capacity savings it is currently targeting as part of its DSM plan. Under a budget-constrained scenario, the utility could achieve 4.1 TWh/year by 2009 and 6.9 TWh/year savings by 2012, in lieu of its current target of only 1.7 TWh/year (by 2009).[65] This could be done at a cost of roughly $2.0 billion in 2004 dollars, spread over eight years (between roughly $200m and $300m per year). This level of financial effort, at 2.2% of projected sales revenue, would place Hydro-Québec amongst, but not above, recognized North American energy efficiency leaders.[66]

As discussed at the outset of this report, in the early 1990s, Hydro-Québec had plans for relatively aggressive energy efficiency, plans that were soonafter aborted. Pursuit of the "Budget-constrained" scenario we discuss in this report would signal a return to the order of magnitude financial effort and energy savings of that period. In fact, the overall financial commitments, when expressed in inflation-adjusted dollars, are strikingly similar, as seen in Figure 7 below.

Figure 7: Comparative Financial Efforts: HQ 1990s and OEI/VEIC/Dunsky "Budget-Constrained"



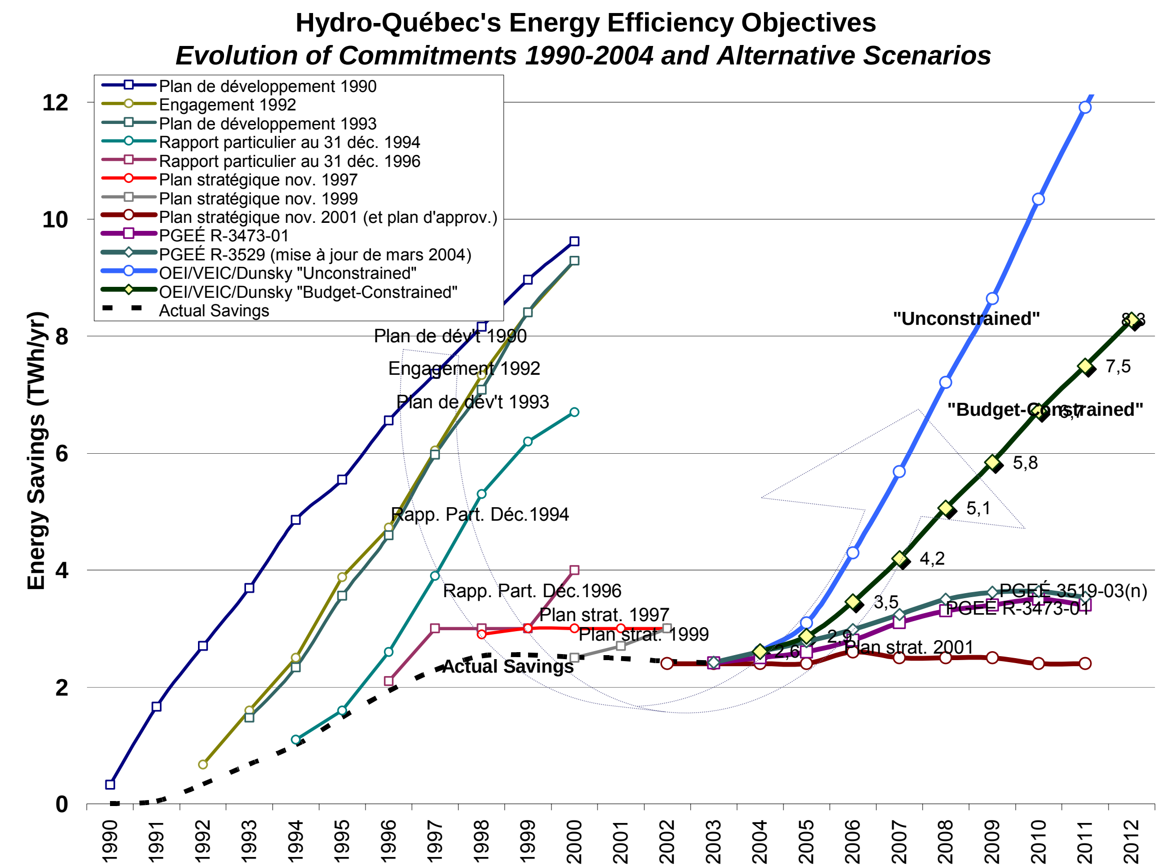
---

65 Projected savings in both cases are expressed at the generation voltage level and are over and above natural savings ("*économies tendancielles*") and savings arising from past HQ DSM efforts.

66 Based on revenue projections provided by Hydro-Québec in response to interrogatories by the FCEI. While a number of ratios can be used to compare utilities' DSM efforts, a *per-revenue* basis is the most conservative reflection for a low-rate region such as Québec (i.e. Hydro-Québec's efforts appear greatest).

Similarly, the quantum and trajectory of energy savings from our "budget-constrained" scenario also resemble those projected by Hydro-Québec in the era when DSM was considered an energy resource, as can be seen in Figure 8.

Figure 8: Comparative Energy Savings: HQ Successive Commitments and OEI/VEIC/Dunsky "Budget-Constrained" and "Unconstrained"[67]



Notes:
> All savings are reported *at the meter*. As such, they understate by roughly 10% the resulting benefit in terms of avoided generation.
> Savings projected under our alternate scenarios ("Budget constrained" and "Unconstrained") build on the savings already generated from HQ's previous DSM activities (roughly 2 TWh/yr recurring). The same is true for all of Hydro-Québec's forward-looking plans as well.

The "budget-constrained" scenario is of course far less aggressive than the other, *unconstrained* scenario. We are not recommending pursuing the latter; however, it is indicative of the tremendous DSM opportunities available to Hydro-Québec, and of the relative confidence that all parties can feel regarding the ability to achieve the "budget-constrained" targets.

At the heart of our analysis is a key assumption: that the utility will be able to muster the interest and the willingness to treat DSM on a level playing field with new supply. This implies Hydro-

[67] The reader should note that the projected savings from *past* Hydro-Québec efforts are added to all future projections, including our own.

Québec giving this resource the same attention that similarly-producing power plants would command. If Hydro-Québec seems unwilling or uninterested in doing so, we believe there are strong arguments for considering the transfer of DSM funds and responsibilities to alternative delivery agents, as is increasingly done elsewhere in North America. In this regard, the experience and expertise of the existing *Agence de l'efficacité énergétique* should be reassuring in terms of ensuring a smooth transition.

IX. Appendices

A. Total "Budget-Constrained" Scenario Summary Sheet

B. Total "Unconstrained" Scenario Summary Sheet

A. Total “Budget-Constrained” Scenario Summary Sheet

"Budget Constrained" Scenario

Annual Electric Energy (GWh) - Cumulative Net Savings at Generation Voltage and
Incremental Annual Program Expenditures (Thousand 2004 inflation-adjusted Dollars)
All Sectors - Residential, Commercial and Industrial

Residential Retail CFLs	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**Total**
Cumulative GWh	52,2	134,4	222,2	315,9	415,4	520,7	632,0	690,6	
Incremental Program Costs & Incentives (K$ real 2004)	7 665 $	10 177 $	9 147 $	9 495 $	8 224 $	8 484 $	6 995 $	6 958 $	**67 146 $**
Residential Clothes Washers	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**Total**
Cumulative GWh	15,7	39,9	52,7	65,0	77,0	88,6	99,9	110,8	
Incremental Program Costs & Incentives (K$ real 2004)	6 531 $	4 727 $	5 305 $	5 234 $	5 164 $	3 470 $	3 436 $	3 404 $	**37 270 $**
Residential Windows	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**Total**
Cumulative GWh	8,0	23,1	45,4	74,8	103,5	131,3	158,4	184,7	
Incremental Program Costs & Incentives (K$ real 2004)	2 400 $	2 400 $	2 400 $	2 400 $	2 400 $	2 400 $	2 400 $	2 400 $	**19 202 $**
Residential Refrigerator/Freezer Retirement	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**Total**
Cumulative GWh	-	-	-	-	-	-	-	-	
Incremental Program Costs & Incentives (K$ real 2004)	0 $	0 $	0 $	0 $	0 $	0 $	0 $	0 $	**0 $**
Residential High Use Retrofit	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**Total**
Cumulative GWh	64,6	145,3	242,2	355,2	484,4	629,7	791,2	968,8	
Incremental Program Costs & Incentives (K$ real 2004)	22 243 $	27 314 $	32 247 $	37 047 $	41 717 $	46 262 $	50 686 $	54 992 $	**312 509 $**
Overlap - Windows	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**Total**
Cumulative GWh	(0,4)	(1,2)	(2,3)	(3,7)	(5,2)	(5,2)	(5,2)	(5,2)	
Incremental Program Costs & Incentives (K$ real 2004)	0 $	0 $	0 $	0 $	0 $	0 $	0 $	0 $	**0 $**
Overlap - EnerGuide	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**Total**
Cumulative GWh	(22,1)	(48,6)	(75,1)	(101,6)	(128,1)	(138,0)	(138,0)	(138,0)	
Incremental Program Costs & Incentives (K$ real 2004)	(3 454 $)	(5 896 $)	(5 775 $)	(5 656 $)	(5 540 $)	(4 684 $)	0 $	0 $	**(31 004 $)**
HQ Programs	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**Total**
Cumulative GWh	235,2	367,6	450,4	535,4	620,4	637,0	637,0	637,0	
Incremental Program Costs & Incentives (K$ real 2004)	18 287 $	16 172 $	13 162 $	13 163 $	13 163 $	8 276 $	0 $	0 $	**82 224 $**
TOTAL RESIDENTIAL	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**Total**
Cumulative GWh	**353,1**	**660,6**	**935,6**	**1 241,1**	**1 567,5**	**1 864,2**	**2 175,3**	**2 448,7**	
Incremental Program Costs & Incentives (K$ real 2004)	53 674 $	54 895 $	56 487 $	61 682 $	65 129 $	64 209 $	63 517 $	67 754 $	**487 346 $**
Retrofit	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**Total**
Cumulative GWh	26,6	176,3	324,0	468,6	610,1	827,9	1 043,5	1 256,4	
Incremental Program Costs & Incentives (K$ real 2004)	15 606 $	87 591 $	86 636 $	85 213 $	82 908 $	123 198 $	120 961 $	118 589 $	**720 701 $**
Commercial New Construction	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**Total**
Cumulative GWh	1,2	18,1	26,9	43,5	51,3	67,6	92,7	114,9	
Incremental Program Costs & Incentives (K$ real 2004)	1 667 $	23 505 $	12 523 $	23 828 $	11 200 $	23 480 $	36 748 $	32 536 $	**165 487 $**
Commercial Renovation	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**Total**
Cumulative GWh	14,3	71,1	165,2	292,2	443,1	592,0	734,7	869,9	
Incremental Program Costs & Incentives (K$ real 2004)	9 039 $	36 936 $	61 849 $	84 367 $	101 590 $	101 146 $	97 663 $	93 354 $	**585 943 $**
Commercial Replacement/Remodel	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**Total**
Cumulative GWh	26,3	128,7	297,0	522,6	791,2	1 056,1	1 311,6	1 556,1	
Incremental Program Costs & Incentives (K$ real 2004)	159 $	629 $	1 042 $	1 411 $	1 698 $	1 673 $	1 603 $	1 520 $	**9 735 $**
Overlap Initiatives	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**Total**
Cumulative GWh	(61,8)	(123,6)	(182,2)	(228,5)	(302,5)	(302,5)	(302,5)	(339,8)	
Incremental Program Costs & Incentives (K$ real 2004)	(9 152 $)	(9 057 $)	(10 736 $)	(10 147 $)	(10 119 $)	0 $	0 $	0 $	**(49 211 $)**
HQ Programs	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**Total**
Cumulative GWh	143,5	220,8	290,4	348,9	428,4	428,4	428,4	428,4	
Incremental Program Costs & Incentives (K$ real 2004)	10 854 $	10 868 $	11 552 $	10 946 $	10 293 $	0 $	0 $	0 $	**54 513 $**
TOTAL COMMERCIAL	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**Total**
Cumulative GWh	**150,1**	**491,3**	**921,3**	**1 447,3**	**2 021,5**	**2 669,5**	**3 308,3**	**3 885,7**	
Incremental Program Costs & Incentives (K$ real 2004)	28 173 $	150 471 $	162 866 $	195 618 $	197 570 $	249 497 $	256 975 $	245 998 $	**1 487 168 $**
Small/Medium Industrial	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**Total**
Cumulative GWh	5,5	16,6	27,7	44,3	60,9	77,5	94,1	110,8	
Incremental Program Costs & Incentives (K$ real 2004)	550 $	1 100 $	1 101 $	1 654 $	1 655 $	1 657 $	1 658 $	1 660 $	**11 035 $**
Overlap - Initiatives	**2 005**	**2 006**	**2 007**	**2 008**	**2 009**	**2 010**	**2 011**	**2 012**	**Total**
Cumulative GWh	(21,0)	(48,6)	(74,0)	(99,4)	(125,9)	(125,9)	(125,9)	(125,9)	
Incremental Program Costs & Incentives (K$ real 2004)	(3 443 $)	(3 738 $)	(3 291 $)	(3 048 $)	(2 990 $)	0 $	0 $	0 $	**(16 510 $)**
HQ Programs	**2 005**	**2 006**	**2 007**	**2 008**	**2 009**	**2 010**	**2 011**	**2 012**	**Total**
Cumulative GWh	39,7	77,3	109,3	140,2	170,0	170,0	170,0	170,0	
Incremental Program Costs & Incentives (K$ real 2004)	4 030 $	4 186 $	3 729 $	3 462 $	3 396 $	0 $	0 $	0 $	**18 804 $**
TOTAL SMALL/MED. INDUSTRIAL (SMI)	**2 005**	**2 006**	**2 007**	**2 008**	**2 009**	**2 010**	**2 011**	**2 012**	**Total**
Cumulative GWh	**24,3**	**45,3**	**63,0**	**85,2**	**105,1**	**121,7**	**138,3**	**154,9**	
Incremental Program Costs & Incentives (K$ real 2004)	1 137 $	1 548 $	1 540 $	2 068 $	2 061 $	1 657 $	1 658 $	1 660 $	**13 329 $**
LARGE INDUSTRIAL	**2 005**	**2 006**	**2 007**	**2 008**	**2 009**	**2 010**	**2 011**	**2 012**	**Total**
Cumulative GWh	**97,5**	**190,8**	**286,2**	**381,6**	**439,9**	**439,9**	**439,9**	**439,9**	
Incremental Program Costs & Incentives (K$ real 2004)	5 357 $	5 238 $	10 772 $	10 783 $	8 013 $	0 $	0 $	0 $	**40 164 $**
TOTAL ALL SECTORS (incl. HQ)	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**Total**
Cumulative GWh	**625,1**	**1 388,1**	**2 206,1**	**3 155,2**	**4 133,9**	**5 095,3**	**6 061,8**	**6 929,2**	
Incremental Program Costs & Incentives (K$ real 2004)	88 342 $	212 153 $	231 666 $	270 151 $	272 772 $	315 363 $	322 150 $	315 412 $	**2 028 007 $**

TOTAL ALL SECTORS (net of HQ)	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**Total**
Cumulative GWh	**109,1**	**531,5**	**1 069,8**	**1 749,1**	**2 475,2**	**3 420,0**	**4 386,5**	**5 254,0**	
Incremental Program Costs & Incentives (K$ real 2004)	49 812 $	175 688 $	192 450 $	231 797 $	237 907 $	307 087 $	322 150 $	315 412 $	**1 832 303 $**

B. Total "Unconstrained" Scenario Summary Sheet

"Unconstrained" (Maximum Achievable) Scenario

Annual Electric Energy (GWh) - Cumulative Net Savings at Generation Voltage and Incremental Annual Program Expenditures (Thousand 2004 Inflation-adjusted Dollars)

All Sectors - Residential, Commercial and Industrial

Residential Retail CFLs	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**Total**
Cumulative GWh	53,6	147,6	267,3	386,9	480,3	573,4	666,1	704,9	
Incremental Program Costs & Incentives (K$ real 2004)	13 764 $	17 649 $	20 904 $	17 715 $	14 865 $	12 399 $	12 318 $	12 238 $	**121 852 $**
Residential Clothes Washers	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**Total**
Cumulative GWh	44,2	106,5	130,3	153,7	176,8	199,4	221,8	243,7	
Incremental Program Costs & Incentives (K$ real 2004)	55 474 $	69 494 $	35 232 $	34 556 $	33 895 $	33 246 $	32 612 $	31 990 $	**326 499 $**
Residential Windows	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**Total**
Cumulative GWh	35,8	78,8	125,0	170,3	214,9	258,7	301,7	343,9	
Incremental Program Costs & Incentives (K$ real 2004)	38 130 $	41 771 $	43 104 $	42 268 $	41 448 $	40 646 $	39 860 $	39 091 $	**326 318 $**
Residential Refrigerator/Freezer Retirement	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**Total**
Cumulative GWh	22,6	72,8	132,8	197,3	258,8	312,3	338,1	336,7	
Incremental Program Costs & Incentives (K$ real 2004)	22 145 $	50 455 $	62 653 $	70 716 $	70 721 $	64 640 $	60 633 $	60 848 $	**462 813 $**
EnerGuide - Enhanced	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**Total**
Cumulative GWh	92,5	215,8	369,9	554,8	770,6	1 017,1	1 294,6	1 602,8	
Incremental Program Costs & Incentives (K$ real 2004)	48 907 $	63 628 $	77 815 $	91 486 $	104 656 $	117 340 $	129 555 $	141 316 $	**774 704 $**
Novoclimat- SF Enhanced	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**Total**
Cumulative GWh	27,9	83,7	176,8	288,4	418,6	567,5	716,3	865,2	
Incremental Program Costs & Incentives (K$ real 2004)	17 127 $	32 110 $	51 478 $	60 228 $	68 596 $	76 596 $	75 022 $	73 480 $	**454 636 $**
Novoclimat- MF	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**Total**
Cumulative GWh	2,7	5,4	8,1	10,8	13,5	16,2	18,9	21,6	
Incremental Program Costs & Incentives (K$ real 2004)	2 406 $	2 357 $	2 308 $	2 261 $	2 214 $	2 169 $	2 124 $	2 081 $	**17 921 $**
Other Retail	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**Total**
Cumulative GWh	62,3	161,8	261,3	362,2	450,9	535,9	609,2	649,7	
Incremental Program Costs & Incentives (K$ real 2004)	221 269 $	275 979 $	222 489 $	216 230 $	207 219 $	196 519 $	191 503 $	188 290 $	**1 719 499 $**
Overlap - Windows	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**Total**
Cumulative GWh	(1,8)	(3,9)	(6,2)	(8,5)	(10,7)	(10,7)	(10,7)	(10,7)	
Incremental Program Costs & Incentives (K$ real 2004)	0 $	0 $	0 $	0 $	0 $	0 $	0 $	0 $	**0 $**
Overlap - EnerGuide	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**Total**
Cumulative GWh	(22,1)	(48,6)	(75,1)	(101,6)	(128,1)	(138,0)	(138,0)	(138,0)	
Incremental Program Costs & Incentives (K$ real 2004)	(3 454 $)	(5 896 $)	(5 775 $)	(5 656 $)	(5 540 $)	(4 684 $)	0 $	0 $	**(31 004 $)**
Overlap - Novoclimat	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**Total**
Cumulative GWh	(5,5)	(13,2)	(19,9)	(26,5)	(34,2)	(34,2)	(34,2)	(34,2)	
Incremental Program Costs & Incentives (K$ real 2004)	(1 090 $)	(1 110 $)	(1 177 $)	(1 177 $)	(1 177 $)	0 $	0 $	0 $	**(5 732 $)**
HQ Programs	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**Total**
Cumulative GWh	235,2	367,6	450,4	535,4	620,4	637,0	637,0	637,0	
Incremental Program Costs & Incentives (K$ real 2004)	18 287 $	16 172 $	13 162 $	13 163 $	13 163 $	8 276 $	0 $	0 $	**82 224 $**
TOTAL RESIDENTIAL	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**Total**
Cumulative GWh	**547,4**	**1 174,2**	**1 820,6**	**2 523,3**	**3 231,8**	**3 934,7**	**4 620,8**	**5 222,4**	
Incremental Program Costs & Incentives (K$ real 2004)	**432 967 $**	**562 609 $**	**522 194 $**	**541 789 $**	**550 061 $**	**547 148 $**	**543 628 $**	**549 334 $**	**4 249 729 $**
Commercial Retrofit	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**Total**
Cumulative GWh	88,7	587,7	1 079,9	1 562,1	2 033,5	2 759,8	3 478,2	4 187,9	
Incremental Program Costs & Incentives (K$ real 2004)	76 558 $	429 704 $	453 691 $	418 036 $	406 728 $	604 384 $	593 411 $	581 771 $	**3 564 284 $**
Commercial New Construction	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**Total**
Cumulative GWh	1,2	18,1	26,9	43,5	51,3	67,6	92,7	114,9	
Incremental Program Costs & Incentives (K$ real 2004)	1 667 $	23 505 $	12 523 $	23 828 $	11 200 $	23 480 $	36 748 $	32 536 $	**165 487 $**
Commercial Renovation	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**Total**
Cumulative GWh	14,3	71,1	165,2	292,2	443,1	592,0	734,7	869,9	
Incremental Program Costs & Incentives (K$ real 2004)	9 039 $	36 936 $	61 849 $	84 367 $	101 590 $	101 146 $	97 663 $	93 354 $	**585 943 $**
Commercial Replacement/Remodel	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**Total**
Cumulative GWh	26,3	128,7	297,0	522,6	791,2	1 056,1	1 311,6	1 556,1	
Incremental Program Costs & Incentives (K$ real 2004)	159 $	629 $	1 042 $	1 411 $	1 698 $	1 673 $	1 603 $	1 520 $	**9 735 $**
Overlap - Initiatives	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**Total**
Cumulative GWh	(61,8)	(123,6)	(182,2)	(228,5)	(302,5)	(302,5)	(302,5)	(339,8)	
Incremental Program Costs & Incentives (K$ real 2004)	(9 152 $)	(9 057 $)	(10 736 $)	(10 147 $)	(10 119 $)	0 $	0 $	0 $	**(49 211 $)**
HQ Programs	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**Total**
Cumulative GWh	143,5	220,8	290,4	348,9	428,4	428,4	428,4	428,4	
Incremental Program Costs & Incentives (K$ real 2004)	10 854 $	10 868 $	11 552 $	10 946 $	10 293 $	0 $	0 $	0 $	**54 513 $**
TOTAL COMMERCIAL	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**Total**
Cumulative GWh	**212,2**	**902,7**	**1 677,2**	**2 540,8**	**3 445,0**	**4 601,4**	**5 743,0**	**6 817,3**	
Incremental Program Costs & Incentives (K$ real 2004)	**89 126 $**	**492 585 $**	**529 921 $**	**528 441 $**	**521 390 $**	**730 683 $**	**729 424 $**	**709 181 $**	**4 330 751 $**
Small/Medium Industrial	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**Total**
Cumulative GWh	5,5	16,6	27,7	44,3	60,9	77,5	94,1	110,8	
Incremental Program Costs & Incentives (K$ real 2004)	1 125 $	1 501 $	1 470 $	1 930 $	1 890 $	1 454 $	1 424 $	1 395 $	**12 190 $**
Overlap - Initiatives	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**Total**
Cumulative GWh	(21,0)	(48,6)	(74,0)	(99,4)	(125,9)	(125,9)	(125,9)	(125,9)	
Incremental Program Costs & Incentives (K$ real 2004)	(3 443 $)	(3 738 $)	(3 291 $)	(3 048 $)	(2 990 $)	0 $	0 $	0 $	**(16 510 $)**
HQ Programs	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**Total**
Cumulative GWh	39,7	77,3	109,3	140,2	170,0	170,0	170,0	170,0	
Incremental Program Costs & Incentives (K$ real 2004)	4 030 $	4 186 $	3 729 $	3 462 $	3 396 $	0 $	0 $	0 $	**18 804 $**
TOTAL SMALL/MED. INDUSTRIAL (SMI)	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**Total**
Cumulative GWh	**24,3**	**45,3**	**63,0**	**85,2**	**105,1**	**121,7**	**138,3**	**154,9**	
Incremental Program Costs & Incentives (K$ real 2004)	**1 713 $**	**1 949 $**	**1 909 $**	**2 344 $**	**2 296 $**	**1 454 $**	**1 424 $**	**1 395 $**	**14 484 $**
LARGE INDUSTRIAL	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**Total**
Cumulative GWh	**97,5**	**190,8**	**286,2**	**381,6**	**439,9**	**439,9**	**439,9**	**439,9**	
Incremental Program Costs & Incentives (K$ real 2004)	**5 357 $**	**5 238 $**	**10 772 $**	**10 783 $**	**8 013 $**	**0 $**	**0 $**	**0 $**	**40 164 $**
TOTAL ALL SECTORS (incl. HQ)	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**Total**
Cumulative GWh	**881,4**	**2 313,0**	**3 847,1**	**5 530,9**	**7 221,8**	**9 097,6**	**10 942,0**	**12 634,5**	
Incremental Program Costs & Incentives (K$ real 2004)	**529 163 $**	**1 062 381 $**	**1 064 797 $**	**1 083 357 $**	**1 081 760 $**	**1 279 285 $**	**1 274 476 $**	**1 259 909 $**	**8 635 128 $**

Total ALL SECTORS (net of HQ)	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**Total**
Cumulative GWh	**365,5**	**1 456,5**	**2 710,8**	**4 124,8**	**5 563,0**	**7 422,3**	**9 266,7**	**10 959,2**	
Incremental Program Costs & Incentives (K$ real 2004)	**490 634 $**	**1 025 916 $**	**1 025 582 $**	**1 045 003 $**	**1 046 896 $**	**1 271 009 $**	**1 274 476 $**	**1 259 909 $**	**8 439 423 $**